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North Carolina State University

Welcome to North Carolina State University!

About the Catalog

This catalog showcases all of the programs and plans offered at our university, from undergraduate baccalaureate degrees, to the Doctor of Veterinary Medicine.

The Undergraduate Catalog (http://catalog.ncsu.edu/undergraduate/) houses important information on academic policies for student success, undergraduate admission and readmission information, and different ways you can be involved on during your undergraduate career at NC State.

The Graduate Catalog (p. 63) hosts a wealth of information on paths to your degree, career and research opportunities, and the NC State Graduate School Handbook.

Learn about all of the student activities (p. 41) available to the Wolfpack, exceptional services (p. 47) offered to all students, and other important resources (p. 33) that we’re proud to provide.

Check out the Course Descriptions (p. 683) to see every course option being offered for the 2020-2021 academic year, and view the new dynamic Course Search (http://catalog.ncsu.edu/course-search/) to search courses by subject or keyword.

We’re happy you’re here, and we can’t wait to show you all that NC State University has to offer. What are you waiting for?
About Us

North Carolina State University (https://www.ncsu.edu/) (NC State) began as a land-grant institution grounded in agriculture and engineering. Today, we're building a leading public research university that excels across disciplines.

NC State is a powerhouse in science, technology, engineering and math. We lead in agriculture, education, textiles, business and natural resources. We're at the forefront of teaching and research in design, the humanities and the social sciences. And we're home to one of the planet's best colleges of veterinary medicine.

Our more than 36,000 undergraduate and graduate students learn by doing. They pursue research and start new companies. They forge connections with top employers and serve local and global communities. And they enjoy an outstanding return on investment.

Introduction

Founded March 7, 1887 by the North Carolina General Assembly under the provisions of the national Land-Grant Act, North Carolina State University is now one of the nation's preeminent research institutions and the university of choice for accomplished, high-performing students from around the world.

NC State's extensive public and private partnerships create a unique culture of collaboration to address the grand challenges facing society. The university's solution-driven research, technology and scholarship lead to new ideas, products and services. It's no wonder NC State is know for its forward-looking philosophy: Think and Do.

With more than 35,000 students and 8,000 faculty and staff, NC State is a comprehensive university known for its leadership in interdisciplinary innovation. As a leader in experiential education, NC State provides remarkable opportunities for students to put learning into practice and to develop career-ready skills.

The university is consistently ranked as a top-tier university by U.S. News & World Report and is regularly named by Kiplinger’s as a top-10 best value in public higher education, a ranking that combines academic quality and affordability. Because of this value, NC State students graduate with lower-than-average debt, according to U.S. News.

Beginning their freshman year, NC State students are able to explore their major right away — by conducting research alongside faculty or starting a challenging co-op or internship. NC State has a large and diverse student population with the feel of a tight-knit community.

NC State is located in the Research Triangle region, home to many of the country’s leading Fortune 500 technology, research and pharmaceutical companies. NC State’s Centennial Campus is home to more than 150 corporate and government research partners, incubator companies and NC State research units.

Mission, Vision and Values

Mission

As a research-extensive land-grant university, North Carolina State University is dedicated to excellent teaching, the creation and application of knowledge, and engagement with public and private partners. By uniting our strength in science and technology with a commitment to excellence in a comprehensive range of disciplines, NC State promotes an integrated approach to problem solving that transforms lives and provides leadership for social, economic, and technological development across North Carolina and around the world.

Vision

NC State University will emerge as a preeminent technological research university recognized around the globe for its innovative education and research addressing the grand challenges of society.

Values

Consonant with our history, mission, and vision, North Carolina State University affirms these core values:

• Excellence—in all endeavors
• Freedom—of thought and expression
• Respect—for cultural and intellectual diversity
• Responsibility—for individual actions and service to society
• Stewardship—in sustaining economic and natural resources
• Integrity—in the pursuit, creation, application, and dissemination of knowledge

History

Founded March 7, 1887 by the North Carolina General Assembly, the school—then known as the North Carolina College of Agriculture and Mechanic Arts—embodied ideals that were rapidly transforming the field of higher education. Chief among them was the belief that colleges should not be reserved for a select few and that the children of farmers, mechanics and other workers should have access to the opportunities and benefits of higher education.

NC State was established under the provisions of the Morrill Act of 1862, which allowed the U.S. government to donate federally owned land to the states for the purpose of establishing colleges that would teach “agriculture and the mechanic arts.” The brand-new school held its first classes in the fall of 1889 with 72 students, six faculty members and one building. In the early 1900s, a new federal program sparked an era of outreach work at the college. The 1914 passage of the Smith-Lever Act created an educational partnership between land-grant colleges and the U.S. Department of Agriculture. Under this new cooperative extension program, the colleges would send staff to meet with farmers around the state and provide practical agricultural instruction. This led North Carolina to establish the Cooperative Agricultural Extension Service (now the North Carolina Cooperative Extension Service (http://www.ces.ncsu.edu/)) at NC State.

By the 1920s, North Carolina State College (as the school was then known) was beginning to grow beyond its original agricultural and mechanical focus, adding schools of engineering, textiles, education and business, as well as a graduate school. The Depression posed economic challenges for higher education throughout the nation, and State College was no exception. As the crisis slowly eased, the college renewed its growth, adding students and developing new programs until the onset of World War II. State College contributed to the war effort by hosting a number of military detachments and training exercises and by refitting the work of several departments and programs to military and defense purposes.

The campus experienced unparalleled growth during the postwar years as the G.I. Bill brought thousands of former servicemen to campus. In the following decades, the college continued to expand its curricula, creating schools of design, forestry, physical and mathematical sciences,
and humanities and social sciences. During these years of growth, the name was changed again, this time to North Carolina State University at Raleigh—the university's current official name.

The university celebrated its 100th anniversary in 1987, which also saw the creation of Centennial Campus (http://centennial.ncsu.edu/), bringing together academic, corporate, government and nonprofit leaders to partner in teaching, research and economic development.

NC State has developed into a vital educational and economic resource, with more than 34,000 students and 8,000 faculty and staff. A wealth of university outreach and extension programs continue to provide services and education to all sectors of the state’s economy and its citizens. Consistently ranked a best value (http://www.kiplinger.com/tools/colleges/school.php?id=7794/) among the nation’s public universities, NC State—the state’s largest university—is an active, vital part of North Carolina life. Today, more than 128 years after its founding, NC State continues to follow its original mission: opening the doors of higher education to the citizens of North Carolina and providing teaching, research and extension that strengthen the state and its economy.

**Campus**

NC State University is located west of downtown Raleigh on 2,099 acres. The campus acreage includes Centennial Campus on 1,105 acres and Centennial Biomedical Campus on 215 acres. West Campus includes the College of Veterinary Medicine and the stadium/arena complex. Nearby are research farms, biology and ecology sites, horticulture and floriculture nurseries and research forests that cover an additional 3,000 acres. Elsewhere across the state are research farms and 4-H camps.

**Research Triangle Park**

NC State is one of three nationally renowned research universities in the Triangle area, along with Duke University in Durham and the University of North Carolina at Chapel Hill. Within the 30 mile triangle formed by the three universities is Research Triangle Park, a 7,000-acre research park founded in 1959 by leaders in academia, business and government. Today, Research Triangle Park is home to some of the most innovative technology and research-based companies in the world.

**Faculty**

The university has 9,553 employees, including 2,360 faculty. Among the many honors and recognitions received by members of the faculty are 9 memberships in the National Academy of Sciences, 18 memberships in the National Academy of Engineering, one membership in the Institute of Medicine, and 778 members of NC State’s Academy of Outstanding Teachers.

**Students**

In the 2018 Fall Semester, the university’s head count enrollment totaled 35,479. Included in this number were 25,199 students in undergraduate degree programs, 10,280 in graduate degree programs, 400 First Professional and 1,801 non-degree-seeking students. The total enrollments by college were:

- Agriculture and Life Sciences - 3,575
- Design - 841
- Education - 1,717
- Engineering - 9,617
- Natural Resources - 1,976
- Humanities and Social Sciences - 4,480
- Management - 3,947
- Sciences - 4,070
- Textiles - 1,110
- Veterinary Medicine - 483
- Division of Academic and Student Affairs - 1,345

The student population included 2,055 African American students, 4,190 other non-white students, and 16,562 female students. Students at the university come from 56 states (including DC and territories) and 132 foreign countries. The international enrollment is a distinctive feature of the institution as 4,068 international students give the campus a cosmopolitan atmosphere.

**Outreach and Extension**

As North Carolina’s flagship research intensive, community engaged land-grant university, NC State has a unique mission to serve the citizens of this state through technical assistance, professional development, lifelong education, technology transfer, and other means of applying knowledge to real world issues and problems. Faculty, students, and staff from all ten academic colleges and other units engage in collaborative research, learning, and service partnerships with business, industry, government, and communities, in the Triangle region and across the state. Extension and engagement imperatives include economic development, environmental stewardship, K-12 education, leadership development, and entrepreneur support. NC State’s Office of Extension, Engagement, and Economic Development reaches over one million citizens annually through Cooperative Extension, Industrial Extension, McKimmon Center for Extension and Continuing Education, NC State’s Economic Development Partnership, the General Hugh Shelton Leadership Center, and the North Carolina Small Business and Technology Development Center.

**Administration**

NC State is one of 16 constituent institutions of the multi-campus University of North Carolina system (http://www.northcarolina.edu/). The UNC Board of Governors is the policy-making body legally charged with “the general determination, control, supervision, management, and governance of all affairs, of the constituent institutions.”

NC State is a member of the National Association of State Universities and Land-Grant Colleges. It is also a member of the American Council on Education, the College Entrance Examination Board, the Council of Graduate Schools, the National Commission on Accrediting and the Southern Association of Colleges and Schools.

North Carolina State University is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools (http://www.sacscoc.org/) to award associate, baccalaureate, master’s and doctoral degrees. Contact the:

Commission on Colleges
1866 Southern Lane
Decatur, Georgia, 30033-4097

Or call 404-679-4500 for questions about the accreditation of North Carolina State University. We are providing this contact information here to enable interested constituents:
1. to learn about the accreditation status of NC State,
2. to file a third-party comment at the time of NC State’s decennial review, or
3. to file a complaint against the institution for alleged non-compliance with a standard or requirement.

Normal inquiries about NC State, such as admission requirements, financial aid, educational programs, etc., should be addressed directly to the university and not the Commission’s office.

Executive Officers (https://leadership.ncsu.edu/)
Board of Trustees (https://leadership.ncsu.edu/board-of-trustees/)
UNC Board of Governors (http://www.northcarolina.edu/apps/bog/members.htm)

**University Administration**

**Office of the Chancellor**

W. Randolph Woodson, Chancellor

P.J. Teal, Secretary of the University

Lindsay Recchie, Assistant to the Chancellor

Maggie Thompson, Chancellor's Communications Specialist

Mary Catherine Cole, Program Associate

Lisa Pierson, Business Officer

**Office of the Executive Vice Chancellor and Provost**

Warwick A. Arden, Executive Vice Chancellor and Provost

Dr. Mark Bernahard, Vice Provost for Continuing Education

Leslie Boney, Vice Provost for Outreach and Engagement

Dr. Fashaad Crawford, Vice Provost for Assessment and Accreditation

Dr. Louis Hunt, Senior Vice Provost for Enrollment Management and Services

Dr. Duane Larick, Senior Vice Provost for Academic Strategy and Resource Management and Chief of Staff

Dr. Bailian Li, Senior Vice Provost for Global Engagement

Dr. Thomas K. Miller, Senior Vice Provost for Academic Outreach and Entrepreneurship

Dr. Margery Overton, Senior Vice Provost for Institutional Strategy and Analysis

Greg Raschke, Senior Vice Provost and Director of Libraries

Sheri Schwab, Vice Provost for Institutional Equity and Diversity

Dr. Katharine Stewart, Vice Provost for Faculty Affairs

**Chancellor’s Cabinet**

Warwick Arden, Executive Vice Chancellor and Provost

Brad Bohlander, Chief Communications Officer, Associate Vice Chancellor of University Communications

Boo Corrigan, Director of Athletics

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Allison Newhart, Vice Chancellor and General Counsel

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### Academic Calendar

#### Fall 2020 Semester

<table>
<thead>
<tr>
<th>Date(s)</th>
<th>Day(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 10</td>
<td>Monday</td>
<td>First day of classes</td>
</tr>
<tr>
<td>November 13</td>
<td>Friday</td>
<td>Last day of classes</td>
</tr>
<tr>
<td>November 16-20</td>
<td>Mon - Fri</td>
<td>Final examinations</td>
</tr>
<tr>
<td>December 4</td>
<td>Friday</td>
<td>Fall Degree Conferral</td>
</tr>
<tr>
<td>December 24 - January 1</td>
<td>Thu - Fri</td>
<td>Winter Break</td>
</tr>
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#### Spring 2021 Semester

<table>
<thead>
<tr>
<th>Date(s)</th>
<th>Day(s)</th>
<th>Description</th>
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<tbody>
<tr>
<td>January 11</td>
<td>Monday</td>
<td>First day of classes</td>
</tr>
<tr>
<td>January 18</td>
<td>Monday</td>
<td>Holiday (Martin Luther King, Jr. Day); university closed</td>
</tr>
<tr>
<td>March 15-19</td>
<td>Mon - Fri</td>
<td>Spring break; no classes</td>
</tr>
<tr>
<td>April 29</td>
<td>Thursday</td>
<td>Last day of classes</td>
</tr>
<tr>
<td>April 30</td>
<td>Friday</td>
<td>Reading Day</td>
</tr>
<tr>
<td>May 3-11</td>
<td>Mon - Tue</td>
<td>Final examinations</td>
</tr>
<tr>
<td>May 15</td>
<td>Saturday</td>
<td>Spring Commencement Exercises</td>
</tr>
</tbody>
</table>

#### Summer 2021 Session I

<table>
<thead>
<tr>
<th>Date(s)</th>
<th>Day(s)</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>May 19</td>
<td>Wednesday</td>
<td>First day of classes</td>
</tr>
<tr>
<td>May 31</td>
<td>Monday</td>
<td>Holiday (Memorial Day); university closed</td>
</tr>
<tr>
<td>June 22</td>
<td>Tuesday</td>
<td>Last day of classes</td>
</tr>
<tr>
<td>June 23-24</td>
<td>Wed - Thur</td>
<td>Final examinations</td>
</tr>
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</table>

#### Summer 2021 Session II

<table>
<thead>
<tr>
<th>Date(s)</th>
<th>Day(s)</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>June 28</td>
<td>Monday</td>
<td>First day of classes</td>
</tr>
<tr>
<td>July 5</td>
<td>Monday</td>
<td>Holiday (Independence Day); university closed</td>
</tr>
<tr>
<td>July 30</td>
<td>Friday</td>
<td>Last day of classes</td>
</tr>
<tr>
<td>August 2-3</td>
<td>Mon - Tue</td>
<td>Final examinations</td>
</tr>
</tbody>
</table>

**Note:** Dates in this publication are those that have been approved by appropriate agencies of the university at the time of publication (July 2020). Changes may be announced in official university publications subsequent to this publication and maintained on the S (http://www.ncsu.edu/registrar/calendars/) and Student Services Center website (https://go.ncsu.edu/academiccalendar/).

### Admission and Enrollment

View the following links for helpful information about the various paths to admission to NC State, enrollment options and procedures, financial aid eligibility, and university tuition and fees.

- Admission (p. 17)
- Enrollment (Registration) (p. 24)
- Financial Aid (p. 26)
- International Programs and Activities (p. 27)
- Supplemental Academic Programs (p. 29)
- Tuition and Fees (Graduate) (p. 30)
- Tuition and Fees (Undergraduate) (p. 30)

### Admission

What best describes the type of student you are? Are you looking to attend NC State for one of our outstanding undergraduate baccalaureate degree programs? Are you thinking about pursuing your doctoral degree here? Or, do you want to explore some of our course offerings as a Non-Degree Studies student? Check out the links below to view admissions requirements and procedures based on your academic history, needs and goals.

- Undergraduate Admission (p. 17)
- Graduate Admission (p. 21)
- Non-Degree Studies (p. 23)
- Readmission (p. 24)

### Undergraduate Admission

NC State is a member of the Common Application (http://www.commonapp.org/) and the Coalition for Access, Affordability, and Success (http://www.coalitionforcollegeaccess.org/). Students may choose to apply through either application system. Undergraduate Admissions implements a notification date system for both domestic freshman and transfer applicants. International applicants are notified of their admission decision on a rolling basis once their application is complete. Freshmen are strongly encouraged to apply during the fall of their senior year in high school by the early action deadline.

Application Dates and Deadlines (https://admissions.ncsu.edu/apply/dates-and-deadlines/)

Freshman and transfer applicants for the College of Design and Fashion and Textile Design program must submit a complete application including a portfolio and additional essay by November 1 and list it as their first choice major.

All applications for the spring semester should be submitted prior to October 1. A few programs do not accept applications for spring entry including applied mathematics and mathematics, College of Design studio-based majors, College of Engineering, Exploratory Studies, fashion and textile design, physics and statistics.

Students are notified of their decision on their wolfPAW account (https://wolfpaw.ncsu.edu/Default.asp) and admitted students (https://admissions.ncsu.edu/enroll/) must confirm their enrollment by May 1, or within ten days of if they are accepted after May 1.
The Undergraduate Admissions website (http://admissions.ncsu.edu/) provides more information on the application review process and procedure.

Office of Undergraduate Admissions
NC State University
121 Peele Hall
Campus Box 7103
10 Watauga Club Drive
Raleigh, NC 27607
Phone: 919-515-2434
Email: undergrad-admissions@ncsu.edu

Admission to the university is highly competitive. Applicants are asked to indicate their first and second choices for a curriculum, including undeclared majors within a college, or, if undecided, to indicate their choice of participating in University College Exploratory Studies. Applicants not admitted in their first curriculum choice will be reviewed for admission in their second curriculum choice. The admissions decision is based on a holistic review of a complete application. Of primary importance is the high school record, including the level and difficulty of the courses taken, the overall grade point average, rank in class, and scores on the SAT or the ACT. Extracurricular involvement, leadership, and many other factors are also considered.

Admissions Requirements

The Board of Governors of the University of North Carolina System has determined that the Minimum Course Requirements (MCR) for all constituent institutions, including NC State, shall include a high school diploma or its equivalent and the following course units taken in high school:

1. Six course units in language, including
   • Four units in English
   • Two units in a language other than English

2. Four course units of mathematics in any of the following combinations:
   • Algebra I and II, Geometry, and one unit beyond Algebra II
   • Algebra I and II, and two units beyond Algebra II or
   • Integrated Math I, II, III and one unit beyond Integrated Math III

3. Three course units in science, including
   • At least one unit in a life or biological science, and
   • At least one unit in physical science, and
   • At least one laboratory course

4. Two course units in social studies, including
   • One unit in U.S. history
   • One other unit in social studies

Competitive applicants will typically exceed these minimum courses. It is recommended that every student take a foreign language course and a mathematics course in their senior year.

NC State does not conduct individual interviews with applicants, however, students are always welcome to walk-in and meet with an admissions officer at NC State’s Joyner Visitor Center. Information sessions and student led campus tours are also available Monday through Friday at the Joyner Visitor Center (http://admissions.ncsu.edu/visit/schedule-your-visit/).

How to Apply

1. Review our deadlines: The application opens in August
2. Complete the application through the Common App or the Coalition App; we do not have a preference. Applicants for Studio-Based Majors will also need to submit a portfolio.
3. Pay the $85 application fee, or provide an official fee waiver.
4. Self-report your test scores. Visit our website (https://admissions.ncsu.edu/apply/freshmen/application-process/) for more information and for our school codes.
5. Submit your official academic transcript.
6. Check your status in your wolfPAW (https://apply.ncsu.edu/portal/wolfpaw/) account throughout the application process.

Admissions Dates and Deadlines

Decisions are released on the corresponding notification date as long as the application is complete by the deadline.

Fall Entry Early Action:
   • Deadline: November 1
   • Notification Date: January 30

Fall Entry Regular Decision:
   • Deadline: January 15
   • Notification Date: March 30

Spring Entry Regular Decision:
   • Deadline: October 1
   • Notification Date: December 1

Some programs do not accept applications for spring entry. Visit our website for details.

Studio-Based Majors

The following programs are considered studio-based majors and are fall entry only:

   • Architecture
   • Art & Design
   • Fashion & Textile Design
   • Graphic Design
   • Industrial Design

Application Deadline: November 1
Portfolio and Optional Essay Due: November 1

Agricultural Institute

NC State’s 2-year Agricultural Institute (AGI) (http://catalog.ncsu.edu/undergraduate/agriculture-life-sciences/agricultural-institute/) accepts freshman and transfer applicants.

Fall Entry:
• Deadline: June 1
• Decision Date: Rolling

Spring Entry:
• Deadline: November 1
• Decision Date: Rolling

Credit Opportunities
Students can jump-start their college careers by acquiring pre-enrollment credits by one or more of the following means:

1. by passing a proficiency examination administered by a teaching department at NC State;
2. by meeting a specific minimum score on certain Advance Placement Program (AP), International Baccalaureate (IB) examinations, and/or A and AS Level Equivalencies; and/or
3. by attaining a minimum score on certain College Level Examination Program (CLEP) subject tests.

Learn about the recognized test curriculum, accepted test scores and credit awarded at admissions.ncsu.edu/apply/credit-opportunities (http://admissions.ncsu.edu/apply/credit-opportunities/).

Out-of-State Students
Undergraduate applicants from outside North Carolina are reviewed using the same criteria as applicants from North Carolina. NC State is limited to enrolling not more than 18 percent of total new undergraduate students from outside the state as set forth by the University of North Carolina System.

The path to NC State is not always direct. About 20 percent of our students start their college career at another college or university. All transfer applicants should have at least 30 transferable college credit hours completed, including specific coursework and a competitive GPA based on the major you are applying for. Meeting these recommendations does not guarantee admission but sets you up to be considered a competitive applicant in the review process. View our recommendations for competitive applicants (https://admissions.ncsu.edu/apply/transfers/application-review/#recommendations-for-competitive-applicants).

What We Look For
Here are some of the items we’re looking at when evaluating your transfer application to NC State:

1. Your college coursework and GPA
2. Your high school coursework and test scores if you have less than 30 transferable college semester credit hours completed
3. Your interest in the program you’re applying for
4. Your accomplishments/involvement outside of the classroom
5. Your background and opportunities
6. Your individual story

Visit our Transfer Admissions website (https://admissions.ncsu.edu/apply/transfers/application-review/) for more information and recommendations for competitive transfer applicants. Students are always welcome to walk-in and meet with an admissions officer at NC State’s Joyner Visitor Center. Information sessions and student-led campus tours are also available Monday through Friday at the Joyner Visitor Center (http://admissions.ncsu.edu/visit/schedule-your-visit/).

How to Apply
1. Review our deadlines: The application opens in August. Be sure to pay attention to additional requirements and timelines for Studio-Based Majors and the Agricultural Institute.
2. Plan your path, and review our recommendations for competitive applicants.
3. Complete the application through the Common App (http://www.commonapp.org/) or the Coalition App (http://www.coalitionforcollegeaccess.org/); we do not have a preference. Applicants for Studio-Based Majors will also need to submit a portfolio.
4. Pay the application fee or provide an official fee waiver.
5. Submit your official academic transcript(s) from each institution you have attended.
6. Check your status in your wolfPAW (https://apply.ncsu.edu/portal/wolfpaw/) account throughout the application process.

Admissions Dates and Deadlines
Decisions are released on the corresponding notification date as long as the application is complete by the deadline.

Fall Entry Regular Decision:
• Deadline: January 15
• Notification Date: March 30

Spring Entry Regular Decision:
• Deadline: October 1
• Notification Date: December 1

Some programs do not accept applications for spring entry. Visit our website for details.

Studio-Based Majors
The following programs are considered studio-based majors and are fall entry only:

• Architecture
• Art & Design
• Fashion & Textile Design
• Graphic Design
• Industrial Design

Application Deadline: November 1
Portfolio and Optional Essay Due: November 1

Agricultural Institute
NC State’s 2-year Agricultural Institute (AGI) (http://catalog.ncsu.edu/undergraduate/agriculture-life-sciences/agricultural-institute/) accepts freshman and transfer applicants.

Fall Entry:
• Deadline: June 1
• Decision Date: Rolling
Spring Entry:
• Deadline: November 1
• Decision Date: Rolling

Transfer Credit
Search our transfer course equivalency database (https://www.acs.ncsu.edu/php/transfer/) to get an initial idea of which course credits from other institutions transfer to NC State. An official course evaluation is provided to students once they are admitted.

Visit Us
Transfer Admissions Center
Joyner Visitor Center
1210 Varsity Drive
Raleigh, NC 27607
Phone: 919-513-1200

At NC State we value diversity and welcome international students. Located in Raleigh, North Carolina, we are proud to be home to the most diverse student body in North Carolina hosting students from 117 different countries.

The Office of International Services (https://internationalservices.ncsu.edu/future-students/) is the main resource for international students regarding immigration regulations, university policies, employment and travel. They provide assistance to you and your family as you prepare to arrive on campus and to smooth the transition to studying in the U.S.

What We Look For
Here are some of the items we’re looking at when evaluating your transfer application to NC State:

1. Your Academic Achievement
3. Your level of English language skills
4. Your interest in the program you are applying for
5. Your accomplishments/involvement outside the classroom
6. Your background and opportunities
7. Your individual story

Visit our International Admissions website (https://admissions.ncsu.edu/apply/international/international-application-review/) for more information on application considerations, including interactive interviews (for Chinese applicants) and SAT or ACT composite scores (for Freshman applicants only).

How to Apply

1. Review our deadlines: The application opens in August. Be sure to pay attention to additional requirements and timelines for Studio-Based Majors and the Agricultural Institute.
2. Complete the application through the Common App (http://www.commonapp.org/) or the Coalition App (http://www.coalitionforcollegeaccess.org/); we do not have a preference. Applicants for Studio-Based Majors will also need to submit a portfolio.
3. Pay the application fee ($100 for international applicants).
4. Submit your academic credentials. Visit our website for details.
5. Show proof of English proficiency (https://admissions.ncsu.edu/apply/international/international-application-review/), if you are not from a country where English is the official or commonly spoken language.
6. Check your status in your wolfPAW (https://apply.ncsu.edu/portal/wolfpaw/) account throughout the application process.

Admissions Dates and Deadlines
Decisions are released on the corresponding notification date as long as the application is complete by the deadline.

Fall Entry Early Action:
• Deadline: November 1
• Notification Date: January 30

Fall Entry Regular Decision:
• Deadline: January 15
• Notification Date: March 30

International applicants must apply by the deadline and will have their admissions decisions released on a rolling basis once your application is complete.

Spring Entry Regular Decision:
• Deadline: October 1
• Notification Date: December 1

Some programs do not accept applications for spring entry. Visit our website for details.

Studio-Based Majors
The following programs are considered studio-based majors and are fall entry only:
• Architecture
• Art & Design
• Fashion & Textile Design
• Graphic Design
• Industrial Design
Application Deadline: November 1
Portfolio and Optional Essay Due: November 1

Agricultural Institute

NC State’s 2-year Agricultural Institute (AGI) (http://catalog.ncsu.edu/undergraduate/agriculture-life-sciences/agricultural-institute/) accepts freshman and transfer applicants.

Fall Entry:
• Deadline: June 1
• Decision Date: Rolling

Spring Entry:
• Deadline: November 1
• Decision Date: Rolling

Use of Agents or Educational Agencies

NC State does not partner with incentive-based agents or educational agencies to represent the University or to administer any part of the application process.

We recognize that in many countries agents or consultants are retained by students and their families to assist in applying to universities in the United States. It is not necessary to engage an agent in order to have a strong chance of admission to NC State. Admission decisions are not based on the recommendations of agents.

NC State expects an application to be the work of the applicant and that all information on the application is complete, accurate and truthful. We may reject application materials, cancel an admissions offer or dismiss a student from attendance, if it is determined that application materials have been falsified.

It is critical that applicants use their own email address, phone number, and mailing address on their application to ensure that all communication from NC State is delivered in an accurate and timely manner. Missing any important communication from NC State may delay applicants’ application process and admission decisions.

Financial and Immigration Information

All international applicants seeking an F-1 or J-1 student visa must submit a Certificate of Financial Responsibility (CFR) as part of the admission process. The purpose of this form is to certify financial solvency for the student throughout his/her program of study - this is a federal requirement that must be met before the Office of Undergraduate Admissions can issue any visa certificates.

In addition, applicants deemed admissible who are already in the U.S. must also fill out a Visa Clearance Form (VCF). This includes international applicants who are in a nonimmigrant visa category other than F-1 or J-1 (ex: H-4, L-2, DACA, E-2, Pending Permanent resident etc.). These applicants are not required to complete a CFR, unless they plan to change to F-1 or J-1 student status (if eligible).

CFR and VCF forms are reviewed by the Office of Undergraduate Admissions upon receipt. If the information provided by the applicant is incomplete or not acceptable (e.g. sponsor and bank official signatures, bank statements, etc.), the applicant will be notified that his/her documents were not approved and why. Notification is done via e-mail. The applicant will then have an opportunity to correct the problem(s) and resubmit the form(s). Applicants can check the status of their applications through their WolPAW account.

Once the applicant is considered admitted (fully or conditionally) to the University, the Office of Undergraduate Admissions mails out the appropriate Certificate of Eligibility (Form I-20 for an F-1 visa or Form DS-2019 for a J-1 visa) along with the full admission letter and other important pre-arrival information. Newly fully admitted international students will also receive information and guidance from the Office of International Services (OIS) via email prior to their arrival to NC State. Conditionally admitted international students will received information from the Intensive English Program (IEP) prior to their arrival as well.

New F-1 and J-1 international students must check-in with the Office of International Services upon arrival to campus and attend the New International Student Orientation, which is scheduled a few days before the semester begins.

New international students who are accepted to NC State have the opportunity to participate in a Summer Start program during the month of July before fall classes begin. More information can be found here. https://newstudents.dasa.ncsu.edu/summerstart/

Contact Us

Office of Undergraduate Admissions
Jeong Powell
Director, International Admissions and Recruitment
Phone: 919-515-2434
Email: jcpowell@ncsu.edu

Graduate Admission

For a list of graduate degrees, details on the programs, and admissions information, please consult the Graduate Programs website (https://grad.ncsu.edu/programs/).

The Graduate School is committed to provide a transformative experience for graduate students and postdoctoral researchers at NC State by preparing these talented individuals to become true leaders ready to tackle the major challenges facing our state, nation, and world. NC State is recognized as a national leader in the STEM disciplines, and the University supports advanced study and innovative research in numerous fields, including agriculture, life sciences, design, education, engineering, natural resources, humanities and social sciences, management, textiles, and veterinary medicine, along with many exciting interdisciplinary programs.

NC State currently offers over 160 master’s programs and more than 60 doctoral programs in both traditional and emerging disciplines, including biomedical engineering, biotechnology, genomics, geographical information systems, nanotechnology, and natural resources. The University also offers a broad range of certificate programs that afford graduate students and postdoctoral scholars with opportunities to collect certification for key skills and knowledge. Moreover, several Professional Science Master’s programs are offered that tailor educational outcomes to employer needs.

The Graduate School also proudly offers numerous professional development experiences throughout the year. These opportunities are meant to endow graduate students and postdoctoral scholars with a competitive edge that enhances their ability to land jobs and to experience long-term career success. Graduate School professional development programming incorporates training that pertains to four core
competency areas: professional and personal development, leadership and management, academic development, and communication. Signature programs include the Notes From the Field seminar series, the Transition to Industry Immersion Program, the Dissertation and Thesis Institute, the Teaching and Communication Certificate program, the Preparing Future Faculty program, the STEM Faculty Launch program, the Team Case Studies course, and the Job Search Strategies course.

The criteria used for admissions decisions vary according to programs and schools/colleges, reflect an evaluation of the applicant’s potential for graduate work, and consider the ability of a program to accommodate additional students. Commonly, departmental admissions committees consider requests for admission and forward their recommendations to the Graduate School. However, Graduate School regulations govern the criteria for the classification of graduate student status.

Applications and all supporting documents must be received on or before the priority deadlines OR the Program Deadlines (https://grad.ncsu.edu/programs/), whichever is earlier. Please be aware of specific program deadlines (https://grad.ncsu.edu/programs/), as many are earlier than the Graduate School priority deadlines. All application fees are totally non-refundable. Note that applications must be submitted to the Graduate School by midnight Eastern Standard Time on the deadline.

The Graduate School (https://grad.ncsu.edu/)
1020 Main Campus Drive, Box 7102
Raleigh, NC 27695

For a list of graduate degrees, details on the programs, and admissions information, please consult the Graduate Programs website (https://grad.ncsu.edu/programs/).

Applications and all supporting documents must be received on or before the priority deadlines OR the Program Deadlines (https://grad.ncsu.edu/programs/), whichever is earlier. Please be aware that many program deadlines are earlier than the Graduate School priority deadlines.

**Domestic Applicants**

- Unofficial transcripts from all colleges and universities previously attended
  - If you are currently enrolled in an institution taking courses, you will need to provide a list of courses in progress
  - All foreign transcripts must be translated to English through a certified Credential Evaluation Service
  - Official transcripts and statements of degree will be required if you are recommended for admission
- 3 Recommendations from people who know your academic record and potential for graduate study
  - All recommendation letters are submitted online through a link that will be sent to each recommender’s email once their information is listed on the recommendation list
- Standardized Test Scores
  - Depending on the prospective program’s admission requirements, this may include: GRE, GMAT, and/or MAT scores
- Statement of Purpose & CV/Resume
- Supplemental Documentation
  - Depending on the prospective program’s admission requirements, this may include: research papers, additional essay questions, or writing/media samples
- Application Fee
  - International Application: $85.00
  - Graduate Certificate Application: $25.00
  - Payments are made online as the last step of the Admissions application through any major credit card issuer
  - All application fee submissions are totally non-refundable

**International Applicants**

- Unofficial transcripts from all colleges and universities previously attended
  - If you are currently enrolled in an institution taking courses, you will need to provide a list of courses in progress
  - All foreign transcripts must be translated to English through a certified Credential Evaluation Service
  - Official transcripts and statements of degree will be required if you are recommended for admission
- 3 Recommendations from people who know your academic record and potential for graduate study
  - All recommendation letters are submitted online through a link that will be sent to each recommender’s email once their information is listed on the recommendation list
- Standardized Test Scores
  - English Proficiency Scores (IELTS/TOEFL) are mandatory for International Students (please see the following link for more information: https://grad.ncsu.edu/students/rules-and-regulations/handbook/2-3-graduate-school-admissions/#p)
  - Depending on the prospective program’s admission requirements, this may include: GRE, GMAT, and/or MAT scores
- Statement of Purpose & CV/Resume
- Supplemental Documentation
  - Depending on the prospective program’s admission requirements, this may include: research papers, additional essay questions, or writing/media samples
- Application Fee
  - International Application: $85.00
  - Graduate Certificate Application: $25.00
  - Payments are made online as the last step of the Admissions application through any major credit card issuer
  - All application fee submissions are totally non-refundable

For a list of graduate degrees, details on the programs, and admissions information, please consult the Graduate Programs website (https://grad.ncsu.edu/programs/).

**Application Checklist**

Applications and all supporting documents must be received on or before the priority deadlines OR the Program Deadlines (https://grad.ncsu.edu/programs/), whichever is earlier. Please be aware that many program deadlines are earlier than the Graduate School priority deadlines.

- Unofficial transcripts from all colleges and universities previously attended
  - If you are currently enrolled in an institution taking courses, you will need to provide a list of courses in progress
  - All foreign transcripts must be translated to English through a certified Credential Evaluation Service
  - Official transcripts and statements of degree will be required if you are recommended for admission
3 Recommendations from people who know your academic record and potential for graduate study
  • All recommendation letters are submitted online through a link that will be sent to each recommender's email once their information is listed on the recommendation list

Standardized Test Scores
  • Depending on the prospective program's admission requirements, this may include: GRE, GMAT, and/or MAT scores

Statement of Purpose & CV/Resume

Supplemental Documentation
  • Depending on the prospective program's admission requirements, this may include: research papers, additional essay questions, or writing/media samples

Application Fee
  • Domestic Application: $75.00
  • Graduate Certificate Application: $25.00
  • Payments are made online as the last step of the Admissions application through any major credit card issuer
  • All application fee submissions are totally non-refundable

For a list of graduate degrees, details on the programs, and admissions information, please consult the Graduate Programs website (https://grad.ncsu.edu/programs/).

Application Checklist

Applications and all supporting documents must be received on or before the priority deadlines OR the Program Deadlines (https://grad.ncsu.edu/programs/), whichever is earlier. Please be aware that many program deadlines are earlier than the Graduate School priority deadlines.

• Unofficial transcripts from all colleges and universities previously attended
  • If you are currently enrolled in an institution taking courses, you will need to provide a list of courses in progress
  • All foreign transcripts must be translated to English through a certified Credential Evaluation Service
  • Official transcripts and statements of degree will be required if you are recommended for admission

• 3 Recommendations from people who know your academic record and potential for graduate study
  • All recommendation letters are submitted online through a link that will be sent to each recommender's email once their information is listed on the recommendation list

Standardized Test Scores
  • English Proficiency Scores (IELTS/TOEFL) are mandatory for International Students (please see the following link for more information: https://grad.ncsu.edu/students/rules-and-regulations/handbook/2-3-graduate-school-admissions/#p)
  • Depending on the prospective program's admission requirements, this may include: GRE, GMAT, and/or MAT scores

• Statement of Purpose & CV/Resume

• Supplemental Documentation
  • Depending on the prospective program's admission requirements, this may include: research papers, additional essay questions, or writing/media samples

• Application Fee
  • International Application: $85.00
  • Graduate Certificate Application: $25.00
  • Payments are made online as the last step of the Admissions application through any major credit card issuer

Non-Degree Studies

NC State's Non-Degree Studies (NDS) program provides opportunities for students who are not full-time degree-seeking students to enroll at NC State for a variety of reasons. NDS caters to:

• Working professionals looking to advance in their careers,
• Students who need to meet NC State admission requirements for an undergraduate or graduate program,
• Students who would like to try out classes at NC State,
• High school students (https://registrar.ncsu.edu/nds/aeo-students/) who wish to earn college credit and have exhausted enrollment options at their home institutions,
• North Carolina Senior learners (https://registrar.ncsu.edu/nds/over65/) wishing to audit courses tuition-free,
• and so many others.

Eligibility

• Students must have graduated from high school at least one year before beginning enrollment or have the written support of their high school principal
• Students must be eligible to return to any previous institution(s) attended
• Students must maintain a minimum cumulative GPA of 2.0 at all times to remain eligible to continue

NDS Classifications

Undergraduate Studies
  • Students who have not yet obtained a baccalaureate degree
  • Students enrolled in an undergraduate certificate program

Post-Baccalaureate Studies
  • Students who have obtained a baccalaureate degree

Academic Enrichment Opportunities
  • Rising high school juniors and seniors with a cumulative weighted GPA of 3.5 or higher

North Carolina Senior Auditors ("65+")
  • North Carolina residents aged 65-years and older

How to Apply to the NDS Program

Students interested in the NDS program will apply online through our ApplyNDS portal. Depending on what type of student you are, whether you have previously been a student at NC State, and your residency (in-state, out-of-state, or international), there may be different components to the application. Details are available on the NDS website (https://registrar.ncsu.edu/nds/). It is important that applicants follow each step of the application carefully, as your application may not be considered if we are missing any important information or documentation.
Application Dates and Deadlines

The deadline to apply to the NDS program for the Fall 2020 semester is August 14, 2020. Applicants are notified of their decision on a rolling basis. The deadline for the Spring 2021 application will be posted to the NDS website during the summer.

Contact Us

Non-Degree Studies
Department of Registration and Records
1000 Harris Hall
Phone: 919-515-2572
Email: studentservices@ncsu.edu
Website: go.ncsu.edu/nds

Readmission

Sometimes students may take some time away from NC State, and that's okay. Any Undergraduate or Agricultural Institute student who has not enrolled in a Fall or Spring semester may apply for readmission to continue their degree program if they wish to continue.

Eligibility

Students are eligible to apply for readmission if you fall into one of the following categories:

• Former Undergraduate and Agricultural Institute students eligible to return to NC State University
• Suspended Undergraduate Students (additional action required)
• Former Undergraduates who obtained a degree and wishes to seek an additional undergraduate degree

Students who desire a change of curriculum can apply through the Change of Degree Application (CODA) upon readmission, except for Leadership in the Public Sector. The Leadership in the Public Sector (LPS) major, housed within the College of Humanities and Social Sciences, is an online degree completion program for students who have been away from NC State University for more than three years. It is not available for transfer via CODA. If you are interested in this program, please review the LPS Program website and contact the program advisor or director before readmitting into your previous major.

Students who have completed their undergraduate degrees and wish to return to pursue an additional degree must complete the application for readmission and complete the Readmission to Additional Degree form. Students who have a break in enrollment for at least 3 years may appeal for Contractual Readmission. Students who are contractually readmitted will be placed on Academic Warning and must maintain a 2.0 GPA on all coursework attempted after readmission. Failure to do so will result in permanent dismissal from the university.

Students are encouraged to begin the Contractual Readmission process early. Colleges may have additional requirements or deadlines; students should consult with their college and/or academic advisor before starting the contractual readmission application. Visit our website for more information and to download the Contractual Readmission Application Form.

How to Apply

Application dates and deadlines are updated on our website throughout the year.

All students applying for readmission to NC State must pay a non-refundable, $60 Readmission Application Fee.

The Readmission application is available online at our ApplyReadmit portal. Decisions are released on a rolling basis.

Residency Determination

All students applying for undergraduate readmission and requesting in-state tuition are required to complete the North Carolina Residency Determination Service (RDS) prior to completing the Readmission application. You will need your Residency Certification Number (RCN) in order to complete your Readmission application.

Contact Us

Readmission
Department of Registration and Records
Phone: 919-515-2572
Email: readmission@ncsu.edu

Enrollment (Registration)

Enrollment Process

Enrollment is conducted using MyPack Portal, NC State's online student services application. The Student Services Center website houses tutorials and guides for completing enrollment as easily and efficiently as possible. A schedule of courses for each semester is also available online prior to the beginning of the enrollment period.

Enrollment consists of three steps:

1. Students meet with advisors to determine course requirements and to have their Advising Hold released;
2. Students enroll in courses in MyPack Portal; and
3. Students pay tuition, fees, and all other debts to the university by the established deadlines.

Students can find more information about how to search for classes, how to enroll, how to drop and edit their class schedules, and how to utilize degree planning tools on the Student Services Center website.
Enrollment Calendar and Timeline

Students are assigned a date and time during which they can begin enrolling for the upcoming term. These assignments are determined by a number of factors, including the student's academic career (i.e., undergraduate, graduate, etc.), classification by credit hours (i.e., junior, senior), and any university groups the student may be a part of.

Enrollment typically begins in October for Spring and Summer semesters, and in March for Fall semesters. The enrollment calendars are published shortly before then.

New freshmen entering in the Fall enroll during summer orientation after meeting with advisors and becoming acquainted with the MyPack Portal.

The enrollment calendar is available online on the Student Services Center website (https://studentservices.ncsu.edu/calendars/enrollment/).

Schedule Revision (drops and adds)

Note: NC State University policies, rules and regulations are updated and reviewed as the need arises. For the most current information regarding this section, please visit the Policies, Rules, and Regulations website (http://policies.ncsu.edu/regulation/reg-02-20-02/).

Courses may be added during the first week of a regular semester without permission of the instructor and during the second week with the permission of the instructor.

Courses may be dropped without regard to course load prior to the Census Date of a regular semester. After the Census Date and prior to the Drop/Revision deadline, full-time undergraduate students who wish to drop courses at any level and whose academic load would thereby fall below the twelve hour minimum course load may do so only for documented medical reasons or other verified, unforeseen grounds of personal or family hardship.

Exceptions to the drop policies require the recommendation of a student’s advisor, the departmental coordinator of advising or the departmental head, and approval by the student’s dean.

The full academic calendar is available on the Student Services Center website (https://go.ncsu.edu/academiccalendar/).

Students who wish to drop all courses must withdraw from the university for the remainder of the semester or summer session in which they are enrolled. All withdrawals for a current or upcoming term are initiated through the self-service Term Withdrawal page in the MyPack Portal. Withdrawals after the drop/revision deadline are approved by the university only under extenuating circumstances. Documentation is required to support these requests. More information about how to initiate a Term Withdrawal is available online (https://studentservices.ncsu.edu/your-classes/withdrawal/).

Veterans Education Benefits

NC State University is approved to administer veterans benefits to eligible students. The Veterans Education Benefits office is located in Witherspoon Student Center, suite 100. Students who are eligible to receive veterans benefits should contact the NC State Certifying Official at veterans-ed@ncsu.edu. For more information see the NC State Veterans Education website (http://registrar.ncsu.edu/veterans/).

Military Priority Registration

NC State strives to ensure the academic success of our military-affiliated students by offering priority registration to student service members, veterans and those using GI Bill benefits. For more information regarding priority registration for military-affiliated students, please contact the university’s Veterans Education Benefits office at veterans-ed@ncsu.edu.

Exchange Programs

Several enrollment programs exist for the purpose of fostering cooperative educational activities. Under these programs students have the opportunity to register for courses at other institutions and to participate in cooperative library arrangements and joint student activities.

Inter-Institutional Program

The Inter-Institutional Registration Program is a voluntary organization comprised of NC State, Duke, North Carolina Central University, University of North Carolina at Chapel Hill, University of North Carolina at Charlotte, and University of North Carolina at Greensboro for the purpose of developing and conducting cooperative educational activities. The program provides the opportunity for students to enroll at another institution for a course accepted for their program of study and not offered on their home campus. Distance education courses are not eligible to be used for Inter-Institutional registration. Other activities include a cooperative library arrangement, joint student activities, and faculty cooperation and interchange. Interested students should contact the Inter-Institutional Coordinator at (919) 515-1427 or visit the Inter-Institutional website (https://studentservices.ncsu.edu/your-classes/exchange-programs/inter-institutional-program/).

UNC Online

The University of North Carolina Online Academic Services supports members of the UNC multi-campus community. This portal provides access to information on University-wide cross-campus online course offerings to enrolled students. It also administers an exam proctoring system to accommodate students, faculty and qualified proctors for scheduled proctored exams. The program provides the opportunity for students to enroll at another institution for a course accepted for their program of study and not offered on their home campus through Distance Education courses only. Students should contact the Inter-Institutional Coordinator at (919) 515-1427 or visit the UNC Online website (http://online.northcarolina.edu/).

Cooperating Raleigh Colleges

The Cooperating Raleigh Colleges Program (CRC) is a voluntary organization comprised of NC State, Meredith College, St. Augustine’s College, Shaw University, Wake Technical Community College, and William Peace University for the purpose of developing and conducting cooperative educational activities within the Raleigh area. The course taken at the visited school must be a course that is accepted for their program of study and not offered through NC State. Interested students should contact the Inter-Institutional Coordinator at (919) 515-1427 or visit the Cooperating Raleigh Colleges website (https://studentservices.ncsu.edu/your-classes/exchange-programs/cooperating-raleigh-colleges/).

Contact Us

For more information, contact:

Student Services Center
Please visit the Student Services Center website (http://studentservices.ncsu.edu) for more detailed information regarding types of aid and how to apply.

Scholarships

NC State offers a variety of scholarships (https://studentservices.ncsu.edu/your-money/financial-aid/types/scholarships/) for both incoming first-year students and those who are continuing at NC State. Consideration for these awards is given to students who are academically competitive and exhibit special talents or characteristics. Some scholarships require that students also demonstrate financial need. Once admitted to NC State, students can apply for scholarship consideration by using PACK ASSIST (https://ncsu.academicworks.com/), NC State University’s scholarship application portal. To maximize scholarship consideration, students should apply for admission by October 15 and complete the FAFSA by March 1.

In addition to these university-wide scholarships, many colleges and departments offer specific awards to students enrolled in their academic programs. These scholarships, funded by alumni, friends of the university, foundations, and industry, are available to both incoming freshmen and to continuing students. Consult the college or department websites for important deadlines and apply online with PACK ASSIST (https://ncsu.academicworks.com/). (https://go.ncsu.edu/packassist/)

NC State encourages students to search for private scholarships. Many organizations offer awards based on place of residence, background, professional affiliations and/or field of study. Students should use the many free online scholarship search websites to search and apply for outside scholarships.

University Academic Scholarships

Scholarships

By completing the FAFSA, students are considered for all forms of federal financial aid, as well as most types of state and institutional aid. Some academic scholarships may require separate applications. Determination of the applicant’s need is based on estimated educational costs as established by the Office of Scholarships and Financial Aid and a consideration of the family’s financial strength, as determined by the analysis of the FAFSA.

Financial Aid

Our mission is to make an NC State education affordable and accessible. We provide scholarships, grants, loans, and work funding to support students and their families. Our staff is here to help you navigate the process of applying for financial aid.

To be considered for financial assistance, a student must complete the Free Application for Federal Student Aid (FAFSA). This form, submitted online at www.fafsa.gov (http://www.fafsa.gov), evaluates the family’s ability to pay for educational expenses. Students who submit a FAFSA to the federal processor by March 1 are given first priority for need-based scholarship and grant consideration.

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Aid is available on a non-discriminatory basis to all qualifying students based on the applicant’s financial need. Financial aid awards are usually made in the form of "packages," which combine aid from all sources including the federal, state and institutional funds, and private entities.

Award packages can include gift aid (scholarships and grants), student loans, and/or employment through the Federal Work-Study program. Students must reapply for aid each year. Renewal is based on continued financial need as well as satisfactory academic progress as defined by the Policy (https://studentservices.ncsu.edu/your-degree/academic-progress/) on Satisfactory Academic Progress for Financial Aid Eligibility.

Please visit the Student Services Center website (http://studentservices.ncsu.edu/your-money/) for more detailed information regarding types of aid and how to apply.

Financial Aid

Website: studentservices.ncsu.edu (https://studentservices.ncsu.edu)

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NC State encourages students to search for private scholarships. Many organizations offer awards based on place of residence, background, professional affiliations and/or field of study. Students should use the many free online scholarship search websites to search and apply for outside scholarships.

University Academic Scholarships

Park Scholarships

The Park Scholarships program, established in 1996, brings exceptional students to NC State University based on outstanding accomplishments and potential in scholarship, leadership, service, and character. The program develops and supports Park Scholars in these areas, preparing them for lifelong contributions to the university, state, nation, and world.

Approximately 40 scholarships will be awarded this year to outstanding entering freshmen for undergraduate study in any discipline at NC State. As one of the most prestigious and comprehensive undergraduate scholarships in the nation, the Park Scholarship covers the cost of attendance for four years and includes educational trips, retreats, and seminars; enrichment grants to fund study abroad, research projects, service activities, and conferences; individualized faculty mentoring; and more.

The Park Scholarships are named for the late Roy H. Park ’31, an NC State alumnus who created the charitable Park Foundation, dedicated to education, media, and the environment. The Park Foundation initially funded the Park Scholars through annual grants; then, in September 2013, the Park Foundation committed $50 million to begin an endowment for Park Scholarships. With others’ support, this endowment will sustain the Park Scholarships program in perpetuity.

To date, 20 classes of Park Scholars have graduated and built a vibrant alumni network. For more information, visit the Park Scholarships website (http://park.ncsu.edu/).

Goodnight Scholars Program

The Goodnight Scholars Program, funded by a gift from Dr. Jim and Ann Goodnight, began in 2008 with 25 scholars. Since that time, it has grown into a comprehensive student development program designed to develop scholars into leaders within the STEM and/or education fields. The Program celebrated its eighth graduating class in May 2019, adding to its network of alumni stretching from coast to coast in the United States and throughout the world: all of whom are using their STEM talent to address critical societal, economical, and educational issues. Currently, the Program has more than 200 active students, and expanded to include transfer students beginning in Fall 2017.

The scholarship is targeted at low and middle-income families from North Carolina and is limited to students studying in the STEM disciplines or affiliated education majors. The current value of the scholarship is $20,500 and is renewable for up to four years for first-year students, and two years for transfer students. In addition to the scholarship, Goodnight Scholars have access to an assortment of developmental programming focused on their professional and personal growth, as well as enrichment grant funding to support their unique endeavors.

Dr. Jim Goodnight is founder and CEO of the SAS Institute, the world's leading business intelligence software vendor. Ann Goodnight, director of...
community relations at SAS, serves on the University of North Carolina Board of Governors and is a former member of the NC State Board of Trustees. Both are NC State graduates. Their frequent interactions with Goodnight Scholars provide unique and invaluable exposure to visionary leaders. Please visit the Goodnight Scholars website (https://goodnight.ncsu.edu/) for more information about the program and its exceptional scholars.

The Caldwell Fellows

The Caldwell Fellows is an intensive and comprehensive leadership development program that over 50 years at NC State has produced 1300+ outstanding alumni shaped by the Robert Greenleaf model of Servant Leadership. Supported through endowments held by the NC State Alumni Association, over 100 alumni “invest” in individual Fellows, providing funds for their development through experiential learning. Students selected as Fellows are expected to engage deeply in the program’s rich offerings, which include community-based service-learning, wilderness adventure, international engagement, and capstone training at the Center for Creative Leadership. Students receive three years of stipend (divided 70-30 between tuition and funds available for experiential learning), all contingent upon a student’s maintenance of the program ideals and a 3.25 cumulative GPA.

The application period for selection begins in January of each year, after a student’s initial semester(s) at NC State is complete. The program actively seeks applicants from all colleges at NC State. The rigorous selection process is based on an application portfolio which includes essays, a short video, letters of recommendation, and the first semester transcript at NC State (minimum 3.25 GPA); high school transcripts and standardized test scores are not reviewed. The application is available on the Caldwell Fellows website (http://ncsu.edu/caldwellfellows/). Application reviews by campus faculty and program alumni determine the finalists who are invited to interviews in February. Only first year students are eligible to apply.

The Caldwell Fellows program was created to honor the legacy of John T. Caldwell and to carry out his spirit and ideals. As Chancellor of NC State for 16 years, he presided over the university as a servant leader: inspiring excellence, modeling moral behavior and marshaling the strengths of the entire campus to further the common good. Guided by a deep respect for the potential inside every individual, he held a vision of NC State as a place where young people could find and refine their unique capabilities and potential. The Caldwell endowment is the only university-wide merit-based scholarship funded by alumni and supporters of NC State.

The program also derives from the NC Fellows program, originally known as the Richardson Fellows program, established in 1968 by Smith Richardson of the Richardson Vicks Corporation. Concerned for the state’s future leadership, Mr. Richardson established Fellows Programs on North Carolina campuses and charged them with developing leadership in their promising students. Caldwell Fellows maintain close ties with the internationally acclaimed Center for Creative Leadership, also created by the Smith Richardson Foundation.

Open minds and open hearts are core to the Caldwell Fellows community. Curiosity, creativity, respect for diversity, and commitment to service to the greater good are common qualities which are sought and developed in all Fellows.

International Programs and Activities

Study Abroad

Study abroad allows students to develop skills required to face the grand challenges of society - deepen intercultural sensitivity, think more critically and creatively, and broaden both personal and academic perspectives. Distinguish yourself from your peers by developing skills in independence, flexibility, and the ability to deal with ambiguity. Make the world your classroom at NC State.

Study Abroad Programs

NC State offers programs worldwide that meet academic, career, and personal interests. Study Abroad is for every major: fulfill major, minor, or general education program courses abroad. Plus, participation in NC State study abroad programs fulfill the Global Knowledge co-requisite degree requirement for NC State students. Students should work with their academic advisor to identify a time frame and outline a course plan for study abroad. For all majors, with academic planning, study abroad does not delay graduation at NC State. View program options by major. (http://go.ncsu.edu/studyabroadbymajor/)

Funding Study Abroad

Study Abroad is affordable at NC State. Semester exchange programs provide the most economical option for most students since standard tuition and fees keep the cost of a semester abroad comparable to a semester on campus at NC State. Students are eligible to receive financial aid (including loans, grants, and scholarships) for the cost of any study abroad program. Study abroad scholarships provide additional funding to about 1/3 of applicants receiving an award, plus many other financial resources are available in support of study abroad. View information about NC State Study Abroad Scholarships (https://studyabroad.ncsu.edu/funding/nc-state-scholarships/).

Applying for Study Abroad

With hundreds of opportunities to choose from—each differing in courses, duration, language, cost, location—early planning is key to a successful study abroad experience. Well prepared students typically start planning a year in advance. Learn more at http://studyabroad.ncsu.edu.

Study Abroad
315 Holmes Hall
Campus Box 7344
Raleigh, NC 27695
Phone: 919-515-2087
Email: study_abroad@ncsu.edu
Kim Priebe, Director

Global Perspectives Certificate

The goal of the Global Perspectives Certificate is to:

- recognize students for their international studies and activities and
- encourage students to continue their global interests both overseas and within the United States.

All undergraduate degree-seeking students and all majors are welcome, including undergraduate international students. Upon completion,
students will receive an official certificate and a notation on their transcript documenting their global experiences during their studies. Learn more about the GPC and get started today at gpc.dasa.ncsu.edu (http://gpc.dasa.ncsu.edu/).

North Carolina Japan Center

Jonathan Brewster, Director

The NC Japan Center was established in July 1980 to strengthen the state’s academic, economic, scientific, and cultural ties with Japan. In its many aspects, the Center serves as a focal point for interaction between Japanese and North Carolinians. It is a statewide resource intended to assist all citizens, universities, companies, and public and private institutions in relations with the Japanese. The NC Japan Center works to inform people of the state about modern Japan and its people. It also provides information and resources for Japanese citizens living in North Carolina.

Consistent with NC State’s “Think and Do” land-grant mission, the NC Japan Center works in partnership with the Economic Development Partnership of North Carolina to attract Japanese businesses to the state, as well as strengthens relationships between NC State and academic partners in Japan. An external Board of Advisors includes prominent citizens of North Carolina who have a strong interest in Japan and US-Japan relations. Its Academic Advisory Committee consists of faculty from colleges across the university who provide guidance and direction for academic exchange and development. The NC Japan Center cooperates closely with the NC State Japanese language program and provides a full range of non-credit Japanese language courses to the public. For more information, please contact Jonathan Brewster at (919) 515-3450 or visit the North Carolina Japan Center’s website (http://www.ncsu.edu/japan/).

International Students

The Office of International Services (OIS) is charged with meeting the immigration advising and cross-cultural programming needs for the university’s more than 4000 international students and 700 J-1 Exchange Visitor scholars who come from more than 120 different countries. Services provided by OIS include advising students and scholars on immigration regulations and university policies; authorizing certain types of on or off-campus employment authorization for F-1 and J-1 visa holders; and providing cultural programs designed to enrich the cultural and academic experience of the campus community. OIS programs include: New International Student Orientation, Culture Corps, ISSERV service learning program, English Conversation Club, and many others. New international students are required to participate in New International Student Orientation. OIS also provides opportunities for U.S. students to get involved in the international community at NC State by inviting participation in various cross-cultural programs such as volunteering at the International Student Orientation and English Conversation Club.

International applicants must apply to the Admissions Office by the stated deadlines and must meet all the necessary requirements for admission. In addition, international applicants must meet certain language and financial criteria (see the TOEFL and Financial Information sections under Freshman Admission).

The North Carolina Global Training Initiative (GTI) sponsors several short-term certificate, internship, and research programs that international students may be interested in. These full-time non-degree study programs allow international students to study at NC State for one semester in order to learn about U.S. culture and education, improve their conversational English, take undergraduate courses in their field of study back home or in preparation for admission to a degree program here in the U.S., and experience life in the U.S. These programs have a later application deadline and are great for students to take before enrolling in an undergraduate or graduate degree program in the US or for siblings and friends of current degree-seeking students who want to study in the US together.

International students may be interested in joining the GTI’s Cultural Exchange Network (CENet). CENet connects NC State’s domestic and international students through joint participation in social, academic, and service learning events and workshops. Visit the CENet website (go.ncsu.edu/CENet (http://go.ncsu.edu/CENet/)) for more details about the program and how you can apply.

Anyone interested in the GTI’s programs can visit us on the web at www.ncsu.edu/gti (http://www.ncsu.edu/gti/) for more information.

Outline of minimum immigration requirements for F-1 and J-1 students:

• Keep passport and I-20 or DS-2019 current
• Maintain full-time enrollment every semester (12 hours/semester for undergraduates)
• Make good academic progress toward your degree
• Do not work or intern off campus without prior written approval from OIS
• Do not work on campus more than 20 hours in any one week during the semester
• Update any address change in MyPack Portal within ten days of moving
• Update OIS immediately of any changes in name, funding, or visa status
• Consult with an OIS advisor before changing curriculum/majors, withdrawing, dropping below full-time, transferring to another school/program, etc.
• Purchase and maintain the NC State University approved Health and Accident Insurance or other insurance plan that meets the published minimum coverage requirements.
• Keep your valid passport and recently signed visa certificate (I-20 or DS-2019) with you when you travel abroad. Consult with an OIS advisor about visa and travel questions

Further information about immigration requirements, employment and travel questions, cultural opportunities, and other critical information designed to assist international students are detailed on the OIS website. For individual advising, please call (919) 515-2961 to make an appointment with an advisor or stop by during our walk-in hours of 10:00am-11:45am and 1:00pm-2:45pm on Monday, Tuesday, Thursday and Friday (no walk-ins on Wednesdays).

Office of International Services (OIS)

111 Lampe Drive
Campus Box 7222
NC State University
Raleigh, NC 27695-7222

Phone: (919) 515-2961
Email: ois@ncsu.edu
Website: http://internationalservices.ncsu.edu/
The Intensive English Program (Conditional Admission and IEP-only)

The Intensive English Program (IEP) at North Carolina State University is a full-time, non-credit academic program offered to international, non-native English speakers. Its mission is to provide high-quality language instruction to those seeking academic preparation, professional development and/or personal enrichment. Programs of study are offered in the fall, spring, and summer semesters.

In the IEP, students take up to 25 hours per week of intensive language study in all core language skills. Students who enroll in the IEP will be tested for the appropriate level of English instruction when they arrive on campus.

Classes are located on NC State’s main campus and nearby on Hillsborough Street. IEP students are also offered the opportunity to participate in numerous cultural enrichment activities designed to help them get to know the surrounding area and interact with other students. Academic coaching (tutoring) is offered to students free of charge.

Students join the IEP as conditionally admitted students or IEP-only students. While the course of instruction is identical for both, IEP-only students are not guaranteed admission to degree programs, but may apply directly to such programs while enrolled in the IEP.

Conditional Admission

For undergraduate applicants who meet the competitive academic requirements for admission, but who do not yet possess the minimum English proficiency requirements for full, direct admission, NC State offers conditional admission. For NC State conditionally admitted students, the IEP provides the opportunity to improve one’s English language skills before moving into a degree program.

Successful completion of the IEP requires achieving at least a B or higher in each course, meeting strict attendance obligations, and passing all exit requirements.

Intensive English Program

North Carolina State University
2526 Hillsborough Street, Suite 200
Raleigh, North Carolina USA 27607
Office hours: 8am-5pm, Monday-Friday

Phone: 919-515-4002
Email: iep@ncsu.edu
Website: https://intensive-english.ncsu.edu/

Incoming Exchange Students

NC State has a growing number of international exchange partners from around the world. The Study Abroad Office warmly welcomes incoming exchange students to NC State's internationally renowned programs for a semester or for the full academic year.

Visit the NC State Study Abroad website (https://studyabroad.ncsu.edu/subpage-example/incoming-student/) for information about exchange programs at NC State, the application process, English proficiency requirements, preparation and arrival, and what you can expect during your time in Raleigh!

Study Abroad Office
Phone: +1 919-515-2087

Email: study_abroad@ncsu.edu
Website: https://studyabroad.ncsu.edu/

Cultural Exchange Network (CENet)

The Cultural Exchange Network (CENet) at NC State is a student organization comprised of undergraduate and graduate students from all fields of study and from around the world. CENet fosters global learning and international friendship through social, academic and service activities.

CENet is facilitated by the Global Training Initiative (GTI) and details can be found on the website (go.ncsu.edu/CENet (http://go.ncsu.edu/CENet/)).

Supplemental Academic Programs

Cooperative Education Program

The Cooperative Education Program (co-op) is an opportunity for students to gain hands-on work experience while pursuing a degree. Through alternate semesters of full-time study and full-time work experience, students can:

• Strengthen their job prospects after graduation; companies usually prefer hiring students who have related work experience, especially within their organization
• Be well-paid
• Explore career fields and confirm their choice of major
• Work with state-of-the-art equipment in the industry
• Experience "corporate culture" by working with professionals and observing how they handle job situations in the given field

The co-op plan can be completed in five years, during which time the student receives 12 to 18 months of industrial experience.

To be eligible for a co-op, students must:

• Be full-time students (in any degree program)
• Have completed a minimum of 30 credit hours (or one semester for transfer students)
• Have been admitted into a degree program prior to reporting for a co-op job
• Have a cumulative GPA of at least 2.50 (3.00 for graduate students)

For more information, visit: https://go.ncsu.edu/co-op (https://go.ncsu.edu/co-op/)

The Peer Mentor Program

The Peer Mentor Program (PMP), offered through the Department of Multicultural Student Affairs, is a student advisory program aims to foster a network of support for culturally diverse first-year students ("mentees"). The peer mentoring relationship is designed to aid in the academic, emotional, and socio-cultural adjustment to college life of mentees. Peer Mentors serve as peer support personnel for mentees and share program goals and responsibilities aimed at ensuring the retention of student participants.

For more information, visit: https://oied.ncsu.edu/divweb/msa/peer-mentor-program/
**Supplemental Instruction**

Supplemental Instruction (SI) is a voluntary academic support opportunity for students in selected sections of historically difficult, large lecture courses. SI supports students who want to improve their understanding of course material in a small group setting. Students are actively engaged with small group activities facilitated by the SI leader, a trained peer tutor. Several sessions are offered at various times each week. A schedule of current SI sessions can be found on the SI website (https://tutorial.dasa.ncsu.edu/si/si-schedule/).

**Tuition and Fees (Graduate)**

The University Cashier’s Office (https://treasurer.ofb.ncsu.edu/cashier/) provides billing, financial aid disbursement and account management services to all students. All students paying tuition and fees are entitled to University services, facilities and programs, including the services, facilities, and programs offered by the Student Center, Health Services, Physical Education Department, and Athletics Department.

Visit the Student Services Center website (https://studentservices.ncsu.edu/your-money/tuition-and-fees/) for the most up-to-date information on campus finances and student tuition and fees.

Students should view the Graduate School website for important information on Residence for Tuition Purposes (https://grad.ncsu.edu/admissions/residency/) and the North Carolina Residency Determination Service (RDS) for graduate programs.

**Tuition and Fees (Undergraduate)**

- **North Carolina Resident**: $4,550 per semester (effective 2019-2020 academic year)
- **Nonresident**: $14,610 per semester (effective 2019-2020 academic year)

A statement of tuition and fees is posted on each student’s account that registered during a normal registration period. Students (and authorized parents) are notified via e-mail (eBILL) when a new statement has posted. Payment in full or approved financial aid information must be received by the due date appearing on the statement. The due date is approximately two weeks before classes begin. Students registering during a late registration period will be required to pay their tuition and fees at the time of registration and may be subject to a late registration fee. Fees are the same for both residents and nonresidents and are required of all students. Nonresident students are required to pay an additional $10,060 per semester for tuition.

**Estimated Annual Undergraduate Expenses**

(Independent Student living on Campus)

<table>
<thead>
<tr>
<th>Description</th>
<th>First Semester</th>
<th>Second Semester</th>
<th>Full Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC Residents</td>
<td>4,550</td>
<td>4,550</td>
<td>9,100</td>
</tr>
<tr>
<td>Out of State</td>
<td>14,610</td>
<td>14,610</td>
<td>29,220</td>
</tr>
<tr>
<td>Residents</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health Insurance</td>
<td>1,308</td>
<td>1,308</td>
<td>2,616</td>
</tr>
<tr>
<td>Room Rent</td>
<td>3,384</td>
<td>3,384</td>
<td>6,768</td>
</tr>
<tr>
<td>Meals</td>
<td>2,417</td>
<td>2,417</td>
<td>4,834</td>
</tr>
</tbody>
</table>

Books and Supplies  | 541            | 541             | 1,082     |
Personal Expenses   | 804            | 804             | 1,608     |
Transportation - in state | 561        | 561             | 1,122     |
Transportation - off campus/out of state | 664 | 664 | 1,328 |

**Total Estimated Expenses**

<table>
<thead>
<tr>
<th>Description</th>
<th>First Semester</th>
<th>Second Semester</th>
<th>Full Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC Residents</td>
<td>$13,565</td>
<td>$13,565</td>
<td>$27,130</td>
</tr>
<tr>
<td>Out of State Residents</td>
<td>$23,728</td>
<td>$23,728</td>
<td>$47,456</td>
</tr>
</tbody>
</table>

1. **Note:** Tuition and fees are fixed items of cost. The rates listed above are for Undergraduate students in a degree program. Tuition and fee rates for Distance Education courses are billed based on the student’s affiliation, see the Student Services Center website (https://studentservices.ncsu.edu/your-money/tuition-and-fees/distance-education/) for full details.

2. **Health Insurance** is billed unless you waive out of the program each semester. For more information, visit the Student Health website (https://healthypack.dasa.ncsu.edu/insurance-and-billing/ship/).

3. **Room rent** is shown as main-campus, double occupancy rate.

4. **Meals, books and supplies, other personal expense, and transportation** are shown as estimates.

5. **For estimated costs of other student classifications please go to the** Student Services Center website (https://studentservices.ncsu.edu/your-money/financial-aid/estimated-cost-of-attendance/).

**Expenses Other than Tuition and General Fees**

**Application Fee**: A nonrefundable fee $85 U.S. must accompany each application for admission ($100 for international students). Applicants may pay the fee online using their WolfPAW account.

**Room Rent**: New incoming students receive instructions on how to apply for housing with the letter of acceptance. Continuing students receive room reservation information each January at their residence hall rooms. The 2020-2021 residence hall room rent ranges from $3,210 to $3,925 per semester and plus a mandatory $140.00 ResNet (internet) charge. The Wolf Village Apartments charge $3,375 per semester plus mandatory charges for ResNet ($140) and cable television ($46) per person per semester. Wolf Ridge Apartments range form $3,585 per person to $4,230 per person per semester plus mandatory charges for ResNet ($140) and cable television ($46) per person per semester.

**Meals**: During their first academic year, new freshmen living on campus are required to participate in one of the university’s available meal plans. Meal plans are available to all registered students and costs for 2020-2021 range from $800 to $2,400. Students may also pay for meals individually at the various dining facilities available both on and near campus.
Books and Supplies: Books and supplies are usually purchased during the first week of classes directly from the NCSU Bookstores. Allow approximately $541 per semester for purchasing books and supplies.

Personal Expenses: Personal expenses vary widely among students but the estimate of $804 is based on what students report that they spend on these items.

Cooperative Education Program Fee: Required of all participating co-op students for each semester in which they are enrolled in an off campus work assignment. This fee, set at $490 for the 2020 Fall Semester, the 2021 Spring Semester, or the combined 2021 Summer Sessions, is used for partial support of the Cooperative Education Program staff in job development and placement activities. Students paying this fee are entitled to all university services, facilities, and programs during the semester or combined summer sessions for which they are enrolled.

COE Program Enhancement Fee - Students enrolled in the College of Engineering will be charged a COE Program Enhancement Fee. This fee is used for program and infrastructure improvements in the College of Engineering to ensure our engineering students are provided career-ready skills that continue to advantage them in the marketplace. Each semester, undergraduates will be charged $750 (12 or more hours), $562.50 (9-11 hours), $375.00 (6-8 hours), and $187.50 (0-5 hours). Each semester graduate students will be charged $750 (9 or more hours), $499.95 (6-8 hours), and $249.98 (0-5 hours). Engineering students who enroll in a co-op work session will not be billed for the computing fee unless they also enroll in an NC State course.

Professional Golf Management Fee: Students enrolled in the Professional Golf Management program (PGM) will be charged $350/semester. The fee pays for golf play and practice privileges at several area golf courses.

Required Fees
Required fees are levied for services, facilities, and programs available to all students whether or not the student takes advantage of them. Students are assessed fees based on the course load they are taking. An itemization of required fees and other detailed information concerning expenses or related data can be obtained on the Student Services Center website (https://studentservices.ncsu.edu/your-money/tuition-and-fees/fees-explanation/) or by contacting:

University Cashier’s Office
NC State, Box 7213
Raleigh, North Carolina 27695-7213
919-515-2986 (Option 4), or via e-mail at studentaccounts@ncsu.edu (studentaccounts@ncsu.edu)

Refund Policy
Reduction in Hours: The last day to reduce hours and receive a refund or reduction in rates is the same as the last day to register or add hours, typically the 10th day of a fall or spring term and the 4th day of a summer session. Tuition and Fees are not prorated after this date for reduced course loads. Specific dates are posted on the Student Services Center website (https://studentservices.ncsu.edu/your-money/bill/refunds-and-reimbursements/refunds-for-reduction-in-hours/) and in MyPACK Portal.

Withdrawal: Dropping all courses for which you are registered constitutes a Withdrawal from the University. Refunds for official withdrawals from NC State University are prorated based upon the percentage of the enrollment period attended. No refunds are made for official withdrawals after 50 percent of the enrollment period has passed. The prorated withdrawal schedule for each semester is publicized on the Student Services Center website (https://studentservices.ncsu.edu/your-money/bill/refunds-and-reimbursements/refunds-for-withdrawal/). In some instances circumstances such as severe medical issues can justify an appeal of your refund percentage. You may submit an appeal to the Fee Appeals Committee when you believe special consideration is merited. Applications for such appeals may be obtained from the Student Services Center website (https://studentservices.ncsu.edu/forms/cashier/refundapp.pdf).

Residency Determination Service (RDS)
The Residency Determination Service (RDS) was established in coordination with the University of North Carolina (UNC), the North Carolina Community College System (NCCCS), the North Carolina State Education Assistance Authority (NCSEAA), and the North Carolina Independent Colleges and Universities (NCICU) as the centralized service for determining residency for students. This service enables a student to use one residency determination for admissions applications to multiple North Carolina public colleges and universities and to demonstrate residency for state aid programs consideration at all (public and private) North Carolina colleges and universities. In compliance with state law, the UNC system requires Undergraduate, Agricultural Institute, and Non-Degree Studies students to request a residency classification through the RDS.

Learn more online at https://ncresidency.cfnc.org.

Residence Status for Tuition Purposes
According to the North Carolina General Assembly (North Carolina General Statutes Section (G.S.) 116-143.1(b) (http://www.ncga.state.nc.us/EnactedLegislation/Statutes/HTML/BySection/Chapter_116/GS_116-143.1.html)), a student qualifies as a resident for tuition purposes if he or she has:

• an established legal residency (domicile) in North Carolina
• maintained that legal residence for at least 12 continuous months prior to being considered for in-state residency

The North Carolina State Residence Classification Manual (http://www.northcarolina.edu/sites/default/files/documents/state_residence_classification_manual.pdf) offers complete information on residency statutes, as well as explanations as how the two qualifications above are evaluated.

Initial Classification: The student’s initial residence classification occurs during the admission application process when the student is first admitted to a community college or UNC institution. The North Carolina State Residence Classification Manual (http://www.northcarolina.edu/sites/default/files/documents/state_residence_classification_manual.pdf) offers complete information on residency statutes, as well as explanations as how the two qualifications above are evaluated.

Reclassification: A student, accepted for admission, who is initially classified as a nonresident and believes he or she meets the requirements of G.S. 116-143.1, -143.3, or any other applicable laws and regulations may request a reclassification by completing the RDS process. The request for reclassification may be submitted either in direct response to the initial classification (if the student believes the initial classification is erroneous), or at a future time if the student has experienced a change in circumstances that he or she believes makes him or her eligible for in-state resident status. Students must submit requests for reclassification in accordance with approved procedures and
application deadlines. The institution will not assume responsibility for initiating such an inquiry independently.

Residency Reclassification Application Deadlines. Except for deadlines set out in the General Statutes, institutions (undergraduate or graduate) may set their own deadlines so long as they are not inconsistent with the deadlines. The deadline to submit the reclassification application along with all supporting documentation cannot be later than the 10th business day of the term for which the student is seeking residency reclassification. All conditions necessary for achieving in-state status must still be satisfied prior to the beginning of the academic term for which the student is seeking reclassification. It is the student’s responsibility to provide the documentation necessary to support his or her claims for in-state residency for tuition purposes by the applicable deadlines.

Residence. To qualify as a resident for tuition purposes, a person must become a legal resident and remain a legal resident for at least twelve consecutive months (365 days) immediately prior to classification. Thus, there is a distinction between legal residence and residence for tuition purposes. Furthermore, twelve months legal residence means more than simple abode in North Carolina. In particular, it means maintaining a domicile (permanent home of indefinite duration) as opposed to “maintaining a mere temporary residence or abode incident to enrollment in an institution of higher education.” The burden of establishing facts which justify classification of a student as a resident entitled to in-state tuition rates is on the applicant for such classification, who must show his or her entitlement by the preponderance (the greater part) of the residency information.

Parents’ Domicile. If an individual, irrespective of age, has living parent(s) or court appointed guardian of the person, the domicile of such parent(s) or guardian is, prima facie, the domicile of the individual; but this prima facie evidence of the individual’s domicile may or may not be sustained by other information. Further, non-domiciliary status of parents is not deemed prima facie evidence of the applicant child’s status if the applicant has lived (though not necessarily legally resided) in North Carolina for the five years preceding enrollment or registration.

Effect of Marriage. Marriage alone does not prevent a person from becoming or continuing to be a resident for tuition purposes, nor does marriage in any circumstance insure that a person will become or continue to be a resident for tuition purposes. Marriage and the legal residence of one’s spouse are, however, relevant information in determining residency intent. Furthermore, if both a husband and his wife are legal residents of North Carolina and if one of them has been a legal resident longer than the other, then the longer duration may be claimed by either spouse in meeting the twelve month requirement for in-state tuition status.

Military Personnel. Any active duty member of the armed services qualifying for admission to an institution of higher education but not qualifying as a resident for tuition purposes shall be charged the in-State tuition rate and applicable mandatory fees so long as the member establishes residency in North Carolina within 30 days after the discharge and is continuously enrolled in the degree of other program in which the member was enrolled at the time the member is discharged.

Any dependent relative of a member of the armed services who is abiding in this State incident to active military duty, as defined by the Board of Governors of The University of North Carolina and by the State Board of Community Colleges while sharing the abode of that member shall be eligible to be charged the in-State tuition rate, if the dependent relative qualifies for admission to an institution of higher education. The dependent relatives shall comply with the requirements of the Selective Service System, if applicable, in order to be accorded this benefit. In the event the member of the armed services is reassigned outside of North Carolina or retires, the dependent relative shall continue to be eligible for the in-State tuition rate and applicable mandatory fees so long as the dependent relative is continuously enrolled in the degree or other program in which the dependent relative was enrolled at the time the member is reassigned or retires. In the event the member of the armed services receives an Honorable Discharge from military service, the dependent relative shall continue to be eligible for the in-State tuition rate and applicable mandatory fees so long as the dependent relative establishes residency within North Carolina within 30 days after the discharge and is continuously enrolled in the degree or other program in which the dependent relative was enrolled at the time the member is discharged. A person charged less than out-of-state tuition rate solely by reason of this section shall not, during the period of receiving that benefit, qualify for or be the basis of conferring the benefit of G.S. 116-143.1.

Grace Period. If a person (1) has been a bona fide legal resident, (2) has consequently been classified a resident for tuition purposes, and (3) has subsequently lost North Carolina legal residence while enrolled at a public institution of higher education, that person may continue to enjoy the in-state tuition rate for a grace period of twelve months measured from the date on which North Carolina legal residence was lost. If the twelve months ends during an academic term for which the person is enrolled at a State institution of higher education, the grace period extends, in addition, to the end of that term. The fact of marriage to one who continues domicile outside North Carolina does not by itself cause loss of legal residence marking the beginning of the grace period.

Minors. Minors (persons under 18 years of age) usually have the domicile of their parents, but certain special cases are recognized by the residence classification statute in determining residence for tuition purposes.

a) If a minor’s parents live apart, the minor’s domicile is deemed to be North Carolina for the time period(s) that either parent, as a North Carolina legal resident, may claim and does claim the minor as a tax dependent, even if other law or judicial act assigns the minor’s domicile outside North Carolina. A minor thus deemed to be a legal resident will not, upon achieving majority before enrolling at an institution of higher education, lose North Carolina legal residence if that person

1. Upon becoming an adult “acts, to the extent that the person’s degree of actual emancipation permits, in a manner consistent with bona fide legal residence in North Carolina” and
2. Begins enrollment at an institution of higher education not later than the fall academic term following completion of education prerequisite to admission at such institution.”

b) If a minor has lived for five or more consecutive years with relatives (other than parents) who are domiciled in North Carolina and if the
relatives have functioned during this time as if they were personal guardians, the minor will be deemed a resident for tuition purposes for an enrolled term commencing immediately after at least five years in which these circumstances have existed. If under this consideration a minor is deemed to be a resident for tuition purposes immediately prior to his or her eighteenth birthday, that person on achieving majority will be deemed a legal resident of North Carolina of at least twelve months duration. This provision acts to confer in-state tuition status even in the face of other provisions of law to the contrary; however, a person deemed a resident of twelve months duration pursuant to this provision continues to be a legal resident of the State so long as he or she does not abandon North Carolina domicile.

Lost but Regained Domicile. If a student ceases enrollment at or graduates from an institution of higher education while classified as a resident for tuition purposes and then both abandons and re-acquires North Carolina domicile within a twelve month period, that person, if he or she continues to maintain the reacquired domicile into re-enrollment at an institution of higher education, may re-enroll at the in-state tuition rate without having to meet the usual 12-month durational requirement. However, any one person may receive the benefit of this provision only once.

Change of Status. A student admitted to initial enrollment in an institution (or permitted to enroll following an absence from the institutional program which involved a formal withdrawal from enrollment) must be classified by the admitting institution either as a resident or as a nonresident for tuition purposes prior to actual enrollment. A residence status classification once assigned (and finalized pursuant to any appeal properly taken) may be changed thereafter (with correspondingly change in billing rates) only at intervals corresponding with the established primary divisions of the academic year.

Transfer Students. When a student transfers from one North Carolina public institution of higher education to another, he or she is treated as a new student by the institution to which he or she is transferring and must be assigned an initial residence status classification for tuition purposes.

Non-U.S. Citizens. Persons who are not U.S. citizens but who have certain visa and immigration statuses that grant them the legal ability to establish and maintain a bona fide domicile in this country are subject to the same considerations as U.S. citizens in determining residence status for tuition purposes. If it is later discovered that the person’s visa or immigration status was obtained fraudulently, the institution shall have the right to seek and collect payment of full, out-of-state tuition, along with fees and costs associated with such collection. Non-U.S. citizens present in the United States under certain visa statuses such as tourists, visitors on business, and temporary foreign/international students do not have the legal capacity to establish a bona fide domicile in this country (and thus, not in North Carolina). As examples, holders of non-immigrant visa statuses such as B, C, D, F, J, M, Q, S, and TN visas (and dependent visas for spouses and children such as a TD visa) cannot establish domicile with these documents, in and of themselves, unless there is a change in their visa status. An EAD, in and of itself, does not confer any domicile with these documents, in and of themselves, unless there is a change in their visa status. An EAD, in and of itself, does not confer any domicile with these documents, in and of themselves, unless there is a change in their visa status. An EAD, in and of itself, does not confer any domicile with these documents, in and of themselves, unless there is a change in their visa status. An EAD, in and of itself, does not confer any domicile with these documents, in and of themselves, unless there is a change in their visa status.

UNC System Employees. A person who is a full-time employee, in a permanent position, of The University of North Carolina, or is the spouse or dependent child of a full-time employee, in a permanent position, of The University of North Carolina, and who is a legal resident of North Carolina, qualifies as a resident for tuition purposes without having maintained that legal residence for at least 12 months immediately prior to his or her classification as a resident for tuition purposes.

The following categories of persons are eligible for tuition waivers:

Survivors of Deceased Law Enforcement/Emergency Workers. Tuition waivers are available to the surviving spouse and children of a law enforcement officer (including sheriffs), firefighter, volunteer firefighter or rescue squad worker who was killed as a direct result of a traumatic injury sustained in the line of duty (including both active service and training for active duty). Additional eligibility requirements must be met.

Families of Disabled Law Enforcement/Emergency Workers. Tuition waivers are available to the spouses and children of law enforcement officers (including sheriffs), firefighters, volunteer firefighters, or rescue squad workers who are permanently and totally disabled as a direct result of a traumatic injury sustained in the line of duty (including both active service and training for active service). Additional eligibility requirements must be met.

Note: Decisions on residence for tuition purposes are based on NC G.S. 116-143.1 and 116-143.3 and on the State Residence Classification Manual which was prepared by the General Administration of the University of North Carolina system.

This information is subject to change.

Campus Resources

NC State’s vast university offices and divisions exist to serve our students, faculty, staff, visitors and guests. The units below showcase just a sampling of the important work being done on and off campus every day to ensure that our community has the resources they need to achieve and thrive at NC State.

- Distance Education and Learning Technology Applications (DELTA) (p. 33)
- Office of Information Technology (p. 34)
- Office of Institutional Equity and Diversity (p. 34)
- Office of Professional Development (p. 35)
- Office of Research and Innovation (p. 35)
- University Advancement (p. 36)

Distance Education and Learning Technology Applications (DELTA)

Dr. Tim Petty, Associate Vice Provost, Online and Distance Education Sharon Broere, Director, Online and Distance Education Administrative Services

DELTA centrally administers NC State’s online and distance education program activities and support services. We schedule online and distance-based courses and sections. We provide application, enrollment and services for non-degree studies' students. We provide student communications, course detail information, a virtual orientation, an online FAQ, campus proctoring services and remote testing arrangements. DELTA collaborates with other NC State units to provide library resources, student registration, campus authentication, financial aid and billing services for online and distance education students. For more information, visit the Online and Distance Education website (https://online-distance.ncsu.edu/).
DELTA also manages the university’s learning technology infrastructure, including various asynchronous learning management systems (WolfWare, Moodle), Zoom, a tool for synchronous online teaching and learning, and lecture capture technologies for all technology-assisted courses, whether online or on-campus.

**Office of Information Technology**

NC State offers you a leading-edge academic computing environment to enrich your student life and learning. Here, you’ll find that many colleges and administrative and academic units are involved in providing various IT resources, services and information.

The Office of Information Technology (OIT) provides centralized campus-wide computing and information and communication technology services in support of the university’s academic and administrative goals. Some of OIT’s major services are:

- Campus-wide data network infrastructure, including the multi-gigabit network backbone and wireless computing infrastructure
- MyPack Portal, the gateway to university online enterprise systems and services, such as Human Resources, Financials and the Student Information System
- ResNet, high-speed wired and wireless Internet access for students living in campus housing
- Cable TV and telephone, which are available to all students, faculty and staff
- Hundreds of software packages for student use from computing labs, and many also available from the NC State Virtual Computing Lab (VCL) environment
- G Suite, which provides the university’s official email and calendaring services and numerous collaborative tools powered by Google
- University’s central Web servers
- File space
- Classroom technology support
- High Performance Computing (HPC) for researchers and students in computational science
- IT security for campus computing resources, including acceptable use, rules and regulations
- NC State Help Desk, which provides support to students and other users of campus resources
- Hardware and software support for student-owned computers through the OIT Walk-in Center

**Unity ID and Password**

As an NC State student, you will have a Unity ID and password, which are your credentials to access campus-wide computing services and facilities.

Information about your Unity ID and password and help are provided during student orientation sessions, from the NC State Help Desk, and online on the OIT (https://oit.ncsu.edu) website.

**Unity Labs**

As a student, you may use the Unity computer labs that are equipped with Windows, Linux and Macintosh workstations that provide direct access to information technologies. Colleges and academic departments support additional computing facilities, and overall, there are about 123 student-computing labs on campus, with about 2,800 workstations with high-speed network connections. NC State does not require you to own a computer, although specific colleges or programs may make this requirement. Information about computer recommendations, specifications and purchasing options are published online on the OIT (https://oit.ncsu.edu) website and updated annually.

**Help**

For additional information, see NC State’s computing resources:

- OIT (https://oit.ncsu.edu) website
- OIT Walk-in Center, West Dunn Building (corner of Dan Allen and Thurman drives)
- NC State Help Desk, 515-HELP (4357); help@ncsu.edu; or help.ncsu.edu (https://help.ncsu.edu)

Marc Hoit, Vice Chancellor for Information Technology and Chief Information Officer

**Office of Institutional Equity and Diversity**

The Office for Institutional Equity and Diversity (OIED) is committed to fostering an inclusive, accessible and diverse intellectual and cultural campus experience related to the mission of NC State University.

**Diversity Engagement, Training and Education**

The Diversity, Engagement, Training and Education unit within the Office for Institutional Equity and Diversity provides leadership in the university’s efforts to coordinate, implement and facilitate educational programs, promote cultural competence and foster an understanding of and appreciation for diversity, equity and inclusion throughout the university community. Activities include providing diversity training, programs and consultation for the recruitment, retention and success of students, faculty and staff and reviewing and recommending changes to university policies, procedures and regulations to promote diversity and enhance inclusion.

**Equal Opportunity and Equity**

The Equal Opportunity and Equity unit of the Office for Institutional Equity and Diversity strives to make NC State University a discrimination-free, harassment-free environment for faculty, students and staff to work, live and learn. This unit is responsible for managing and monitoring the university’s equal opportunity compliance activities, overseeing the university’s equal opportunity policies, responding to complaints, conducting investigations, developing and delivering training and educational outreach to campus and consulting with supervisors, managers and unit equity officers regarding equal opportunity concerns and initiatives.

**Bias Impact Response Team**

The Bias Impact Response Team (BIRT) at NC State supports the campus community by providing a system through which a person can report incidents of bias on and around campus. BIRT seeks to effectively engage with impacted individuals and groups to achieve awareness, support, education and restoration. See the BIRT website at bias-incident.ncsu.edu (http://bias-incident.ncsu.edu/).
Campus Community Centers

NC State's Campus Community Centers report to the Office for Institutional Equity and Diversity (OIED). Collectively, the centers foster community; celebrate identity and culture; raise awareness; and support, empower and advocate for positive change for underrepresented and marginalized students, families and communities. They assist OIED in its goal of fostering an inclusive, accessible and diverse intellectual and cultural campus experience by creating spaces and activities that improve campus climate and enhance the overall educational experience for all students.

See Campus Community Centers under Student Services for information on the African American Cultural Center, GLBT Center, Multicultural Student Affairs and the Women's Center, which report to the Office for Institutional Equity and Diversity.

Office of Research and Innovation

Mladen A. Vouk, Vice Chancellor for Research and Innovation
Wade Fulghum, Assistant Vice Chancellor, Office of Research Commercialization
Genevieve Garland, Assistant Vice Chancellor for Research Operations and Communications
Jonathan Horowitz, Associate Vice Chancellor for Research Infrastructure and Development
Rick Liston, Assistant Vice Chancellor for Administration
Lorena McLaren, Executive Director, Corporate and Foundation Relations, University Development
Pradip Pramanik, Director, Proposal Development Unit
Shawn Troxler, Associate General Counsel
Alyson Wilson, Associate Vice Chancellor for National Security and Special Research Initiatives

Office of the Vice Chancellor

Vice Chancellor

As Chief Research Officer (CRO), the Vice Chancellor oversees all research activities at NC State. Under his authority, units reporting to the Office of Research and Innovation centrally manage research administration, the university’s intellectual properties, and industry and government agency alliances on the university’s award-winning research campus. Researchers at NC State are supported by $405++ million in sponsored programs from federal, local government, industry, and nonprofit organizations. NC State’s research portfolio exceeds 5,000 invention disclosures, 960+ US patents (OR rated #6 in patents issued), 800 active commercialization agreements, and 595+ products to market. Centennial Campus hosts more than 70 corporate, government and nonprofit partners working with the university’s 75+ centers and institutes, laboratories and research departments.

Research Operations

The Research Operations Unit provides strategic leadership and support to the Office of Research and Innovation. The office consists of three units: Strategic Initiatives, Education and Training, and Marketing and Outreach.

Integrated Support Services Center (ISSC)

The ISSC was created to provide streamlined, professional services to faculty and administrators, eliminating costly duplication, creating efficiency and improving timeliness.

Research Development

Research Development Office (RDO)

The RDO facilitates collaboration between faculty and interdisciplinary research experts, providing strategic and responsive support that enhances the university’s most valued research initiatives. By searching a centralized, easy-to-access portal, researchers quickly find internal and external funding opportunities. Once identified, potential funding translates to successful grants with the help of Research Development’s tools and training resources that support researchers as they plan, write, and submit competitive proposals.
Centers + Institutes
NC State’s Centers and Institutes reflect the university’s commitment to interdisciplinary scholarly pursuit, including research, instruction and public service. These cutting-edge organizations are frontrunners in their field, blazing the trails for other researchers to follow. Research and innovation on topics ranging from climate change to textiles add value to the everyday lives of our state’s citizens, maintaining public trust and admiration and standing at the forefront in global excellence for research and discovery. Here, the leadership of these organizations can access the materials, procedures and policies necessary to manage their efforts responsibly, equitably and with the highest integrity.

Proposal Development Unit (PDU)
The PDU supports faculty teams in the development of large-scale, interdisciplinary research proposals. These services include team facilitation, budget development, writing and editing, and administrative assistance, thereby enabling investigators to concentrate on the research-related aspects of their proposals. PDU support is available to NC State faculty planning proposals with estimated total budgets of at least $1M.

Research Administration and Compliance
Sponsored Programs & Regulatory Compliance Services (SPARCS)
SPARCS facilitates the submission of proposals, negotiation of agreements, the administration of internally and externally funded projects, and the administration of subagreements that provide funding to NC State. This includes all aspects of externally sponsored research and scholarship, from pre-award management to non-fiscal post-award management.

Office of Research Commercialization
Office of Research Commercialization (ORC)
NC State University is a research powerhouse and a powerful economic engine for North Carolina. ORC plays a crucial role in this by protecting and promoting University research discoveries and intellectual property, working with and guiding industry partners, and promoting the acceleration of startups. ORC provides innovators with a wide range of programs and services to protect, market, and license intellectual property developed at NC State. Collaboration with NC State innovators and industry partners has led to the creation of more than 125+ startups and 575+ commercialized products that benefit society on a local, national and global scale. Among surveyed universities without medical schools, NC State consistently ranks among the top 10 for key technology transfer metrics.

University Advancement
The mission of University Advancement of NC State University is to facilitate communication, internally and externally, and to enhance the image of the University; to provide meaningful programs and service to alumni and friends; to seek service-support participation and ambassadorship from constituents; to build and sustain a strong volunteer leadership network; to raise money from private sources; to manage the collection of private gifts for North Carolina State University; to manage an effective alumni and development database and gift systems; and to coordinate with the General Administration in areas of government and legislative priorities in Raleigh and Washington.

The office oversees a division that includes development, alumni relations, university communications, and advancement services. Visit the University Advancement website (https://leadership.ncsu.edu/advancement/) for more information.

Advancement Services
Advancement Services supports the operations of Alumni Relations, University Development and University Communications. The department oversees the alumni and donor database, working to process gifts and conduct research about potential contribution opportunities. Other initiatives include management of the University online giving website, support of the alumni association alumni web portal, conducting education and training in the areas of national best practices and rules and regulations pertaining to fundraising activities, ethics, and accountability, and management of an international listserv dedicated to the furtherance of the entire advancement services profession.

The NC State Alumni Association
The NC State Alumni Association engages alumni through programs and services that foster pride and enhance lifelong connections to NC State. The Association encourages alumni to be Red and White for Life — with connections to the university and fellow alumni no matter where they live by linking alumni to the university through membership, a statewide, national, and growing international network of alumni, programming for special-interest groups and students, events and an array of communication tools, including the award-winning NC State magazine. The Alumni Association offers membership options and benefits for alumni who join, and supports a growing Student Alumni Association (SAA), with events and programming that builds connections and enhances their student experience. The Association also sustains the prestigious Caldwell Fellows Scholarship Program, funded by alumni endowments and contributions, and designed to foster academic excellence, leadership, personal growth and service learning.

The Association upholds campus traditions such as the official class ring, Homecoming, Ram Roast, the Tradition Keepers Medals, Wolfpack Freshmen Welcome events, and Founders’ Day, as well as the Legacy Luncheon for incoming freshmen whose parents and/or grandparents attended NC State. In addition, the Association is responsible for the Evening of Stars Gala to celebrate NC State’s distinguished alumni, and the Faculty Awards to recognize the achievements of the university’s outstanding undergraduate and graduate faculty. The Association offers services such as the Wolf Treks alumni travel program and Career Services. Students and alumni can visit the Alumni Association in the Dorothy and Roy Park Alumni Center on Centennial Campus, or contact the Alumni Association at (919) 515-3375 or (800) 627-2586. For a complete overview of programs, services and events, visit the Alumni Association’s website (http://www.alumni.ncsu.edu).

University Development
University Development works with the colleges and programs at North Carolina State University to secure private financial support for priority projects and programs. This support may come from individuals (alumni, parents, students, faculty, staff, and friends), corporations, philanthropic foundations and other organizations. The mission of University Development is to strengthen relationships with alumni and friends and reconnect them with campus colleagues in their colleges and areas of interest, reach out to alumni and friends living out-of-state to carry the messages of NC State’s progress, success, and vision for the
future, and to serve as liaisons to university-wide programs to support their fundraising and outreach efforts.

University Development provides services to the colleges and programs in capital campaigns, gift planning, corporate & foundation relations, and annual giving. University Development also facilitates external and internal communication among fundraisers, and coordinates approaches to prospective donors.

University Communications and Marketing

University Communications and Marketing builds positive relationships between NC State University and its many constituents through strategic internal and external communications that convey the university’s brand identity. The office is comprised of university relations, marketing and creative strategies, web communications, and special events, and focuses on:

- Increasing awareness of the university's distinctive benefits
- Ensuring consistency in university-wide messaging and visual identity by facilitating integration and coordination of public relations and communications efforts throughout the university
- Monitoring and responding to public issues and perceptions
- Providing marketing, communication and Web strategy, counsel and creative services to campus clients
- Providing guidance and resource assistance for university events

Leadership

Brian C. Sischo, Vice Chancellor for University Advancement
Brad C. Bohlander, Associate Vice Chancellor for University Communications & Chief Communications Officer
Jim Broschart, Associate Vice Chancellor for University Development
Derek Bryan, Assistant Vice Chancellor of Finance and Administration
Jeff Baynham, Interim Associate Vice Chancellor for Advancement Services
Maggie Musick, Interim Executive Assistant to the Vice Chancellor
Reid Ricciardi, Executive Director of Talent Management
Benny Suggs, Associate Vice Chancellor and Executive Director for Alumni Relations & Alumni Association
Alan Taylor, Assistant Vice Chancellor for Principal Gifts
Christina Walker, Chief of Staff and Executive Director of University Advancement

NC State Policies

North Carolina State University is committed to academic integrity, and all students are required to adhere to the NC State Code of Student Conduct (https://policies.ncsu.edu/policy/pol-11-35-01/). Individual policies on conduct, including those listed below, are posted on University Policies, Regulations, and Rules (https://policies.ncsu.edu/) (PRRs).

- University Patent Procedures (https://policies.ncsu.edu/policy/pol-10-00-01/)
- Grievance Procedures for Graduate Students (https://policies.ncsu.edu/regulation/reg-11-40-02/)
- Code of Student Conduct (https://policies.ncsu.edu/policy/pol-11-35-01/)
- Academic Integrity (https://policies.ncsu.edu/policy/pol-11-35-01/)
- Policy on Illegal Drugs (https://policies.ncsu.edu/policy/pol-04-20-05/)

Sexual Harassment Policy (https://policies.ncsu.edu/regulation/reg-04-25-02/)
Racial Harassment Policy (https://policies.ncsu.edu/regulation/reg-04-25-02/)
University Copyright Procedures (https://policies.ncsu.edu/regulation/reg-01-25-03/)

Equal Opportunity and Non-Discrimination

It is the policy of the State of North Carolina to provide equality of opportunity in education and employment for all students and employees. Accordingly, the university does not practice or condone unlawful discrimination in any form against students, employees or applicants on the basis of race, color, religion, creed, sex, national origin, age, disability or veteran status. Nor does the university allow discrimination on the basis of sexual orientation with respect to internal university matters that do not contravene federal or state law and that do not interfere with the University’s relationships with outside organizations, including the federal government, the military, ROTC, and private employers. [NOTE: The NC State University equal opportunity and nondiscrimination policy includes transsexual individuals within the policy’s prohibitions against discrimination on the basis of sex. This includes actual or perceived gender identity and gender expression. See Price Waterhouse v. Hopkins, 490 U.S. 228 (1989); Smith v. City of Salem, 378 F.3d 566 (6th Cir. 2004);] Retaliation against any person complaining of discrimination is in violation of federal and state law and North Carolina State University policy, and will not be tolerated.

Unlawful Harassment

Harassment based upon race, color, religion, creed, sex, national origin, veteran status, age, or disability is a form of discrimination in violation of federal and state law and North Carolina State University policy and will not be tolerated. It is the internal policy of North Carolina State University to prohibit harassment on the basis of sexual orientation. Retaliation against any person complaining of harassment is in violation of federal and state law and North Carolina State University policy, and will not be tolerated. North Carolina State University will respond promptly to all complaints of harassment and retaliation. Violation of this policy can result in serious disciplinary action up to and including expulsion for students or discharge for employees.

Every individual is encouraged, and should feel free, to seek assistance, information and guidance from his/her supervisor, the Office for Equal Opportunity, the Office of Student Conduct or the Employees Relations section of Human Resources. For additional information, contact: Office for Equal Opportunity, 1 Holladay Hall, Box 7530, North Carolina State University, Raleigh, NC 27695-7530, Phone: (919) 513-1234 or 515-3148.

Disability Resource Office

Individuals desiring reasonable accommodations for their documented disabilities should contact the Disability Resource Office (https://dro.dasa.ncsu.edu/) (DRO), 2751 Cates Avenue, Holmes Hall, (919) 515-7653 (Voice), (919) 515-8830 (TTY). Services and accommodations are provided based on an individual’s documented needs and are determined in consultation with the individual and a DRO representative. For students, such requests should be made far in advance of registration deadlines to ensure timely services and
accommodations. DRO will maintain appropriate confidentiality of records and communication regarding disability.

**Associations and Accreditation**

**Associations**
The university is a member of the Association of Public and Land-grant Universities, the American Council on Education, the Association of Governing Boards of Universities and Colleges, the Association of American Colleges and Universities, the Education Advisory Board, the Engagement Scholarship Consortium, the National Association of College and University Business Officers, the Oak Ridge Associated Universities, the Southern Association of Colleges and Schools Commission on Colleges, Campus Compact, the University Professional and Continuing Education Association, and the Cooperating Raleigh Colleges.

**Accreditation**
North Carolina State University is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools to award associate, baccalaureate, master's and doctoral degrees. Contact the Southern Association of Colleges and Schools Commission on Colleges at 1866 Southern Lane, Decatur, Georgia 30033-4097 or call 404-679-4500 for questions about the accreditation of NC State University.

In addition, many of the university's professional programs and departments are accredited by national professional associations, including:

Specialized Academic Program Accreditation (https://provost.ncsu.edu/institutional-quality/accreditation/specialized-program-accreditation/)

**College of Agriculture & Life Sciences** (https://cals.ncsu.edu/)

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Accrediting Body</th>
<th>Last Yr Accred</th>
<th>Next Yr Accred</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Education (BS)¹</td>
<td>Council for the Accreditation of Educator Preparation (CAEP)</td>
<td>2015</td>
<td>2022</td>
</tr>
<tr>
<td>Biological Engineering (BS)²</td>
<td>Engineering Accreditation Commission of ABET</td>
<td>2017</td>
<td>2023</td>
</tr>
</tbody>
</table>

¹ Accredited through the College of Education.
² Accredited through the College of Engineering.

**College of Design** (https://design.ncsu.edu/)

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Accrediting Body</th>
<th>Last Yr Accred</th>
<th>Next Yr Accred</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture (B.Arch, M.Arch)</td>
<td>National Architectural Accreditation Board (NAAB)</td>
<td>2018</td>
<td>2026</td>
</tr>
</tbody>
</table>

**College of Engineering** (http://www.engr.ncsu.edu/)
The Office of Assessment and Accreditation website (https://provost.ncsu.edu/institutional-quality/accreditation/specialized-program-accreditation/) provides the accreditation dates for the following programs. Each of the following programs' next comprehensive review date is 2022-2023.

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Accrediting Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace Engineering (BS)</td>
<td>Engineering Accreditation Commission of ABET</td>
</tr>
<tr>
<td>Biological Engineering (BS)</td>
<td>Engineering Accreditation Commission of ABET</td>
</tr>
<tr>
<td>Program Name</td>
<td>Accrediting Body</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>Biomedical Engineering (BS)</td>
<td>Engineering Accreditation Commission of ABET</td>
</tr>
<tr>
<td>Chemical Engineering (BS)</td>
<td>Engineering Accreditation Commission of ABET</td>
</tr>
<tr>
<td>Civil Engineering (BS)</td>
<td>Engineering Accreditation Commission of ABET</td>
</tr>
<tr>
<td>Computer Engineering (BS)</td>
<td>Engineering Accreditation Commission of ABET</td>
</tr>
<tr>
<td>Computer Science (BS)</td>
<td>Computing Accreditation Commission of ABET</td>
</tr>
<tr>
<td>Construction Engineering and Management (BS)</td>
<td>Engineering Accreditation Commission of ABET</td>
</tr>
<tr>
<td>Electrical Engineering (BS)</td>
<td>Engineering Accreditation Commission of ABET</td>
</tr>
<tr>
<td>Engineering - Mechanical Engineering Systems Concentration (BS)</td>
<td>Engineering Accreditation Commission of ABET</td>
</tr>
<tr>
<td>Engineering - Mechatronics Concentration (BS) (Joint Program with UNC-Asheville)</td>
<td>Engineering Accreditation Commission of ABET</td>
</tr>
<tr>
<td>Environmental Engineering (BS)</td>
<td>Engineering Accreditation Commission of ABET</td>
</tr>
<tr>
<td>Industrial Engineering (BS)</td>
<td>Engineering Accreditation Commission of ABET</td>
</tr>
<tr>
<td>Materials Science and Engineering (BS)</td>
<td>Engineering Accreditation Commission of ABET</td>
</tr>
<tr>
<td>Mechanical Engineering (BS)</td>
<td>Engineering Accreditation Commission of ABET</td>
</tr>
<tr>
<td>Nuclear Engineering (BS)</td>
<td>Engineering Accreditation Commission of ABET</td>
</tr>
<tr>
<td>Paper Science and Engineering (BS)</td>
<td>Engineering Accreditation Commission of ABET</td>
</tr>
<tr>
<td>Textile Engineering (BS)</td>
<td>Engineering Accreditation Commission of ABET</td>
</tr>
</tbody>
</table>

**College of Humanities & Social Sciences (http://www.chass.ncsu.edu/)**

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Accrediting Body</th>
<th>Last Yr Accred</th>
<th>Next Yr Accred</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Factors/Ergonomics Psychology (PhD)</td>
<td>Human Factors and Ergonomics Society (HFES)</td>
<td>2018</td>
<td>2024</td>
</tr>
<tr>
<td>Public Administration (MPA)</td>
<td>National Association of Schools of Public Affairs and Administration (NASPAA)</td>
<td>2014</td>
<td>2021</td>
</tr>
<tr>
<td>School Psychology (PhD)</td>
<td>American Psychological Association</td>
<td>2014</td>
<td>2021</td>
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</tbody>
</table>

**Poole College of Management (http://www.mgt.ncsu.edu/)**

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Accrediting Body</th>
<th>Last Yr Accred</th>
<th>Next Yr Accred</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting (BS, MAC)</td>
<td>Association to Advance Collegiate Schools of Business (AACSB International)</td>
<td>2020</td>
<td>2025</td>
</tr>
<tr>
<td>Business Administration (BS, MBA)</td>
<td>Association to Advance Collegiate Schools of Business (AACSB International)</td>
<td>2020</td>
<td>2025</td>
</tr>
<tr>
<td>Master of Global Innovation Management (MGIM)</td>
<td>Association to Advance Collegiate Schools of Business (AACSB International)</td>
<td>2020</td>
<td>2025</td>
</tr>
</tbody>
</table>

**College of Natural Resources (https://cnr.ncsu.edu/)**

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Accrediting Body</th>
<th>Last Yr Accred</th>
<th>Next Yr Accred</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest Management (BS)</td>
<td>Society of American Foresters</td>
<td>2015</td>
<td>2025</td>
</tr>
<tr>
<td>Paper Science &amp; Engineering (BS)¹</td>
<td>Engineering Accreditation Commission of ABET</td>
<td>2017</td>
<td>2023</td>
</tr>
<tr>
<td>Parks, Recreation &amp; Tourism Management (BS)</td>
<td>Council on Accreditation of Parks, Recreation, Tourism &amp; Related Professions</td>
<td>2017</td>
<td>2022</td>
</tr>
<tr>
<td>Professional Golf Management (BS)</td>
<td>Professional Golf Association of America</td>
<td>2015</td>
<td>2021</td>
</tr>
<tr>
<td>Wood Products (BS)</td>
<td>Society of Wood Science &amp; Technology</td>
<td>2015</td>
<td>2025</td>
</tr>
</tbody>
</table>

¹ Accredited through the College of Engineering.
<table>
<thead>
<tr>
<th>Program Name</th>
<th>Accrediting Body</th>
<th>Last Yr Accred</th>
<th>Next Yr Accred</th>
</tr>
</thead>
<tbody>
<tr>
<td>College of Sciences (<a href="https://sciences.ncsu.edu/">https://sciences.ncsu.edu/</a>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry (BA, BS)</td>
<td>American Chemical Society (ACS)</td>
<td>2017</td>
<td>2023</td>
</tr>
<tr>
<td>Wilson College of Textiles (<a href="https://textiles.ncsu.edu/">https://textiles.ncsu.edu/</a>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textile Engineering (BS)¹</td>
<td>Engineering Accreditation Commission of ABET</td>
<td>2017</td>
<td>2023</td>
</tr>
<tr>
<td>College of Veterinary Medicine (<a href="http://www.cvm.ncsu.edu/">http://www.cvm.ncsu.edu/</a>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Veterinary Medicine (DVM)</td>
<td>American Veterinary Medical Association Council on Education (AVMA COE)</td>
<td>2014</td>
<td>2021</td>
</tr>
<tr>
<td>Administrative Program Accreditation and Certification (<a href="https://provost.ncsu.edu/institutional-quality/accreditation/specialized-program-accreditation/">https://provost.ncsu.edu/institutional-quality/accreditation/specialized-program-accreditation/</a>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Division of Academic &amp; Student Affairs (<a href="https://dasa.ncsu.edu/">https://dasa.ncsu.edu/</a>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic Skills Enhancement Program within the Academic Support Program for Student Athletes</td>
<td>International Tutor Program Certification within the College Reading &amp; Learning Association (CRLS)</td>
<td>2019</td>
<td>2024</td>
</tr>
<tr>
<td>Cooperative Education (On-the-job experience in chosen field)</td>
<td>Council for Cooperative Education</td>
<td>2016</td>
<td>2022</td>
</tr>
<tr>
<td>Counseling Center</td>
<td>International Association of Counseling Services, Inc. (IACS)</td>
<td>2015</td>
<td>2023</td>
</tr>
<tr>
<td>Student Health Services</td>
<td>Accreditation Association for Ambulatory Health Care (AAAHC)</td>
<td>2019</td>
<td>2022</td>
</tr>
<tr>
<td>Student Health Services</td>
<td>Commission on Office Laboratory Assessment (COLA)</td>
<td>2020</td>
<td>2022</td>
</tr>
<tr>
<td>UG Tutorial Center Program</td>
<td>College Reading &amp; Learning Association (CRLA) CRLA’s International Tutor Program Certification</td>
<td>2019</td>
<td>2024</td>
</tr>
<tr>
<td>¹ Accredited through the College of Engineering.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Health &amp; Public Safety (<a href="https://ehps.ncsu.edu/">https://ehps.ncsu.edu/</a>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Campus Police</td>
<td>Commission on the Accreditation of Law Enforcement Agencies</td>
<td>2020</td>
<td>2024</td>
</tr>
<tr>
<td>Campus Police</td>
<td>International Association of Campus Law Enforcement Administrators (IACLEA)</td>
<td>2016</td>
<td>2020</td>
</tr>
<tr>
<td>College of Veterinary Medicine (<a href="http://www.cvm.ncsu.edu/">http://www.cvm.ncsu.edu/</a>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Veterinary Health Complex</td>
<td>American Veterinary Medical Association performs accreditation inspections</td>
<td>Inspection 2014</td>
<td>Inspection 2021</td>
</tr>
</tbody>
</table>
Equal Opportunity and Non-Discrimination Policy

It is the policy of the State of North Carolina to provide equality of opportunity in education and employment for all students and employees. Educational and employment decisions should be based on factors that are germane to academic abilities or job performance. North Carolina State University ("NC State") strives to build and maintain an environment that supports and rewards individuals on the basis of relevant factors such as ability, merit and performance. Accordingly, NC State engages in equal opportunity and affirmative action efforts and prohibits discrimination, harassment and retaliation, as defined by NC State’s Equal Opportunity and Non-Discrimination Policy (POL 04.25.05) (https://policies.ncsu.edu/policy/pol-04-25-05/).

NC State will promptly, thoroughly and impartially respond to all complaints of Discrimination, Harassment and Retaliation.

Any individual with a complaint of Discrimination, Harassment or Retaliation should use the procedures outlined in the Resolution Procedures for Discrimination, Harassment and Retaliation Complaints.

Substantiated instances of Discrimination, Harassment and Retaliation, as defined in the policy, are violations of the policy and will not be tolerated by NC State.

For more information, please contact:

Office for Institutional Equity and Diversity
231 Winslow Hall
Box 7530
NC State University
Raleigh, NC 27695-7530
Phone: (919) 515-3148
TTY: (919) 515-9617
Website: oied.ncsu.edu/divweb/ (https://oied.ncsu.edu/divweb/)

1 This policy is established in accordance with 41 CFR Part 60 and is implemented in accordance with applicable laws and their amendments, including but not limited to, Title VI and Title VII of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, Executive Order 11246, the Age Discrimination in Employment Act of 1975, Section 504 of the Rehabilitation Act of 1973, the Americans with Disabilities Act of 1990, the Vietnam Era Veterans’ Readjustment Assistance Act of 1974, the Civil Rights Restoration Act of 1988, North Carolina General Statutes Chapters 116 and 126.

2 The policy’s prohibition against discrimination on the basis of sex includes actual or perceived gender identity and gender expression.

3 NC State does not allow discrimination nor harassment on the basis of sexual orientation with respect to internal university matters that do not contravene federal or state law and that do not interfere with NC State’s relationship with outside organizations, including the federal government, the military, ROTC, and private employers.

Student Activities

At NC State, we are dedicated to providing students with not only a world-class education, but a well-rounded and enriching collegiate experience. Students have the opportunity to take in thrilling performances put on by Arts NC State, connect with like-minded peers by joining or beginning any of 700+ student organizations through Student
Involvement, or cheer on the Wolfpack with pride as our 23 varsity sports teams take on the competition.

Take a look through the resources below to see just some of the ways that students can get involved and stay active both on and off campus with the Wolfpack community.

- Arts NC State (p. 42)
- Campus Facilities (p. 43)
- Intercollegiate Athletics (p. 45)
- Student Involvement (p. 46)
- Student Media (p. 46)

**Arts NC State**

The six visual and performing arts programs of Arts NC State - Crafts Center, the Dance Program, the Gregg Museum of Art & Design, the Department of Music, NC State LIVE and University Theatre - provide opportunities for our students and our community to explore, learn, create, and grow. Whether through academic courses, cutting-edge performances and exhibitions or the preservation of traditional crafts, Arts NC State educates our students for the 21st century while providing a living link to our rich cultural heritage. For additional information, please visit the Arts NC State website (https://arts.ncsu.edu/).

**The Crafts Center**

Explore your creative side and Make it Here! The NC State Crafts Center is an excellent resource for all students. Whether you're interested in learning a skill or just want to “de-stress,” the Center has a comprehensive range of offerings in clay, digital photography, wood, jewelry/metals, fibers, glass, lapidary, mixed media and more. The Crafts Center is a diverse and creative space where skill and self-expression are fostered through the making and sharing of art and craft. Join us for special student-only classes such as Friday CRAFTernoons, Stressbusters and more. It’s also a great place to visit, study and surround yourself with creativity. Mentorship thrives at the Center. Professional staff and crafts instructors provide quality technical advice and materials support. With the intent of enhancing quality of life, the Crafts Center reaches out through academic collaboration, support for student life, and partnerships with other arts organizations. Participation in associated crafts guilds that routinely meet at the Crafts Center provides NC State students a creative platform within the university and beyond.

For answers to your questions about the Crafts Center, please call 919.515.2457 or visit the Crafts Center website (https://craftsarts.ncsu.edu/) for our upcoming programming, calendar information, map and directions.

**Dance Program**

The NC State Dance Program gives students the opportunity to study dance through direct experience in choreography and performance. The program’s two student companies, the State Dance Company (DAN 295 Problems of Dance Performance) and the Panoramic Dance Project (DAN 210 Current Trends in Afrocentric and World Dance), are open by audition. A vast array of classes, offered through the Master Class Series, are open to all NC State students, faculty and staff. The program also offers other academic courses such as Dance Composition (DAN 272 Dance Composition - Solo Forms) and Hip-hop Dance (DAN 260 Hip-hop Dance).

The Dance Program provides a rich training ground for choreographers through the study of composition, independent study, and guided choreographic projects. As undergraduate and graduate students pursuing degrees in various fields, the dancers at NC State bring their diverse insights and experiences into the artistic process and contribute meaningfully to the art. The Dance Program’s three annual concerts are described below:

- **The Dance Program Fall Concert**: The Fall Concert features the choreography of current students who create work through independent study, as well as guest artists and company directors. Both the State Dance Company and the Panoramic Dance Project are represented on the Fall Concert.

- **State Dance Company Concert**: The State Dance Company performs a distinguished collection of modern dance for their annual concert. The concert features premiere and repertory work created by the dance program directors and invited guest artists.

- **Panoramic Dance Project Concert**: For their annual spring concert, the Panoramic Dance Project presents a variety of dance styles in a world context with a focus on African, hip-hop and Latin dance. The concert features work by the director, guest artists and selected student choreographers.

For more information, please contact 919.515.7034 or visit the Dance Program website (https://dance.arts.ncsu.edu/).

**Gregg Museum of Art & Design**

The Gregg Museum seeks to inspire creativity, innovation and the expression of ideas. With frequently-changing exhibitions and exciting free programs like films, artist talks, workshops, or yoga nearly every week, there’s always something new to see or do at the Gregg. As one of NC State’s designated Student Centers, the museum and its surrounding gardens offer a great place to study, have a picnic, or hang out with friends in a stimulating environment. Wifi is available both outdoors and inside.

The Gregg collection includes more than 35,000 objects from every continent, such as ceramics, glass, textiles, furniture, photography, paintings and sculptures, folk and outsider art, works on paper, Native American art, industrial design, archaeological artifacts, and fashion and costume. If you’re looking for inspiration or researching a topic involving objects, feel free to approach the museum staff for help. Each semester the Gregg also offers internships (for class credit) and paid student positions that provide experience in museum work.

To schedule tours or class visits, or to plan to use the permanent collection for research, please call 919.515.3503 or visit Gregg.arts.ncsu.edu (https://gregg.arts.ncsu.edu/).

The Gregg is located at 1903 Hillsborough Street, just across Pullen Road from the university’s Memorial Belltower, at the northern tip of Pullen Park. Opening hours are 10am-5pm Tuesday, Wednesday, Friday and Saturday; 10am-9pm Thursday; and 1pm-5pm on Sunday. The galleries are closed Mondays. Admission is free.

**Department of Music**

The Department of Music provides educational and performance opportunities for student and community participants through a variety of musical experiences and academic courses. Both a 15-hour minor in Arts Entrepreneurship and a 20-hour music minor is offered for qualified undergraduate students who wish to engage in more extensive study of
music and the arts. Three tracks are offered: Performance, Composition, and General Studies.

For full descriptions of the academic courses, consult the Department of Music (http://catalog.ncsu.edu/undergraduate/university-college/music/) page in the NC State University Course Catalog, contact 919.515.2981 or visit the Department of Music’s website. (https://music.arts.ncsu.edu/)

A wide variety of performing ensembles provide opportunities for students to develop both artistically and intellectually through applied music study. Through performance, the ensembles play an important role in campus life, presenting public concerts and performing at official functions (both on and off campus) and athletic events. Curricular performing ensembles receive one academic credit that may be used to satisfy free elective requirements in any academic major. Membership in most ensembles requires an audition with the instructor. See the Department of Music’s website (https://music.arts.ncsu.edu/) for audition information.

- **Choral Ensembles.** The Choral program offers students from all academic areas an opportunity to participate in the exploration and performance of the highest quality choral repertoire from all eras. The ensembles include State Chorale, Tenor-Bass Choir (Singing Statesmen), Soprano-Alto Choir (Vox Accalia), and the African American Choral Ensemble. Performance highlights have included concerts every semester, tours and occasional collaborations with other ensembles.

- **Orchestras.** The Raleigh Civic Symphony and Chamber Orchestra combine student and community musicians with professional leaders to present concerts of innovative programming on campus and in other Triangle area venues. Area professionals serve as concertmaster, principal cellist, and guest coaches, to provide high-level instruction and leadership to community and student players. Both orchestras require an audition.

- **Athletic Bands.** The Marching Band (Power Sound of the South) is active during football season, and the Varsity (Pep) Band is active during basketball season. Students must audition for a band and will be placed according to their ability and interest.

- **Concert Bands.** Two concert bands, the Symphonic Band and the Wind Ensemble, are offered each semester. Students must audition for the Wind Ensemble and will be placed according to their ability and interest.

- **Jazz Ensembles.** The jazz program includes Jazz Ensemble I, Jazz Ensemble II and a variety of Jazz Combos. The jazz groups perform both on and off campus during the fall and spring semesters. Students must audition for a jazz ensemble or combo and will be placed according to their ability and interest.

- **Piano.** Beginning piano classes are offered to students from all academic areas for credit. No previous experience is required. Applied lessons are offered to advanced piano students who have passed an audition and are admitted to the music minor program in piano performance with limited additional openings for non-minors.

- **Voice.** A Vocal Techniques class is offered to beginning voice students for credit with instructor approval. Previous voice study is not required. Applied voice lessons are offered to advanced voice students who have passed an audition and are admitted to the music minor program in vocal performance with limited additional openings for non-minors.

- **Pipes & Drums.** Students may learn to play the bagpipes, an instrument known to many of North Carolina’s earliest settlers. Pipes, drums, and other equipment are furnished. Beginning pipe and drum lessons are available to students without previous experience.

**NC State LIVE**

Experience amazing performers from around the world. A typical NC State LIVE season features outstanding professional artists from a wide range of disciplines, including jazz, world music, modern and contemporary dance, drama and comedy. Discounted tickets are available to NC State students, faculty, and staff, as well as parents of current NC State students and members of the NC State Alumni Association. The NC State community also has the opportunity to engage with world-class artists through free workshops, master classes, artist lectures, and more. Contact: 919.513.3030 or visit the NC State LIVE website (https://live.arts.ncsu.edu/).

**University Theatre**

University Theatre is NC State’s volunteer student theatre, open to all students regardless of major. Through our large-scale Main Stage series, cutting-edge performance based Open Door Series, and professional summer TheatreFEST series, students can enjoy theatrical works that tell stories from different perspectives and in varied genres.

Participating both on stage and backstage, students can be a part of the campus theatre community. Audition for a show; develop skills in our various shops, including scenery, costumes, lighting, sound or projections; join a production crew; or become a member of our stage management team. Academic classes are offered in conjunction with our theatre minor and numerous workshops throughout the year. Employment opportunities for live events are also offered. University Theatre is also home to a chapter of Alpha Psi Omega national theatre honor society.

Contact: 919.515.3927 or visit the University Theatre website (https://theatre.arts.ncsu.edu/).

**Ticket Central**

Ticket Central serves as the centralized box office for the visual and performing arts programs at NC State. Ticket Central tickets events in a variety of performance venues including Titmus Theatre, Kennedy-Mclwhee Theatre, and the Talley Student Union. In addition to serving the six Arts NC State programs, Ticket Central provides ticketing services on a fee basis for many campus and community organizations.

The box office is located in the main lobby of Thompson Hall. Normal hours of operation are Monday-Friday 1-6 p.m. If there are performances during the week, the box office will remain open until curtain. On weekends with performances, the box office will open one hour prior to curtain. Hours vary during University holidays and during the summer. Tickets may be purchased in person, over the phone by calling 919.515.1100, or online by visiting the Ticket Central website (https://tickets.arts.ncsu.edu/).

**Campus Facilities**

NC State’s campus facilities are home to many of our student activities and events. From screening films in the historic Witherspoon Student Center, joining Student Government meetings in Talley Student Union, participating in intramural sports at the Carmichael Complex, or watching one of University Theatre’s student-directed plays in Frank Thompson Hall, students and visitors can have a variety of experiences all right
here on campus. Here are just a few of the spots that serve our student activities and services.

The Campus Cinema

The Campus Cinema, located in Witherspoon Student Center, presents films ranging from independent works to the latest Hollywood blockbusters in digital format with Dolby® Digital Surround Sound. The Cinema is a fully functional movie theatre with 460 seats and a concession stand offering freshly popped popcorn, one free popcorn per person. Movie screenings are free to NC State and the general public unless otherwise specified. Check out the cinema website at: https://uab.ncsu.edu/films-schedule/ (http://uab.ncsu.edu/films-schedule/). If you desire any assistive devices, services, or other accommodations to participate in these activities, please contact the UAB Films Advisor at 919-515-5168.

Carmichael Complex

Carmichael Complex consists of Carmichael Gym, Carmichael Recreation Center, Willis R. Casey Aquatic Center, Miller Fields, 12 tennis courts, and 8 basketball courts, which offer a wide variety of indoor and outdoor fitness choices for students. Students may use the pools, indoor track, courts, cardio equipment, the outdoor fields, and tennis courts unless otherwise reserved for classes, events or maintenance. The Carmichael Complex is home to University Recreation and the Department of Health & Exercise Studies. For more information, please visit the Carmichael Complex website (http://recreation.ncsu.edu/facilities/carmichael/) or call (919) 515-PLAY (7529).

Gregg Museum of Art & Design

Gregg Museum of Art & Design is NC State’s collecting museum, with more than 35,000 examples of contemporary and historic ceramics, textiles, glass, furniture, photography, paintings, sculptures, folk and outsider art, archaeological artifacts, works on paper, and fashion garments preserved in its permanent collection. Frequently-changing exhibitions and interesting programs make every visit special.

Located in the original 1928 Chancellor’s Residence at 1903 Hillsborough Street (just across from NC State’s famous Memorial Belltower), the Gregg includes period rooms, formal gardens, and a contemporary 15,000 sq. ft. galleries wing. All are used as exhibition and programming spaces, and are free and open to students and public alike.

Departments, groups, and individuals may also book spaces for private meetings, conferences, workshops, parties, weddings, and other events. Call 919-515-8956 for rates and availability.

To schedule tours or class visits, or to make arrangements to use the permanent collection, call 919-515-3503 or visit Gregg.arts.ncsu.edu (https://gregg.arts.ncsu.edu/). The Gregg and its surroundings offer a great place to meet, hang out, study, play, or have a picnic in a stimulating environment. Wifi is available both outside and indoors. Hours are 10am-5pm Tuesday, Wednesday, Friday and Saturday; 10am-9pm Thursday; and 1pm-5pm on Sunday. The galleries are closed Mondays. Admission is free.

Price Music Center (PMC)

Price Music Center (PMC) is the location for the Department of Music and its programs. Until 1965, the first Pullen Hall had been the original music building, which, along with many band instruments, pianos, and a music library, was destroyed by a student arsonist. Built in 1971, Price Music Center is named to honor Percy Walter (Daddy) Price, the father of today’s musical organizations on campus and the University’s first music director in 1923.

Practice studios are available to NC State students on a first-come, first-served basis. Each practice room has an upright piano and music stand. For questions about practice space in Price, call 919.515.2981. For more information, see Department of Music (https://music.arts.ncsu.edu/).

Price Music Center is located at 2620 Cates Avenue, next to the Talley Student Union. The main office is located on the second floor, room 203. Additional facilities and offices are located in the south wing of Broughton Hall.

Talley Student Union (TSU)

Talley Student Union (TSU) is the hub of student life on campus and is the place to study, shop, dine and engage with your peers. Talley Student Union is anchored with nine food venues, Wolfpack Outfitters, the Woodward Student Involvement Center and Stewart Theatre. If students are looking to connect with the arts, enhance their leadership skills, or connect with peers, Talley Student Union is the place to start. Students can even be part of the amazing student employment team that operates the facility.

Program offices and service areas that can be found in the Talley Student Union include:

• Arts NC State;
• Center for Student Leadership;
• Dance Program;
• Ethics & Public Service;
• Fraternity and Sorority Life; GLBT Center;
• Multicultural Student Affairs; Student Involvement;
• NC State LIVE;
• NC State Student Centers Administration;
• Student Centers Board of Directors;
• Union Activities Board;
• University Theatre Administration;
• Women’s Center;
• RAVE! Events;
• Ticket Central;
• and University Graduate Student Association.

RAVE! Events

To reserve room in the Talley Student Union or to plan your event, please visit R (http://campusenterprises.ncsu.edu/talley-student-union/) AVE!'s website (https://campusenterprises.ncsu.edu/rave-events/) or contact RAVE! Events at 51-EVENT (513-8368).

Frank Thompson Hall

Frank Thompson Hall is the location for University Theatre and the Crafts Center. Built in 1925 as a gymnasium, Thompson Hall reopened in Fall 2009 after an extensive renovation that was an extraordinary partnership between NC State students, private citizens, businesses and the extended NC State community.

Thompson Hall houses University Theatre’s full production activities, performances, and classes. Facilities include the Titmus Theatre, the Kennedy-McIlwee Studio Theatre, the costume shop, the scenic
construction and paint shop, lighting and sound facilities, as well as rehearsal and classroom spaces. The renovation brought state-of-the-art technologies and improved accessibility to the building that now returns to its purpose as a hub of student activity. For more information, see University Theatre (https://theatre.arts.ncsu.edu/).

Located on the ground floor of Thompson Hall, the Crafts Center offers technology-rich studios and specializes in classes and workshops in clay, digital photography, wood, jewelry/metal, fibers, glass, lapidary, mixed media and more. For more than fifty years, the Crafts Center has provided a friendly learning environment for students and craftspeople of all levels. NC State’s Crafts Center is one of the finest university crafts programs in the country. Classes and studio use are available to NC State students, alumni, employees, and the general public. For information, see Crafts Center (https://crafts.arts.ncsu.edu/).

Thompson Hall is located on Dunn Street and Jensen Drive.

**Witherspoon Student Center (WSC)**

Witherspoon Student Center (WSC) currently houses the African-American Cultural Center, Student Government and Student Media which includes the offices of five student-run media organizations:

- Agromeck (yearbook);
- The Nubian Message and Technician (newspapers);
- Windhover (literary magazine);
- and WKNC FM 88.1 (radio station).

Witherspoon includes two accessible balconies; one meeting room available by reservation through REM; the African-American Cultural Center’s Sankofa Room, Gallery and Library; and Campus Cinema, used for films, lectures, classes and special events.

**Intercollegiate Athletics**

**Go Pack!**

NC State has a long and storied history in athletics, as well as a loud and passionate fanbase that supports the Wolfpack faithfully. The university’s athletics programs (http://www.gopack.com/) enjoy a tradition of excellence as they compete in the prestigious Atlantic Coast Conference.

The athletics program is self-supporting and is operated primarily through gate receipts, radio and television revenues, NCAA distributions, student fees, and private donations. Funds for athletics grants-in-aid are provided through the North Carolina State Student Aid Association, also known as the Wolfpack Club.

**Sports**

The Department of Athletics conducts the university’s intercollegiate athletics program, which includes 23 varsity sports. The athletics program is administered by the Director of Athletics, Boo Corrigan. The Council on Athletics is appointed by the Chancellor and serves in an advisory capacity to the Director of Athletics and the Chancellor.

Men’s varsity sports include soccer, cross country, and football in the fall; basketball, swimming and diving, indoor track, and wrestling in the winter; and outdoor track, golf, tennis, and baseball in the spring. Varsity sports for women include soccer, cross country, and volleyball in the fall; basketball, indoor track, swimming and diving, and gymnastics in the winter; and outdoor track, golf, softball and tennis in the spring. The co-ed rifle team competes during the winter.

**Athletics Facilities**

The Wolfpack’s football facility, Carter-Finley Stadium, boasts 57,600 permanent seats. The 106,000 square-foot Murphy Football Center, which is the operations hub for the football program, stands in the south end zone, while the Finley Fieldhouse houses visitor locker rooms and other operations spaces on the north end of the field. Soaring high above it all is Vaughan Towers, a 117,000 square-foot structure along the west grandstand that houses 955 club-level seats, 51 private luxury suites, a University suite for the Chancellor and a state-of-the-art press box.

The men’s basketball squad competes in the PNC Arena, which boasts one of the top capacities in the Atlantic Coast Conference with seating for 19,500 fans. Since PNC Arena opened in 1999-2000, NC State has finished every year in the top-25 nationally in attendance. The women’s basketball squad plays in the James T. Valvano Arena at William Neal Reynolds Coliseum – one of nine areas on campus designated as a “hallowed space.” The arena has seating for 5,500 in the facility which recently underwent a $35 million renovation and now houses the Wolfpack Walk of Fame and History. It’s also the home of gymnastics, wrestling and rifle, as well as NC State’s ROTC programs.

Located in the heart of campus, the Dail Soccer Field is located inside Paul Derr Track under stadium lights. Adjacent to that complex is the Dail Softball Stadium. Situated across from historic Reynolds Coliseum, the picturesque campus setting serves as the background for one of the best softball facilities in the ACC.

With seating for 3,480, Doak Field at Dail Park has been the home of Wolfpack baseball for over 50 years. Across the street from “The Doak” is the J.W. Isenhour Tennis Center. The outdoor stadium, has six lighted courts, chairback seating for up to 1,000 spectators, and an electronic scoreboard. The indoor courts, named in honor of former Wolfpack standout Andy Andrews, provides seating for up to 200 spectators.

The golf team trains at the beautiful Lonnie Poole Golf Course, an 18-hole, 7,350-yard, par 71 public course located on Centennial Campus. The $11.6 million dollar Arnold Palmer Signature multipurpose golf course also houses a research center and The Carol Johnson Poole Clubhouse. This facility also supports critical academic programs, including the Professional Golf Management (PGM) and turfgrass programs.

The Willis R. Casey Aquatic Center serves as the hub for the Pack’s nationally-ranked swimming and diving teams. The site of many ACC Championship meets over the years, it features two pools and spectacular seating for approximately 1,000 fans.

The Wolfpack’s athletics administrative offices and coaches’ offices for soccer, track and cross country, and wrestling are located in the Weisiger Brown General Athletics Facility. The Case Athletics Center houses the Academic Support Program for Student-Athletes.

The fundraising offices of the Wolfpack Club and the athletic department’s ticket offices are located in the Palisades Building near Carter-Finley Stadium: 5400 Trinity Rd. (Suite 500), Raleigh, NC 27607.

For ticket information call (919) 865-1510 or 1-800-310-Pack. The main athletic department receptionist: (919) 515-2101. Visit the official athletic department website (http://www.gopack.com/) for complete information.
Student Involvement

The Wolfpack's starting place for students to get involved at NC State, Student Involvement helps students find fun and meaningful ways to make NC State home through involvement on campus. The department supports the Wolfpack’s diverse community of student organization members, leaders, and advisors through advising, education, and programming. Student Involvement also provides resources to students that make it easy to find any of over 700 student organizations to join or start an organization that doesn’t exist.

Getting involved is an important way students can develop the sense of belonging necessary for academic success, personal and professional development. Being involved on campus is a great way to build a sense of belonging at NC State, increase cultural competencies and develop multiple perspectives, as well develop academically, personally, and professionally.

Student Involvement Center
4201 Talley Student Union
2610 Cates Avenue
Raleigh, NC 27695-7295

Website: studentinvolvement.dasa.ncsu.edu
Phone: 919.515.2797
Email: studentinvolvement@ncsu.edu

Student Government

Founded in 1921, Student Government is a student-run organization that serves as the official voice of the student body. The organization attempts to better the student experience at NC State by working alongside university administrators to address student concerns.

Student Government is organized into five primary areas: executive, legislative, judicial, the treasury, and the Board of Elections. Student organizations may seek funding from Student Government appropriations committee through a bi-annual process.

Website: https://orgs.ncsu.edu/student-govt/
Talley Student Union
Suite 4251
Email: studentgovernment@ncsu.edu

Melanie Flowers, Student Body President
McKenzy Heavlin, Student Body Vice President
Coleman Simpson, Student Senate President
Garrison Seitz, Student Body Treasurer

The University Activities Board

The University Activities Board (UAB) was formed in 1951 to produce quality programming “for the students, by the students.” The mission of UAB is to create innovative activities that stimulate, motivate, educate, and involve the student body. Annual programs include Wolfstock, Pan-African Week, and TUFFTalks.

Website: https://orgs.ncsu.edu/uab/
Zach Hover, President
Josie Thompson, Vice President of Communication

Michael Barilla, Vice President of Finance
Bri Murphy, Vice President of Internal Affairs

Fraternity and Sorority Life

There are over 50 fraternities and sororities at NC State University, each founded to prepare students for society through a values-based fraternal experience. Affiliation with an organization is designed to empower students to pursue their potential, providing opportunities to belong, give, achieve, live and lead. How organizations enact those values through membership, programs, and activities are what makes each organization unique. Fraternities and sororities provide opportunities to get involved, helping students on a large campus build a support network of peers that share similar goals and interests. Organizations challenge members to take on new responsibilities, develop their leadership potential, be active within the campus and surrounding communities, and adopt a commitment to volunteerism and civic engagement. Fraternities and sororities also provide their members with a unique lifetime membership, connecting them with local graduate and alumni chapters and national alumni groups well after graduation.

Approximately half of our chapters provide housing for their members with 15 chapters currently living in Greek Village on campus and 4 new homes under construction. The University, in partnership with our fraternities and sororities, has committed to redevelop Greek Village over the next 10 years. At completion, Greek Village will be home to over 35 different fraternities and sororities in a combination of homes, townhouses and apartments.

For more information on membership, educational programming, or service opportunities, visit the Department of Fraternity and Sorority Life’s website, the office in 5261 Talley Student Union, or call (919) 513-2910.

Website: fsl.dasa.ncsu.edu
Shelly Brown Dobek, Director of Fraternity and Sorority Life

Student Media

Department website: https://ncsu.edu/sma
NC State students have the opportunity to produce and manage a variety of student-oriented media. By working with these media, students gain valuable co-curricular experience in sales, marketing, journalism, broadcasting, production, design, multimedia communication, leadership and management. NC State boasts five media outlets staffed by students and supported in large part by self-generated non-fee revenue, as well as a student-staffed Business and Marketing office which coordinates advertising sales, sponsorships and full-service marketing opportunities for all five media. Many staff positions are paid.

Agromeck

Agromeck, the university’s yearbook, provides a record in words and pictures of student and campus activities each year. Student staff members include photojournalists, writers, designers and editors, all with a common mission: documenting the history of the university from the student perspective. The Agromeck has received the nation’s highest awards for general excellence and photography as well as national Pacemaker and Crown awards.

Nubian Message

Nubian Message provides news and features about the African-American community at NC State, as well as coverage of regional, state and
national issues of interest to our students. To find out more about this bi-weekly publication, visit the Nubian Message online.

**Technician**

*Technician*, the university’s oldest student newspaper, is published each Thursday when school is in session during the fall and spring semesters, and online with breaking news and online-only content year-round at technicianonline.com (https://technicianonline.com). With a print circulation of 4,000 copies at nearly 100 newsstands on and near campus, the *Technician* has earned numerous state and national awards for news, features, sports, opinion writing and photography, as well as general excellence. Online, you’ll find continuous updates of news, features, sports, campus events, and other content of interest to students, including video, audio and photo slideshows.

**The Windhover**

*The Windhover*, the campus literary and visual arts magazine, is published each spring. As a showcase for NC State’s creative writers, poets, artists, photographers and musicians, it has received numerous national awards, including the Pacemaker from the Associated Collegiate Press and Gold Crown from the Columbia Scholastic Press Association. Visit the Windhover online (http://www.ncsu.edu/windhover/).

**WKNC (88.1 FM)**

WKNC (88.1 FM), NC State’s student radio station, operates at 25,000 watts, for a potential effective potential audience of more than 1.4 million through its FM signal alone, as well as an online stream and a mobile app that lets listeners enjoy WKNC from anywhere in the world. It employs a full complement of student managers, DJs, engineers, journalists and bloggers to provide programming 24 hours a day. It also sponsors a variety of live music events both on campus and at various music venues in Raleigh. Visit (and listen to!) WKNC online (http://www.wknc.org). If you have an HD radio, you can also enjoy WKNC HD-2.

**Student Media's Business Office**

Student Media’s Business Office gives students interested in sales and marketing an opportunity to hone their skills while earning commission on every advertisement and sponsorship they sell. From print, to broadcast, to online sales, few (if any) organizations at NC State offer our students a better way to build their “real-world” business and marketing acumen as they work toward earning their degree from NC State. To find out more, visit the Business and Marketing Office online. (https://www.ncsu.edu/sma/)

**The Student Media Board of Directors**

The Student Media Board of Directors is a way for students to get involved in the management of a large business operation. The Board of Directors is the governing arm for all student media which use student fee monies to support their operations. Elections to the Board are held in the spring.

**Student Services**

NC State University knows that there’s more to academic success than books and research papers. That’s why we offer a full range of services to support students in all aspects of their academic careers. Our full-service Student Health Center helps keep students healthy, while our Career Development Center helps them plan for life after graduation.

Take a look through all of our student services below to see how we are here to support your time at NC State.

**A**

- Academic Advising Services (p. 47)
- Academic Support Program for Student Athletes (p. 48)

**C**

- Campus Community Centers (p. 49)
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**O**

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**T**

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**U**

- Undergraduate Research (OUR) (p. 58)
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**W**

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**Academic Advising Services**

2751 Cates Avenue
Pre-Law Advising

Law schools neither prescribe nor recommend a particular undergraduate curriculum for prospective candidates. A student may prepare for law school within any of the majors offered by the nine undergraduate colleges. Pre-Law Services at NC State are offered through the Career Development Center (http://careers.ncsu.edu/). Through Pre-Law Services, students receive guidance on preparing for law school, taking the LSAT, and applying to law school. Students have the opportunity to learn and network through experiential learning programs, internships, seminars and workshops, and the annual Law School Fair.

The Pre-Law Advisors also works with the Pre-Law Students’ Association (PLSA), which is open to all interested students. During the year the PLSA provides programs that have included: NC State Law School Fair, local attorneys, panel of Law School students, Law School Directors of Admission, information on the admissions process. For more information, visit the Pre-Law Services website (https://careers.dasa.ncsu.edu/gain-experience/pre-professional/pre-law/).

Health Professions Advising

Many NC State undergraduate students are planning a career in the health professions and will apply to attend medical, dental, optometry or other health care graduate schools after graduation. Health Professions Advising at NC State University offers guidance, information, and support to students interested in attending health professional school. The Health Professions Advisor can assist you with:

- Prerequisite course selection
- Becoming a competitive candidate
- Selecting potential health professions schools
- Application materials & timelines
- Personal statement assistance
- Interview tips & preparation

Health professional schools do not require students to obtain a designated “Pre-Health” degree. Instead, they seek students who have demonstrated academic success and who also have excelled in other areas including clinical and service experience as well as social development. Like most schools, NC State does not offer a dedicated “Pre-Health” curriculum. Instead, we recommend that students interested in health professions select the academic major that is of greatest interest to them while ensuring that they select courses that provide a strong foundation in the natural sciences required by most professional programs for admission. These include biology, chemistry, physics, and calculus along with recommended courses like genetics and biochemistry. It is also recommended that students select courses that improve communication and writing skills as well as provide a strong foundation in the humanities, psychology and ethics.

For more information on Health Professions Advising, visit the Health Professions Advising website (https://prehealth.dasa.ncsu.edu/).

Veterinary Professions Advising Center (VetPAC)

The Veterinary Professions Advising Center (VetPAC) aims to provide NC State students and alumni the guidance, resources and experience necessary to become uniquely competitive veterinary school applicants. While there is no formal "pre-veterinary" program or degree at NC State, many students interested in pursuing veterinary school often declare majors in the following disciplines: Animal Science, Zoology, Biological Sciences, Biochemistry, Microbiology, and Poultry Science.

VetPAC is housed within the College of Agriculture and Life Sciences. For more information on pre-veterinary advising, visit the VetPAC website (https://cals.ncsu.edu/vetpac/).

Academic Support Program for Student Athletes

The Academic Support Program for Student Athletes (ASPSA) is a comprehensive support program that strives to meet the academic, personal and professional development needs of all student-athletes, promoting excellence and effectiveness in undergraduate and graduate education as well as leadership and civic engagement.

ASPSA is committed to extending the educational experience of its constituency with particular emphasis on empowering student-athletes to become strong self advocates, providing specialized initiatives to facilitate a smooth transition from high school to college and from college to professional life while successfully integrating student-athletes into the campus community; enhancing academic skills for student-athletes at all skill levels and providing academic support personalized to the needs of each student-athlete.

ASPSA will maintain a strong sense of integrity and will continue to strive to be one of the benchmark programs for academic support for all collegiate academic support programs in the nation. The mission of the Office of Academic Support Program for Student Athletes at NC State University is:

1. to support the recruitment, retention and graduation of NC State student-athletes;
2. to provide a comprehensive support system that affords NC State student-athletes equitable opportunity to pursue academic, personal, and professional development and
3. to strongly adhere to the principles of integrity, excellence, and lifelong learning.

200 Case Academic Center
240 Jeter Drive
Campus Box 7104
organizations, resources or support services, visit our website.

For more information about our educational workshops, events, student opportunities; and host educational events and programs.

NC State's Campus Community Centers are proudly comprised of the African American Cultural Center, the GLBT Center, Multicultural Student Affairs, and the Women's Center.

African American Cultural Center

The mission of the African American Cultural Center is to promote awareness of and appreciation for African American and other African descent experiences through activities and events that enhance academic excellence and strengthen cultural competence for the campus and surrounding communities. Students, staff and visitors are welcome to attend our programs and events and to visit the Art Gallery and Library in Witherspoon Student Center, the first building on NC State's campus named for an African American, Dr. Augustus M. Witherspoon.

To learn more about the African American Cultural Center, visit our website (https://diversity.ncsu.edu/aacc/). Our main office is located on the 3rd floor of Witherspoon Student Center.

African American Cultural Center
355 Witherspoon Student Center
Email: aaculturalcenter@ncsu.edu

GLBT Center

The mission of the NC State GLBT Center is to engage, develop and empower members of the gay, lesbian, bisexual and transgender communities and their allies. To fulfill that mission, we help students connect to form social support networks; offer identity-based and health-related information and resources; consult with students individually and collectively on issues related to personal identity and academic success; refer students to a wide variety of resources on campus and in the local community; provide professional and leadership development opportunities; and host educational events and programs.

Our vision is of a campus where students, staff, faculty and alumni feel a shared responsibility to increase their individual understanding of and comfort with diversity, to enhance their ability to connect with members of their own communities, to build coalitions across identity groups and to work collaboratively to raise awareness, promote respect and create a culture where they can advocate for equity, inclusion and social justice on behalf of themselves and others.

For more information about our educational workshops, events, student organizations, resources or support services, visit our website (http://www.ncsu.edu/gltb/). We are located on the 5th floor of Talley Student Union.

GLBT Center
5230 Talley Student Union
Email: glbtcenter@ncsu.edu

Multicultural Student Affairs

Multicultural Student Affairs researches, designs and implements programs that promote the academic success, retention and graduation of students, with an emphasis on students from historically underrepresented and marginalized ethnic populations. Our programs and services aim to expand students' horizons while honoring their respective cultural experiences.

Multicultural Student Affairs collaborates with many university organizations to conduct programs to enhance personal, professional and cultural development and student success. Programs and services have included orientation symposia, peer mentoring, heritage month programming, cultural celebrations, academic recognition programs, student leadership development, recruitment and advising.

We welcome any NC State student to our programs and services. Visit our website (https://diversity.ncsu.edu/msa/) for more information. We are located on the 4th floor of Talley Student Union.

Multicultural Student Affairs
4261 Talley Student Union
Email: multicultural@ncsu.edu

Women's Center

The mission of the Women's Center is to build and create a community of authentic and engaged allies and leaders to pursue gender equity and social justice; enhancing the campus climate through education, advocacy, support and leadership development.

The Women's Center provides leadership opportunities through programming initiatives such as Feminist Friday's, alternative service break trips and volunteer and internship opportunities. Staff in the Women's Center also serve as direct advocates for survivors of interpersonal violence. Students can speak with an advocate by stopping by the center or calling the 24-Hour Sexual Assault Helpline at 919.515.4444.

To learn more about the Women's Center visit our website (https://diversity.ncsu.edu/womens-center/). We are located on the 5th floor of Talley Student Union.

Women's Center
5210 Talley Student Union
Email: womens-center@ncsu.edu

See also Office for Institutional Equity and Diversity under the University Administration section for other units within this office dedicated to diversity, equity and inclusion at NC State.

Career Development Center

The Career Development Center's mission is to prepare and empower students to identify and pursue their career goals. From first year students to graduate students, services are designed to meet the needs of students across all stages of career development. Career coaches are available to meet with students one-on-one or in group settings. Students are provided access to career related assistance ranging from resume development and interview strategies to job search techniques and experiential learning opportunities.

The Career Development Center's online career tool, ePACK, allows students to search and apply for co-op's, internships, and full-time jobs, schedule an appointment with a career counselor, schedule on-campus interviews with employers, find career fairs, and search for career-related events and activities. A wealth of career information is available on the Career Development Center's website (http://careers.dasa.ncsu.edu/).
Career Development Center
2100 Pullen Hall
201 Dan Allen Dr
Campus Box 7307
Raleigh, NC 27695-7303
Phone: 919-515-2396
Email: career-development@ncsu.edu
Arnold Bell, PhD., Executive Director

College Advising Corps (CAC)
In February 2014, the College Advising Corps launched a partnership with the John M. Belk Endowment to expand the Corps to institutions of higher education, such as NC State University. In its inaugural year, 9 recent NC State graduates were placed into 9 rural high schools across North Carolina to assist students navigate the path to college. Going into its second year, the NC State College Advising Corps has placed 21 recent NC State graduates into 21 high schools.

The College Advising Corps aims to increase the number of first-generation college going, low-income, and/or underrepresented students who apply, enter, and complete college. We believe that every student deserves the opportunity to enter and complete higher education.

211 Park Shops
North Carolina State University
Raleigh, NC 27695-7105
Website: http://advisingcorps.dasa.ncsu.edu/
Phone: 919-515-5247, Fax: 919-515-4416
Nicole Ditillo, Program Director

Counseling Center
NC State and the Counseling Center work hard to create a campus culture that supports and connects us all. College is a time for tremendous intellectual, social and professional growth. But as we create leaders and innovators, we also want to cultivate emotional and psychological growth that will allow our students to be successful and flourishing.

The Counseling Center provides individual and group counseling for NC State students wishing for assistance with personal, academic or career concerns. Services are primarily short-term in nature and referrals are made as appropriate. Counseling staff includes psychologists, professional counselors, social workers, graduate interns and psychiatrists who are available to work with students with concerns such as anxiety, depression, relationship issues, substance abuse, test anxiety, time management, dissertation support, and choosing a career. All counseling is strictly confidential with exceptions noted on the Counseling Center website. In addition to counseling, workshops and support groups are offered throughout the year in a variety of areas such as time management, stress reduction, suicide prevention, and relationship skills.

The Counseling Center is located on the 2nd floor of the Student Health Center, 2815 Cates Avenue. Appointments may be scheduled by coming by the Counseling Center during walk in hours daily as posted on our website. Emergency after-hours assistance is available by calling the Counseling Center at 919-515-2423 and selecting the Counselor on Call.

Additional information about services can be found on the Counseling Center’s website (https://counseling.dasa.ncsu.edu/).

The Counseling Center is accredited by the International Association of Counseling Services (http://iacsinc.org/).

The College Advising Corps provides additional services.

Disability Resource Office
The Disability Resource Office (DRO) facilitates accommodations and services for individuals with documented disabilities and serious medical conditions. Accommodations and services are rendered based on the individual’s documented needs and are determined through an interactive process. DRO will maintain appropriate confidentiality of records and communication regarding disability. To receive accommodations and services, please contact the DRO as far in advance as possible.

Visit The Disability Resource Office online (http://dso.dasa.ncsu.edu/) for more information about services, student and faculty rights, and other resources.

Holmes Hall, 3rd Floor
2751 Cates Avenue, Suite 310
NC State Box 7509
Raleigh, NC 27695-7509
Website: http://dro.dasa.ncsu.edu
Phone (voice): 919.515.7653
Phone (TTY): 919.515.8830
Fax: 919.513.2840
Email: disability@ncsu.edu

In accordance with Section 504 of the Rehabilitation Act of 1973 (“Rehab Act”), the Americans with Disabilities Act of 1990 (“ADA”), The ADA Amendments Act of 2008 (“ADAAA”), and state law, NC State is committed to ensure that qualified individuals with a disability in the United States shall be excluded from, denied the benefits of, or be subjected to discrimination under any program or activity. The DRO works diligently to ensure that individuals with disabilities are provided an inclusive experience and equal opportunity by determining eligibility for accommodations for students with disabilities and serving as a resource to faculty in helping them understand their obligation in providing equal access.

Military and Veteran Services
NC State University Military and Veteran Services (MVS) is the university’s centralized resource to coordinate integrated support to military-affiliated students. Our primary objective is to ensure that our veterans and military-affiliated students feel a strong sense of belonging to NC State.

Mission
NC State University is committed to educating, supporting, and honoring student veterans and their families by helping them acquire
the knowledge and skills necessary to achieve their personal and professional goals.

The MVS proudly serves all military-affiliated students, staff, faculty and retirees:

- Discharged and retired veterans
- Active duty military
- Members of the National Guard and Reserve Components
- Spouses and dependents of military and veterans
- Gold Star family members

The goal of the MVS is to ensure you are successful as you:

- Transition from the military to the campus;
- Persist to graduation; and
- Transition from NC State into your chosen career

For more information about our services and resources, visit our website (https://veterans.dasa.ncsu.edu/).

NC State Military and Veteran Services
100 Witherspoon Student Center
2810 Cates Ave.
Campus Box 7318
Raleigh, NC 27695-7318
Phone: 919-515-5041
Email: ncstatevets@ncsu.edu

Nick Drake, Director

NC State Dining

NC State Dining’s award-winning program offers food options that are convenient, fresh, wholesome and delicious. We have over 40 dining locations across campus, all of which accept some form of the meal plan. From traditional all-you-care-to-eat dining halls to a mix of restaurants, cafes and convenience stores, our program is designed to meet the unique needs and tastes of the campus community.

NC State Dining hosts a number of theme meals and monotony breakers during the year, including our famous All Carolinias Meal, which features items grown or produced in North Carolina. We also host a number of cultural meals, too. Check out the special events calendar (http://www.ncsudining.com/university-dining-events/) for more details.

Nutrition

We understand the diverse nutritional needs of our campus population, such as food allergies, intolerances, and special dietary preferences. Our website (https://dining.ncsu.edu/locations/) provides nutritional information for all of our restaurants and dining halls, and many locations have a nutrition kiosk where guests can check the daily menu for allergens and other key ingredients.

Our Well-Fed Wolfpack nutrition team and registered dietitian are nationally recognized for their efforts to make NC State one of the best campuses known for its nutrition and wellness programs (http://www.ncsudining.com/campus-dining/healthwellness/). Our dietitian is available for a free consultation to discuss your nutrition goals and special dietary needs. We place a special emphasis on fresh foods and wellness while providing nutrition resources, education, and awareness across campus.

These efforts have helped us earn national recognition, including the Top 26 Healthiest Colleges and Top 10 Gluten Free Accommodating Colleges in the nation.

Meal Plans

All first-year students living on campus are required to have a meal plan.

Our meal plans (https://dining.ncsu.edu/meal-plan-options/) are designed to cover the cost of meals and snacks in three different ways: Dining Hall Swipes, Meal Credits, and Dining Dollars.

- Dining Hall Swipes: Just one swipe at our dining hall locations and you can enjoy a full meal or a light snack, all with a single swipe.
- Meal Credits: Use Meal Credits to purchase a meal at one of our many restaurants or cafes. Meal Credits are also used to purchase a dining hall take-out meal. Meals Credits vary by location and only one Meal Credit can be used per meal period.
- Dining Dollars: Use Dining Dollars at convenience stores and vending machines, or to make small purchases at a restaurant or cafe in lieu of a Meal Credit.

Our Core Plans (the Dining Hall Plan, Flex Plan, and Flex Plus Plans) are primarily designed for students who desire to have the majority of their meals covered by a convenient, affordable campus dining plan. All three plans include all-day access to our dining halls, so students can come and go when they’re hungry to our three all-you-care-to-eat dining halls and enjoy a full meal or light snack as often as they like throughout the semester. (The all-access pass requires 30 minutes pass between each Dining Hall Swipe.)

We also have the Block 170 Plan (170 meals-per-semester) that can be used at any time in the dining halls or once per meal period in a restaurant or cafe, and includes 100 Dining Dollars. Our Commuter/Apartment Plan is for students who commute or live in on-campus apartments. It includes $800 Dining Dollars that can be used at any dining location and comes with a five percent discount at the register on all purchases.

Picking a Plan

Detailed information and a full guide on selecting a plan is available on our website at dining.ncsu.edu. We recommend you review the plans, then consider your expected daily travel and eating patterns once you’ve received your residence hall assignment and course schedule. Once you’ve picked a plan, register online (https://dining.ncsu.edu/meal-plan-options/meal-plan-signup/) or complete the paper form you’ll receive in your packet before you arrive on campus this fall. You can then try out your plan and make any changes via our website prior to September 15. Be sure to re-evaluate for the spring semester to ensure your plan is the right one for you and make any changes by January 31.

We're Here for You

We take pride in offering quality food and services designed specifically to meet the wants and needs of students. For more information, visit NC State Dining online (http://dining.ncsu.edu) or call 919.515.3090. Follow us on Facebook (https://www.facebook.com/ncstatediningpack/), Twitter (https://twitter.com/ncstatedining/) and Instagram (https://www.instagram.com/ncstatedining/) for information on special events, featured menu items, cooking demos, and more.
NC State Stores

NC State Stores has been the authority on textbooks, school supplies, computers and apparel since our founding in 1954. NC State Stores ensures students have access to the best prices and service to secure course materials through price comparison tools and easy on-campus shopping. The Stores also offer the most extensive collection of officially licensed merchandise available anywhere, featuring apparel from leading brands like Adidas, Southern Tide, Peter Millar, Vineyard Vines, Clinique and more.

Shop online or find out more at bookstore.ncsu.edu (http://bookstore.ncsu.edu/).

Locations

Wolfpack Outfitters is the flagship location, located in Talley Student Union. The store carries fan gear, apparel, gifts, books, novelty items, school supplies, technology and more.

Wolfpack Outfitters also services students on Centennial Campus with a smaller satellite location that carries books, school supplies, apparel and snacks. It is located in Wolf Ridge Apartments next to On the Oval Culinary Creations.

Textbooks

Once a student has completed course registration, they can view their book list from their Class Schedule page in MyPack Portal. From there, students can view all required and recommended course materials, compare prices with the online shopping tool, and place an order.

NC State Stores prides itself on the value it provides, and it is backed up with pricing transparency. NC State stores also offers a textbook buy-back program at the end of each semester, and students can visit the Stores’ website to check their value before bringing them in.

Financial Aid and Scholarship Funds

Wolfpack Outfitters will defer payment of online and in-store textbook orders for students who receive financial aid or academic scholarship funds. These charges will be sent to the University Cashier’s office for processing upon disbursement of funds. Only items fulfilled by NC State Bookstores are eligible for this payment method at checkout. Students who receive athletic scholarships or sponsorship (VA, VR, WIA, Services for the Blind) should make all purchases in the store.

Laptops

The Technology Department offers business class computers that meet the specifications for all areas of study at NC State. All computers sold at the NC State Stores meet or exceed the university-set recommendations, and are guaranteed to last through all four years of college.

By purchasing from the NC State Stores, students are guaranteed to receive the convenience of full warranty support on campus.

New Student Programs (NSP)

New Student Programs (NSP) addresses the holistic needs of each new NC State student to create a foundation of success.

Based on the core value that people matter, we achieve this through:

• Cultivating strategic partnerships across the University
• Promoting an environment of personal responsibility
• Fostering inclusivity through a shared campus identity
• Partnering with parents and families
• Preparing and empowering student leaders to serve the campus
• Striving to be innovative in meeting the needs of our community

New first-year, transfer, and international students can visit our website (https://newstudents.dasa.ncsu.edu) to view new student checklists, learn about orientation, explore pre-semester programs, and view other resources for how to connect with the Wolfpack before arriving on campus.

3219 Broughton Hall
NC State Box 7525
Raleigh, NC 27695-7525
Phone: 919-515-1234
Email: new-students@ncsu.edu
Website: newstudents.dasa.ncsu.edu

Michael Coombes, Director

Office of International Services

The Office of International Services (OIS) is charged with meeting the immigration advising and cross-cultural programming needs for the university’s more than 4000 international students and 700 J-1 Exchange Visitor scholars who come from more than 120 different countries. Services provided by OIS include advising students and scholars on immigration regulations and university policies; authorizing certain types of on or off-campus employment authorization for F-1 and J-1 visa holders; and providing cultural programs designed to enrich the cultural and academic experience of the campus community. OIS programs include: New International Student Orientation, Culture Corps, ISSERV service learning program, English Conversation Club, and many others. New international students are required to participate in New International Student Orientation. OIS also provides opportunities for U.S. students to get involved in the international community at NC State by inviting participation in various cross-cultural programs such as volunteering at the International Student Orientation and English Conversation Club.

International applicants must apply to the Admissions Office by the stated deadlines and must meet all the necessary requirements for admission.
In addition, international applicants must meet certain language and financial criteria (see the TOEFL and Financial Information sections under Freshman Admission).

The North Carolina Global Training Initiative (GTI) sponsors several short-term certificate, internship, and research programs that international students may be interested in. These full-time non-degree study programs allow international students to study at NC State for one semester in order to learn about U.S. culture and education, improve their conversational English, take undergraduate courses in their field of study back home or in preparation for admission to a degree program here in the U.S., and experience life in the U.S. These programs have a later application deadline and are great for students to take before enrolling in an undergraduate or graduate degree program in the US or for siblings and friends of current degree-seeking students who want to study in the US together.

International students may be interested in joining the GTI’s Cultural Exchange Network (CENet). CENet connects NC State’s domestic and international students through joint participation in social, academic, and service learning events and workshops. Visit the CENet website (go.ncsu.edu/CENet (http://go.ncsu.edu/CENet/)) for more details about the program and how you can apply.

Anyone interested in the GTI’s programs can visit us on the web at www.ncsu.edu/gti (http://www.ncsu.edu/gti/) for more information.

Outline of minimum immigration requirements for F-1 and J-1 students:

- Keep passport and I-20 or DS-2019 current
- Maintain full-time enrollment every semester (12 hours/semester for undergraduates)
- Make good academic progress toward your degree
- Do not work or intern off campus without prior written approval from OIS
- Do not work on campus more than 20 hours in any one week during the semester
- Update any address change in MyPack Portal within ten days of moving
- Update OIS immediately of any changes in name, funding, or visa status
- Consult with an OIS advisor before changing curriculum/majors, withdrawing, dropping below full-time, transferring to another school/program, etc.
- Purchase and maintain the NC State University approved Health and Accident Insurance or other insurance plan that meets the published minimum coverage requirements.
- Keep your valid passport and recently signed visa certificate (I-20 or DS-2019) with you when you travel abroad. Consult with an OIS advisor about visa and travel questions

Further information about immigration requirements, employment and travel questions, cultural opportunities, and other critical information designed to assist international students are detailed on the OIS website. For individual advising, please call (919) 515-2961 to make an appointment with an advisor or stop by during our walk-in hours of 10:00am-11:45am and 1:00pm-2:45pm on Monday, Tuesday, Thursday, and Friday (no walk-ins on Wednesdays).

Office of International Services (OIS)
111 Lampe Drive
Campus Box 7222

NC State University
Raleigh, NC 27695-7222
Phone: (919) 515-2961
Email: ois@ncsu.edu
Website: http://internationalservices.ncsu.edu/

Prevention Services

NC State Prevention Services believes that information should be shared from an objective and factual perspective, without bias or an agenda to steer an individual in any one direction unless imminent harm would result. Prevention Services is a no-cost service to all students and offers consultation to parents of students, staff, and faculty. We are flexible in format and willing to work with you, your group(s), and/or your department in some of, but not limited to, the following ways:

- one-on-one conversations focused on resources
- formal/informal presentations and trainings
- formal/informal conversation facilitators
- staff/student group meeting guests
- Q & A resource
- student group leadership trainings/discussions
- event planning for risk management and problem prevention

CARES: Student Behavioral Case Management

The CARES case managers at NC State work collaboratively with campus resources to provide support for students who are in distress or crisis or who are identified as exhibiting concerning or worrisome behaviors. Effective case management ensures that the community at large remains supported and safe while the student involved gains the necessary resources to remain successful academically and personally at NC State. Services include:

- Providing comprehensive outreach and consultation services to the NC State community in order to proactively identify students with concerns
- Providing early intervention and behaviorally based assessments to determine appropriate resources and referrals to campus and community resource
- Working constructively with students to foster resilience and self-advocacy
- Monitoring student progress, seeking input from collateral resources as needed

Learn more about CARES: Student Behavioral Case Management on our website at: https://prevention.dasa.ncsu.edu/nc-state-cares/about/

Alcohol and Other Drug Prevention Education

Alcohol and Other Drug Prevention Education (AOD) is rooted in objectivity, compassion, and non-judgment. Although AOD supports community members that choose to live an abstinent lifestyle, the program does not use an abstinence based methodology or believe in telling others how to live their lives. AOD cannot condone underage drinking or illicit drug use as this would mean advocating for individuals to break the laws of North Carolina. However, our program does understand
that some community member's personal choices do not abide by the law on this topic. Alcohol and Other Drug prevention Education is here to reduce the harm and unwanted consequences associated with alcohol and other drug use. Services include:

- Providing alcohol education programming to all first-year students prior to arriving at NC State
- Consulting with campus partners, students, alumni and faculty regarding AOD topics including risk management and prevention
- Providing training for the campus community on harm reduction strategies
- Facilitating the Howl for Help: Health intervention for AOD related emergencies without violation by the Code of Student Conduct
- Administering BASICS (Brief Alcohol Screening and Intervention for College Students)

Learn more about Alcohol and Other Drug Prevention Education on our website at: https://prevention.dasa.ncsu.edu/alcohol-prevention/about-aod/

**Suicide Prevention Services**

Suicide Prevention Services' goal is to reduce barriers to help-seeking at NC State by promoting a campus culture of caring and taking responsibility for the mental health needs of our students. This program supports individuals and groups on campus as they strive to understand the warning signs, offer guidance in talking to students, friends, and colleagues and to connect them to available resources. Suicide Prevention Services also offers support to those impacted by the loss of a loved one to suicide.

Services include:

- Providing QPR (Question, Persuade, and Refer) Suicide Prevention Training
- Creating and collaborating large scale campus events focused on suicide prevention and mental health awareness
- Developing and providing programming for faculty and staff focused on early intervention
- Supporting the Division of Academic and Student Affairs' postvention efforts following tragic events involving students, faculty or staff

Learn more about Suicide Prevention Services on our website at: https://prevention.dasa.ncsu.edu/suicide-prevention/about-suicide-prevention/

**NC State Prevention Services**

2101 Student Health Center
2815 Cates Avenue
Raleigh, NC 27695
Phone: 919-515-4405
Email: prevention-services@ncsu.edu

**Student Health**

At NC State we believe in enhancing both students individual health and the overall health of our campus community. With an understanding that Wellness is the interdependent and interactive combination of love for what is done each day, the quality of relationships, the security of finances, the vibrancy of physical health, and the pride taken in what is contributed to our communities. Student Health Services is at the cornerstone health and wellness on campus and offers non-urgent medical care and health prevention to students as an outpatient center.

We are staffed by board certified physicians, nurse practitioners, physician assistants, registered nurses and other medical support professionals. Some of our services include primary care, gynecology services, physical therapy, nutrition counseling, pharmacy, and specialty services with local dentists, orthopaedists, and gastroenterologists.

Student Health is accredited by the Accreditation Association for Ambulatory Health Care, Inc (http://www.aaahc.org/) (AAAHC) and Commission on Office Laboratory Accreditation (http://www.cola.org/) (COLA).

To learn more about the many services and benefits we offer students, visit our website at https://healthypack.dasa.ncsu.edu (https://healthypack.dasa.ncsu.edu/).

**Hours of Operation**

**Student Health Services on Main Campus** operates on the following hours:

- Monday: 8 a.m. - 5 p.m.
- Tuesday: 9 a.m. - 5 p.m.
- Wednesday: 8 a.m. - 5 p.m.
- Thursday: 8 a.m. - 5 p.m.
- Friday: 8 a.m. - 5 p.m.
- Saturday: 9 a.m. - 12 p.m. (During fall and spring semesters, excluding breaks, for illness and injury)
- Sunday: Closed

**Student Health Services on Centennial Campus** is our newly opened location in Plaza Hall on Centennial Campus. For hours of operation, please check our website.

**Physical Therapy on Main Campus** allows appointments during the following hours during the fall and spring semesters:

- Monday: 8 a.m. - 5 p.m.
- Tuesday: 9 a.m. - 5 p.m.
- Wednesday: 8 a.m. - 5 p.m.
- Thursday: 8 a.m. - 5 p.m.
- Friday: 8 a.m. - 2 p.m.
- Saturday: Closed
- Sunday: Closed

A nurse advice line is available at all other times to assure students receive qualified nurse and medical advice. During adverse weather, students should check the Student Health Services website, https://healthypack.dasa.ncsu.edu (https://healthypack.dasa.ncsu.edu/) for any variance in operating hours.

**Summer session** hours are Monday through Friday, 8 a.m. to 5 p.m. with **no weekend hours.** We accept patients for care up to 4:20 p.m to provide sufficient time for you to see your healthcare provider.

Patient appointments are typically 20 minutes.

**How to Schedule an Appointment**

Appointments can be scheduled online, via the HealthyPack Portal (https://sso.medicateconnect.com) (https://sso.medicateconnect.com) or by calling Student Health Services at 919.515.2563.
Charges

All registered students pay a health fee which provides access to care and covers most, but not all, office visits for provider services. There are charges associated with x-rays, lab tests, allergy injections, travel vaccines, physical therapy, annual physicals, some office visits and specialty clinics. Students are responsible for the cost of prescriptions and over the counter medications /supplies available at the Student Health Pharmacy, as well as expenses incurred when referred to an off-campus laboratory, physician, hospital or pharmacy. Student Health Services will file most insurances on behalf of the student for services and prescriptions received at Student Health. Charges not covered by insurance may be transferred to the student’s account with University Cashiers Office. Check with us prior to your visit to determine if your insurance plan is considered in-network.

Student Health partners with several specialty groups to offer on campus care. Specialists include Dermatology, Orthopedics and Gastroenterology. Insurance is filed by the specialty group and not Student Health. Check with the specialty group prior to your visit to determine if your insurance plan is considered in-network.

Student Health, in partnership with Campus Smiles Dental Services, provides comprehensive dental care to students. Campus Smiles accepts most dental plans and will file your insurance for you. Cash discount pricing is also available. To make an appointment, contact Student Health and ask for the dental clinic. Two locations are available for your convenience - Main Campus and Centennial Campus.

Staying Healthy and Well

As a part of our mission, Student Health not only provides high quality health care but also a comprehensive disease prevention and health education program to the NC State community. Our outreach health educator and Pack Peer Educators offer a variety of information, programs and services to students on issues facing today’s young adults. Health topics include nutritional counseling, alcohol and drug education, healthy sexuality, women’s health, men’s health and much more.

Pack Peers is our student volunteer program that includes two tracks: Track I- Peer Education and Track II- Clinical Experience. Students interested in becoming engaged in our Pack Peer program should visit our website at https://healthypack.dasa.ncsu.edu/ for more information.

Required Medical Insurance

As mandated by the UNC System, NC State University requires all undergraduate students taking 6 or more credit hours to have and show evidence of a creditable health insurance policy. Students failing to provide proof of coverage by the published deadline each semester will automatically be enrolled in and billed for the university-sponsored health insurance plan through Student Blue. Note: This is a University requirement.

The University-sponsored health insurance plan (Student Blue) has a robust set of benefits at an affordable premium. Each year, complete information is available to students at the start of the fall and spring semesters. For more information regarding the health insurance requirement and/or the University-sponsored health insurance plan, please see the information at: https://healthypack.dasa.ncsu.edu/.

Confidentiality

All health and medical information is kept secure and confidential and is not divulged to anyone without the express written consent of the patient as required by Federal law.

Please Note: Parents must have the written consent of their student for the release of any protected health information (PHI). Guarantor of payment is not considered written consent for access to PHI.

Medical Insurance

NC State University requires all undergraduate degree-seeking students who are taking 6 or more credit hours to either purchase the University-sponsored health insurance plan (Student Blue) or provide evidence of an existing creditable health insurance policy. Students who are already covered by an insurance policy (i.e. through parent plans, family plans, employer-sponsored plans, or student health insurance) and wish to waive out of the university-sponsored plan must submit a waiver for each term.

Students enrolled in Distance Education courses only are not eligible for health insurance and therefore are not required to submit a waiver.

Students who do not waive out by the waiver deadline will automatically be enrolled in and billed each semester for the university-sponsored health insurance plan. This university-sponsored health insurance plan has a robust set of benefits at an affordable premium. More information regarding the health insurance requirement and/or the university-sponsored health insurance plan is available on the Student Health Services website at https://healthypack.dasa.ncsu.edu/.

Student Health Center
2815 Cates Ave
Campus Box 7304
Raleigh, NC 27695-7304
Phone: 919-515-2563
Email: healthypack@ncsu.edu

Julie Casani, M.D., MPH - Director and Medical Director

Student Legal Services

University Student Legal Services (USLS) is a nonprofit corporation initiated by the Student Government at NC State which is funded by student fees. The service is free for currently enrolled NC State students who have paid their student fee. The purpose of the service is to provide education, advice and representation within the scope of the prepaid student legal services plan. The USLS plan is registered with the North Carolina State Bar. The service focuses on helping students resolve their legal problems with as little disruption as possible to their educational endeavors. The office promotes preventative law, enabling the students to make educated choices. The service provides advice, limited court representation, document creation and review as well as educational seminars and materials on legal issues affecting students. The usual areas of law that most impact students are landlord tenant, consumer matters, employment questions, immigration, traffic and DMV issues, criminal issues and expungements as well as domestic matters.

Confidentiality

The staff are not employees of the NC State or the State of North Carolina and as licensed attorneys are required to preserve the confidentiality of clients. All staff working with the office are bound by
the Rules of Professional Conduct relating to nondisclosure of any information that has been discussed. The policy is firmly followed by the office to encourage clients to speak candidly about all information necessary for effective legal representation.

To learn more about Student Legal Services and the services that we can provide, visit our website at studentlegal.dasa.ncsu.edu (https://studentlegal.dasa.ncsu.edu).

1107 Pullen Hall
210 Dan Allen Dr.
Campus Box 7123
Raleigh, NC 27695-7123
Phone: 919-515-7091
Email: studentlegal@ncsu.edu

Pamarah Gerace, Director and Staff Attorney

Student Services Center

The Student Services Center (SSC) is NC State’s one-stop center for student registration, financial aid, and billing needs. The Center was formed in 2016 to merge the resources and services of the University Cashier’s Office, Department of Registration and Records, and Office of Scholarships and Financial Aid in order to better serve the students of NC State. Students can visit the SSC in Harris Hall on Main Campus to order an official transcript, receive an enrollment verification, meet with a financial aid counselor, or discuss payment options with the university cashiers.

The Student Services Center website provides helpful information for students on how to search and register for classes, as well as everything they need to know about staying on track to graduate. Our experts are ready to help incoming, current and former members of the Wolfpack— and their families—accomplish any financial or academic task necessary.

Department of Registration and Records

The Department of Registration and Records is responsible for maintaining student records and enrollment systems, establishing the academic calendar, establishing and upholding policies on academic standards, and providing several other essential services to students and faculty on campus.

Charles Clift, University Registrar

Office of Scholarships and Financial Aid

The Office of Scholarships and Financial Aid is responsible for evaluating students’ financial need and eligibility, awarding financial aid packages, disbursing federal and state financial aid awards, and upholding policies on academic standards for financial aid recipients.

Financial aid counselors and staff at NC State are trained and highly equipped to meet the needs of all students, even those with the most exceptional of circumstances. We are dedicated to working with students as closely as possible to ensure a seamless transition to NC State without financial worry.

Krista Ringler, Associate Vice Provost and Director

University Cashier’s Office

The University Cashier’s Office projects a positive image of the University by providing courteous and professional service. We treat each individual customer with dignity and respect. Financial services for the University are provided in an ethical and professional manner with a focus on fiscal integrity and accountability. The success of our students will always be our primary concern.

Maria Brown, Director

Learn more about the Student Services Center on our website at studentservices.ncsu.edu (https://studentservices.ncsu.edu)

The Student Services Center is bound by the Family Educational Rights and Privacy Act (FERPA), which gives students certain rights to privacy of their education records and rights of access to their education records. Employees and agents of the University are expected to comply fully with this law. Please review the NC State REG 10.00.01 - Family Educational Rights and Privacy Act (FERPA) (https://policies.ncsu.edu/regulation/reg-11-00-01/) for detailed information about this federal law and what it means for our students, their families, and sharing of student information.

2000A Harris Hall
2183 Thurman Dr
Raleigh, NC 27695
Phone: 919-515-6278
Email: studentservices@ncsu.edu

The NC State Libraries

The NC State Libraries’ website (http://www.lib.ncsu.edu) is a rich source of information and serves as a gateway to resources and services.


The Libraries’ collections reflect the strengths of the university across disciplines. We provide demand-driven, network-based collections to the campus community in support of research and teaching. We are recognized as a national leader in building extensive research holdings in the areas of engineering, science, technology, and agriculture. The collection contains over 5.3 million volumes of books, bound journals, and government documents; over 128,000 print and electronic serial subscriptions; over 1.2 million e-books; 635 full-text databases in all disciplines and extensive digital collections; numerous video, audio, and multimedia titles; unique and rare materials in the Special Collections Research Center. The Libraries’ participation in the Triangle Research Libraries Network (TRLN) provides convenient access to the collections of Duke University, UNC-Chapel Hill, and NC Central University.

Key spaces at the libraries include:

- Learning Commons, Faculty Research Commons, Graduate Student Commons
- Large-scale, immersive visualization spaces
- Digital media creation facilities
- Dataspace with advanced computing, software, training, and consultation (Hunt)
- A Game Lab for the scholarly study and enjoyment of games and for interactive workshops and demonstrations
- iPearl Immersion Theater for panoramic display of faculty and student work (Hunt)
• Makerspaces offering 3D printing and scanning and other specialized tools
• Special Collections Reading Room and Exhibit Gallery (Hill)

The Libraries website (http://www.lib.ncsu.edu) provides information about libraries and access to many services, including reference assistance, interlibrary loan, and electronic reserves. Library Course Tools (http://www.lib.ncsu.edu/course/) web pages are available for every course offered at NC State. These customized pages include e-reserves, article databases, librarian recommendations, citation tools, IM a Librarian for help, and more. The Libraries’ Course Books on Reserves program makes over 4,500 required texts available on Course Reserves each year.

Greg Raschke, Senior Vice Provost and Director of Libraries

Transportation

Parking Permits

All students (including Freshmen) living on or off campus may purchase a parking permit until all available student parking space is sold. Demand for permits does exceed supply. Permits are sold online on a semester basis via the Transportation website (http://www.transportation.ncsu.edu), and are available on a first-come, first served basis. Students must be enrolled in classes in order to be able to purchase a parking permit. All parking permits at NC State are virtual.

Parking Enforcement

Permitted parking areas and hourly visitor spaces are enforced: Monday - Friday: 7:00 a.m. to 5:00 p.m. except on Official University Holidays.

Exceptions include:

• Resident parking areas ("RC," "RE," "RW") are enforced: Monday - Thursday: 7:00 a.m. to Midnight; Friday: 7:00 a.m. to 5:00 p.m.
• Any space or area designated as reserved 24/7, handicap parking spaces and no parking areas.

Wolfline (Buses)

Wolfline is NC State’s bus service which is tailored to student class schedules, but also serves the general public fare-free. Wolfline buses operate every day classes are in session, serving all three campuses, three park & ride lots, official NC State housing and privately-owned apartment complexes located on city streets traveled by Wolfline buses on the way to or from these areas. No university ID, pass, or fare is required to ride. Buses are red, white and black with the Wolfline logo lettering.

Wolfline buses travel along designated routes and only stop at designated Wolfline stops, some of which are shared stops with city (GoRaleigh) and regional (GoTriangle) transit providers. A few routes are designated as “limited stop.”

Please visit the Wolfline website (https://transportation.ncsu.edu/riding-the-wolfline-bus/) for the most up-to-date information about park-and-ride lots and locations, bus routes and schedules.

Alternative Transportation Options

NC State University Transportation offers the following alternative transportation options:

• Bicycling: Bicycling is an inexpensive, healthy and environmentally-friendly way to travel to, from and around campus. Bike racks are conveniently located throughout our three campuses, as well as on all Wolfline buses. Students are strongly encouraged to register their bicycles through the Transportation office; Campus Police also offers free engraving on bicycles.
• Lime Bike/Scooter Share: NC State now offers a pilot program with LimeBike, a dockless public bike share, and Lime-S, a dockless electric scooter program. LimeBike technology is integrated into smart bikes and scooters and a smart phone app. There’s no kiosk docking station so bikes and scooters can be ridden anywhere and parked at any bike rack or designated bike parking area throughout campus. Thirty-minute bike rides are $0.50 for NC State students and employees by registering with an @ncsu.edu email address. The cost for a Lime-S scooter is $1 to unlock and $0.06 per minute for NC State students and employees.
• Walking: As an urban campus, NC State University is very walkable with short distances to off-campus locations such as shopping and restaurants, as well as between campus destinations. Many students and staff choose to walk to school or work, and/or combine walking with another alternative mode to get around campus. Visit the Transportation website (https://transportation.ncsu.edu/walking/) to download a Walk Times map.
• Carpool: NC State students who participate in the student carpool program can enjoy carpooling benefits and gain access to premium parking areas. The Transportation office requires at least two commuter students to form a carpool. All registered carpool participants must show proof of vehicle registration and a local address.
• Local/Regional Transit: GoRaleigh, the City of Raleigh’s public transit services, offers city-wide bus service. Four GoRaleigh routes serve the NC State campus. GoTriangle provides regional bus service to NC State from Raleigh, Cary, Apex, Durham, Chapel Hill, Wake Forest, Zebulon, Wendell, and many points in between. GoPass (https://transportation.ncsu.edu/local-transit/) is a bus pass sponsored by NC State Transportation, at a cost of $5 per year for NC State students. GoPasses allow NC State students and staff to ride city (GoRaleigh) and regional (GoTriangle, GoCary, and GoDurham) buses to commute to campus, get to the airport, or visit friends at other nearby universities.
• Zipcar: Zipcar is a car-share program that offers the convenience of car ownership without the hassles of having a car on campus. There are six vehicles available for use at NC State which are parked in designated spots around campus: Dan Allen Drive (Bragaw Hall Carriageway), Avent Ferry Complex, and Centennial Campus. Students can join Zipcar for a $35 annual membership fee, and can reserve Zipcars at a rate of $8 per hour and $69 per day. Costs include gas, insurance and roadside assistance.
• Wolfpack Pick Up: Wolfpack Pick Up is a service designed for students with injuries or living with disabilities. Wolfpack Pick Up services students on both Main Campus and
TRIO Programs

The TRIO Programs are Federal outreach and student services programs designed to serve under resourced individuals, first-generation college students, and individuals with disabilities to progress through the academic pipeline from middle school to post baccalaureate programs.

The Talent Search and Upward Bound Programs serve pre-college level students. Talent Search serves grades 6-12 and Upward Bound serves 9-12 while the Student Support Services STEM Programs support enrolled undergraduate NC State University students. These programs utilize a holistic approach in providing academic tutoring, personal counseling, mentoring, financial guidance, and other support services necessary for educational access, persistence and degree completion.

407 Gorman St  
NC State Box 7319  
Raleigh, NC 27695-7319  
Website: http://trio.dasa.ncsu.edu

Courtney Hughes, Director

Marsha Boyd Pharr, Executive Director

Undergraduate Research (OUR)

The office of Undergraduate Research supports and promotes undergraduate opportunities in discovery-, inquiry- and creativity-based scholarship through mentored research experiences with NC State faculty and other national and international scholars and professionals. Undergraduate Research is scholarly study in any discipline in which this scholarship culminates in advancements in science, technology, engineering, business, the arts, or humanities. Students from any discipline can engage in a holistic approach in supporting both student projects and the communication of results are available.

2229 Broughton Hall  
NC State Box 7576  
Raleigh, NC 27695-7576  
Website: http://undergradresearch.dasa.ncsu.edu  
Phone: 919-513-0095 Fax: 919-513-7542

Dr. Chris Ashwell, Director

University Fellowships Office (UFO)

The University Fellowships Office (UFO)—formerly called the Fellowship Advising Office—helps NC State’s undergraduate students, graduate students, and alums learn of and apply for nationally competitive and prestigious awards. These awards fund a wide range of opportunities, and many are connected to undergraduate and graduate degree programs or internships, overseas opportunities, and independent projects.

Some of our services include:

- Meeting with candidates to discuss their goals and interests and to help identify matching opportunities
- Reviewing and critiquing drafts of application essays and statements
- Providing institutional endorsements for applicants who receive the campus nomination (for the awards that require nominations/endorsements)
- Submitting application materials at the national level on behalf of applicants
- Staging practice interviews for applicants selected at the national level for finalist interviews

Clark Hall  
221 Jensen Drive  
NC State Box 8610  
Raleigh, NC 27695-8610  
Phone: 919-515-2237  
Email: fellowship-advising@ncsu.edu  
Website: https://fellowships.dasa.ncsu.edu/

Courtney Hughes, Director

University Housing

Living on Campus

Living on campus is an essential part of the Wolfpack experience: that’s why students are required to live in University Housing their first year.

When you live on campus, you’ll be at the heart of the Wolfpack nation, making it easy to be a part of all that NC State has to offer. Whether you’re looking for the close-knit community of a village (https://villages.dasa.ncsu.edu/) or the diverse social opportunity of a traditional residence hall, we have the housing option (https://housing.dasa.ncsu.edu/find-a-community/) that’s right for you. With a selection of 20 residence halls (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/) and four on-campus apartment communities (https://housing.dasa.ncsu.edu/find-a-community/apartment-options/), you’ll enjoy the once-in-a-lifetime opportunity to live in the heart of NC State.

Get Started with University Housing

Incoming First-Year Students

1. **Apply for housing**: You should complete your University Housing and Living and Learning Village application as soon as possible. Students who have received acceptance for the Fall semester may access the housing application through the Campus Living section on MyPack Portal (https://mypack.ncsu.edu/). If you decide not to attend NC State, you can cancel your housing application without penalties. Space is assigned in the order in which applications are received. If you have a preferred building or roommate already in mind, an early application will help you get them.

2. **Choose a place to live**: You have a lot of options to choose from, ranging from residence halls to our Wolf Village Apartments. Find
the ones that you like best (https://housing.dasa.ncsu.edu/find-a-community/).

Incoming Transfer Students

Due to the first-year live-on requirement that began in 2017, space is very limited for upper-class students. There are options available, however. NC State has two Living and Learning Villages that reserve space for transfer students.

1. Located in Wolf Village Apartments (https://housing.dasa.ncsu.edu/find-a-community/apartment-options/wolf-village-apartments/) on the main campus, the Second-year Transitions And Transfer Experience (S.T.A.T.E.) Village (https://villages.dasa.ncsu.edu/village-options/state-village/) connects students to a variety of campus resources and programming meant to navigate their years following their freshman experience.


Undergraduate students must be enrolled in at least 12 credit hours to be eligible to live on campus during the fall and spring terms. Students who must drop below these minimum requirements should contact University Housing to request an exception. Summer session housing (https://housing.dasa.ncsu.edu/current-residents/summer-housing/) is also available.

More Information

For more information about living on campus, visit:

University Housing
Monday - Friday | 8:00 a.m. to 5:00 p.m.
1112 Pullen Hall
201 Dan Allen Drive

Email: housing@ncsu.edu
Phone: 919.515.2440
Web: housing.ncsu.edu (https://housing.ncsu.edu/)

Living and Learning Villages

NC State’s Living and Learning Villages are interested-based living communities that engage students both inside and outside the classroom. Villages provide an unparalleled living experience where you’ll make lifelong friends and immerse yourself in the NC State community. There is currently no additional cost to join a village.


The Albright Entrepreneurs Village provides sophomores, juniors, seniors and graduate students across all academic disciplines the opportunity to live, socialize and work with entrepreneurial-minded students. Residents can explore and develop their entrepreneurial interests in an environment that fosters creativity.


Creative, vibrant and colorful only begin to describe the experiences you’ll have as you explore theater, visual arts, crafts, music, dance and more.


BMI strives to establish a brotherhood and develop leaders among black male students. By promoting academic success, personal growth, professional development, and self-responsibility, the group breaks through negative stereotypes and combats challenges facing African-American males in today’s society.


EcoVillage is a first-year student program that welcomes students from all majors, creating both a multi-disciplinary and an inter-disciplinary educational experience that prepares students for lifelong sustainable leadership, engagement, advocacy, and discovery.


The Engineering Village is an extension to the College of Engineering’s First-Year Engineering (https://www.engr.ncsu.edu/academics/undergrad/firstyear/) program introducing students to the field of engineering; encouraging thoughtful consideration to complex challenges facing our communities.

The Exploratory Studies Village is for students entering the university who are knowingly undecided about a major. A year of guided inquiry and exploration coupled with one-on-one sessions with their academic advisor helps move students through the career planning and decision-making process.


Global Village is a living and learning community for those interested in living and interacting with people from different backgrounds, experiences, countries, and viewpoints.

Honors and Scholars Village (https://villages.dasa.ncsu.edu/village-options/honors-and-scholars-village/) - Live in Berry, Becton or Bagwell Hall (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/berry-hall/)

Honors Village and Scholars Village merged in 2017 to become Honors and Scholars Village (https://dasa.ncsu.edu/honors-scholars/). The most noticeable change being that Scholars Village residents will be relocating from Sullivan Hall (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/sullivan-hall/) to east campus beginning Fall 2018. Students from both the University Honors Program (https://honors.dasa.ncsu.edu/) (UHP) and the University Scholars Program (https://scholars.dasa.ncsu.edu/) (USP) will now live together in the Honors Commons. The move will provide village residents with the opportunity to live and learn in a vibrant, socially and intellectually stimulating environment that fosters mindful interaction.


ILV provides experiential learning for students who have a passion for leadership and service. Students are given the opportunity to engage in practical application of leadership to real-world issues and explore leadership development through one on one sessions with professionals. ILV enhances students’ college experience and prepares leaders to make their personal IMPACT on the state, nation, and the world.


Students living in the Native Space community will demonstrate growth and learning along three focal points of the living experience: culture, academics and community engagement. Residents will find a deeper awareness of Native American history and drive cultural awareness through participation in Native American Heritage Month and the annual NC State Pow Wow.


SAY Village is a community for first-year students in any academic discipline who have a passion for working with youth. Students develop one-on-one mentoring relationships with local elementary school students and learn what it means to be a youth advocate.


Provides second-year and transfer students with opportunities to make the most of their NC State experience by focusing on the six core pillars essential to student success: academic success, career development, community and global engagement, diversity, leadership, and life skills.


Encourages and promotes the development and maintenance of a healthy body, mind, and spirit through a wide array of wellness programs and events. Students have the opportunity to experience personal growth while learning about the seven dimensions of wellness.


WISE Village was created for female freshman and sophomore students majoring in science, technology, engineering, and mathematics. Membership in WISE provides a powerful networking opportunity with other goal-oriented women as you pursue your STEM major.

WOW Village enhances women's leadership outside the classroom through empowerment, leadership development, self-awareness and diversity/social justice. WOW creates a holistic community that fosters individual women's growth and development while challenging residents to act as citizens of a global community.

**University Tutorial Center (UTC)**

The University Tutorial Center provides free academic assistance to NC State undergraduate students enrolled for credit in many challenging 100- and 200- level math, physics, and chemistry classes. Several types of assistance are available that are designed to best meet the students' needs, including tutoring by appointment, group tutoring, and Supplemental Instruction (SI). In addition, Writing and Speaking consultations are available to both undergraduate and graduate students. They provide assistance to all students who need help at any stage of the writing process in the English language.

Students are eligible to become a tutor for the UTC if they have an established GPA of 3.25 or better and a least a B+ in the course(s) they wish to tutor. All new tutors are required to take USC 210, Introduction to College Tutoring, during the first semester of employment. All tutors are trained in techniques that are designed to help students become independent learners.

101 Park Shops
101 Current Drive
NC State Box 7118
Raleigh, NC 27695-7118
Website: https://tutorial.dasa.ncsu.edu/
Phone: 919-515-3163 Fax: 919-515-4416

Barbara B. Windom, Director

**Wellness and Recreation**

**About Wellness and Recreation**

The Department of Wellness and Recreation is proud to be a leader of well-being at NC State. We value the impact of movement and inspire behaviors that improve health and well-being. Our programs, services and facilities enhance academic success by assisting students in developing skills and resilience needed for college and beyond.

**Programs and Services**

Take one of the more than 100 Group Fitness (https://wellrec.dasa.ncsu.edu/fitness/group-fitness-2/) classes offered each week, designed for every fitness level. Challenge yourself by taking cycling, TRX®, yoga, BODYPUMP™, Zumba® or a variety of other class formats and experience firsthand how we make fitness fun. Students can take their structured workout to the next level with Small Group Training (https://wellrec.dasa.ncsu.edu/fitness/training-services/small-group-training/), where our coaches lead workshops on Olympic lifting, boxing and more.

Receive one-on-one attention from our nationally-certified personal trainers (https://wellrec.dasa.ncsu.edu/fitness/training-services/personal-training/). Learn how to exercise, improve performance and establish fitness goals. No matter what your fitness level, we have a trainer who wants to work with you.

Our ThriveWell (https://wellrec.dasa.ncsu.edu/wellness-2/) program offers wellness coaching and health education programs for individuals and groups. Wellness coaching takes a holistic approach and discovers how personal wellness impacts student success, strengths, values and goals. Establish a wellness plan and stay accountable with a certified health coach. Learn stress management techniques, strategies and lifestyle modification tips from our team of experts.

Intramural Sports (https://wellrec.dasa.ncsu.edu/sports/intramural-sports/) offers more than 40 different leagues and events throughout the year. Sports range from flag football, basketball, soccer and volleyball to exciting and unique events such as pool battleship, bubble soccer and cricket. Create a team and compete for a championship, join a recreational league with friends or sign up for an individual/dual sport or special event to find a new favorite activity.

For students seeking a more competitive sports experience, check out one of the Club Sports (https://wellrec.dasa.ncsu.edu/sports/club-sports/) teams that include a wide variety of men’s, women’s and co-ed sports. These student-led organizations practice regularly and compete against other colleges and universities at local, state and national levels.

Outdoor Adventures (https://wellrec.dasa.ncsu.edu/outdoor-adventures/) offers students unique outdoor trips and educational clinics. Rent outdoor equipment from the Outdoor Adventures Equipment Rental Center or climb to new heights on the indoor climbing wall. Students can challenge themselves individually or build community with customized programs at our Challenge Course located in Schenck Memorial Forest.

Our Student Employment (https://wellrec.dasa.ncsu.edu/about-us-2/student-employment/) program supports more than 700 students employed annually through Wellness and Recreation. Students enhance their development by learning transferable skills that will prepare them for future careers.

**Carmichael Complex**

Carmichael (https://wellrec.dasa.ncsu.edu/facilities/) is a 300,000-square-foot facility designed to help students achieve their personal wellness, recreation and fitness goals.

Features include:

- Six Strength and Conditioning Centers (30,000-square-foot)
- Six Fitness/Activity Rooms
- 11 Indoor Basketball/ Multipurpose Courts
- 25-yard pool and dive well
- 50-meter pool
- Indoor climbing wall
- Indoor track
- 14 racquetball courts
- One squash court
- Personal training suite
- Men’s and women’s locker rooms
- Single occupant locker rooms
- Steam room
• Sauna
• Equipment Checkout
• Day-use lockers
• Social lounges

Wellness and Recreation manages numerous outdoor facilities that promote healthy, active living.

• Miller Outdoor Recreation Field
• Method Road Recreation Complex
• 12 outdoor tennis courts
• Four outdoor basketball courts
• FitGround outdoor functional training area
• Centennial Campus Recreation Fields
• Centennial Campus Disc Golf Course

**Wolfpack One Card**

The Wolfpack One Card is the official ID card for NC State students, faculty, staff and affiliates. The One Card allows NC State students to:

• Access meal plans
• Enter their residence hall or other buildings with restricted access
• Work out at the gym
• Check out books at the library
• Create and access their AllCampus account to make purchases at participating on-campus locations. All Campus funds are also used for Wolfprint (campus air printers). Wolfprint provides quick and easy printing at a variety of buildings across campus.

Incoming students receive their card during summer orientation. New graduate students will not receive ID cards during the New Graduate Student Orientation, and should visit the One Card office in Talley Student Union to obtain an ID card.

Students are encouraged to store their card in a safe and convenient location as they will use it often during the course of a day. Don't hole punch it or tumble it in a dryer to extend the life of the card. Replacement cards are $20.

To report a lost or stolen card, students should call or visit the Wolfpack One Card office or go online (http://onecard.ncsu.edu/). The office is located on the main level of Talley Student Union. Students can also stop by to ask questions about the many features of the ID card during regular business hours: Monday - Friday from 8 a.m. - 6 p.m.

For more information, call us at 919.515.3090 or visit the Wolfpack One Card website (https://onecard.ncsu.edu/).
Graduate instruction was first offered at North Carolina State University in 1893, and the first doctoral degree was conferred in 1926. In the ensuing years, the Graduate School has grown steadily and now provides instruction and facilities for advanced study and research in the fields of agriculture and life sciences, design, education, engineering, natural resources, humanities and social sciences, management, physical and mathematical sciences, textiles and veterinary medicine.

The Graduate School is currently composed of more than 2,400 graduate faculty members. Educated at major universities throughout the world and established both in advanced teaching and research, these scholars guide the University’s more than 7,000 master’s and doctoral students from all areas of the U.S. and many other countries. The faculty and students have available exceptional facilities, including libraries, laboratories, modern equipment and special research areas.

Additionally, a cooperative agreement exists among the Graduate Schools of the University of North Carolina at Chapel Hill, the University of North Carolina at Greensboro, Duke University, and North Carolina State University which increases the educational and research possibilities associated with each institution.

The Graduate Catalog contains Graduate School requirements and pertinent information for individual graduate programs, a current list of graduate faculty, and a selection of other resources for new students. The Catalog is informational only and is subject to change. Official policies and procedures are in the Graduate Handbook (p. 638) and on the NC State Policies, Rules, and Regulations (https://policies.ncsu.edu/) web site.

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• Watershed Assessment and Restoration (Certificate) (p. 189)
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Y
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• Youth Development and Leadership (Certificate) (p. 188)
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E
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G
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L
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M
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College of Agriculture and Life Sciences

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• Nutrition (Minor) (p. 158)
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• Feed Science (Certificate) (p. 179)
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• Leadership and Volunteer Management (Certificate) (p. 187)
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Agricultural and Extension Education

Our graduate programs offer flexibility and enable graduates to pursue diverse career options. Prepare for a career teaching agricultural education to middle or high school students, or become an Extension agent helping farmers and families succeed in their communities. Pursue other rewarding positions such as agricultural museum curators, environmental educators, agricultural missionaries, agricultural public relations representatives, or congressional officers.

The following graduate programs in Agricultural and Extension Education are available:

• Graduate Certificate in Agricultural and Extension Education (requires 15 hours)
• Master of Science in Agricultural and Extension Education (requires 36 hours including a thesis)
• Master of Agricultural and Extension Education (requires 36 hours; can be taken as an on-campus degree or a 100% internet-based degree program)
• Sixth-Year Certificate in Agricultural Education
• Doctor of Education in Agricultural and Extension Education (requires 72 hours)

Admission Requirements

• A minimum undergraduate GPA of 3.0 for Masters applicants; a minimum graduate GPA of 3.5 for Doctoral applicants
• A minimum GRE combined General Test score of 300 and 4.0 or better on the GRE Analytical Writing Test for master’s applicants. (GRE scores can be waived for Master’s applications with the completion of a 3.0 or higher in six credit hours of graduate-level coursework) The GRE is not required for doctoral applicants beginning Spring 2021.
• Three letters of recommendation
• A statement of purpose: Prospective graduate students will draft a statement of purpose for graduate work. If the student intends to complete a thesis or dissertation, the statement should also indicate the nature of potential research work, including possible topics or questions, and minimally two professors from the Agricultural and Human Science department whose research areas potentially align with those possible research topics. Prospective students should plan to meet with faculty prior to submitting their applications to discuss the research with those professors and include those ideas in the statement.

Master’s Degree Requirements

The Department offers an M.S. degree, which requires a thesis for which the student receives six hours of credit, and a Master of Agricultural and Extension Education (M.R.) as a non-thesis track. Both Master’s degree programs require a total of 36 credit hours. The student’s advisory committee will meet with the student to determine the appropriate courses for their Plan of Work. Minors are optional but, if selected, require a minimum of nine credit hours.

Graduate Certificate Requirements

The Department also offers a graduate certificate in agricultural and extension education. This certificate program involves completion of 15 credit hours divided into two focuses: Agricultural Education and Extension Education.

Sixth-Year Certificate

The Department offers an array of courses that are recognized by the NC Department of Public Instruction as comprising a Sixth-Year Certificate. Students are required to complete 24 hours of advanced graduate work past the Master’s degree. Contact the Director of Graduate Programs for details.

Doctoral Degree Requirements

A Doctor of Education (Ed.D.) degree in Agricultural and Extension Education is offered. A minimum of 72 hours past the Bachelor’s degree is required. More hours may be required based upon the past degrees and experiences of the candidate. The student’s graduate committee will determine the specific courses needed. At least six hours of statistics is required. Twelve hours of credit is earned for writing the dissertation (AEE 895). The student’s advisory committee will meet with the student to determine the appropriate courses for their Plan of Work.

Student Financial Support

A limited number of research and/or teaching assistantships are available on a competitive basis. Applications for open positions are due in January for the following academic year. Other financial aid is available from the Office of Financial Aid and on a competitive basis from the Graduate School.

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• Agricultural and Extension Education (EdD) (p. 74)
• Agricultural and Extension Education (Certificate) (p. 75)
• Agricultural & Extension Education (Minor) (p. 74)

Faculty

Full Professors
Koralalage Sunil Upali Jayaratne
Barbara Kirby
Associate Professors
Jackie Bruce
Travis Dale Park
Wendy J. Warner

Assistant Professors
Joseph L. Donaldson
Misty D. Lambert
Katherine McKee
Joy Morgan

Agricultural and Extension Education (MR)

Degree Requirements

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<td>Foundations Of Agricultural and Extension Education</td>
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<td>AEE 578</td>
<td>Scientific Inquiry in Agricultural and Extension Education</td>
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<tr>
<td>AEE 521</td>
<td>Program Planning in Agricultural and Extension Education</td>
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<td>or AEE 524</td>
<td>Coordinating the High School Agricultural Education Program</td>
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<tr>
<td>or AEE 529</td>
<td>Curriculum Development in Agricultural and Extension Education</td>
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<td><strong>Curriculum/Program Planning</strong></td>
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<td>AEE 523</td>
<td>Adult Education in Agriculture</td>
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<tr>
<td>or AEE 535</td>
<td>Teaching Agriculture in Secondary Schools</td>
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<tr>
<td>or AEE 735</td>
<td>Effective Teaching in Agriculture and Life Sciences</td>
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<tr>
<td><strong>Instructional Methodology</strong></td>
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<tr>
<td>AEE 620</td>
<td>Special Problems in Agricultural and Extension Education</td>
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<td>or AEE 693</td>
<td>Master's Supervised Research</td>
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Associate Professors
Jackie Bruce
Travis Dale Park
Wendy J. Warner

Assistant Professors
Joseph L. Donaldson
Misty D. Lambert
Katherine McKee
Joy Morgan

Agricultural and Extension Education (MS)

Degree Requirements

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<tr>
<th>Code</th>
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<td>AEE 578</td>
<td>Scientific Inquiry in Agricultural and Extension Education</td>
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<tr>
<td>AEE 735</td>
<td>Effective Teaching in Agriculture and Life Sciences (recommended for those who desire to teach in higher education)</td>
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<td><strong>Additional Course in Research or Statistics</strong></td>
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<td>ST 507</td>
<td>Statistics For the Behavioral Sciences I</td>
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<td>Statistical Methods For Researchers I</td>
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<td><strong>Research</strong></td>
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<td>AEE 777</td>
<td>Qualitative Research Methods in the Agricultural &amp; Life Sciences</td>
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<td>or ST 507</td>
<td>Statistics For the Behavioral Sciences I</td>
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<td>or ST 511</td>
<td>Statistical Methods For Researchers I</td>
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<td>or AEE 535</td>
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<td>36</td>
</tr>
</tbody>
</table>

Faculty

Full Professors
Koralalage Sunil Upali Jayaratne
Barbara Kirby
These can be in AEE or in disciplines such as Animal Science, Crop Science, Horticulture, Entomology, Forestry, and Youth Development and Family Life Education, among others. Although it is not required, students can also declare a minor. Students will need to take 9-12 hours in a specialty and work with a professor from that area.

Faculty

Full Professors
Koralalage Sunil Upali Jayaratne
Barbara Kirby

Associate Professors
Jackie Bruce
Travis Dale Park
Wendy J. Warner

Assistant Professors
Joseph L. Donaldson
Misty D. Lambert
Katherine McKee
Joy Morgan

Agricultural and Extension Education (EdD)

Degree Requirements

<table>
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<tr>
<th>Code</th>
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<th>Hours</th>
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<td>AEE 501</td>
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<td>AEE 578</td>
<td>Scientific Inquiry in Agricultural and Extension Education</td>
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<tr>
<td>ST 511</td>
<td>Statistical Methods For Researchers I</td>
<td>6</td>
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<tr>
<td>ST 512</td>
<td>Statistical Methods For Researchers II</td>
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<tr>
<td>AEE 777</td>
<td>Qualitative Research Methods in the Agricultural &amp; Life Sciences</td>
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<td>ED 710</td>
<td>Applied Quantitative Methods in Education I</td>
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<td>ED 730</td>
<td>Introduction to Qualitative Research in Education</td>
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<td>ED 731</td>
<td>Advanced Qualitative Research and Data Analysis in Education</td>
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Elective Courses

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<td>AEE 500</td>
<td>Agricultural Education, Schools and Society</td>
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<td>Foundations Of Agricultural and Extension Education</td>
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<td>AEE 503</td>
<td>Youth Program Management</td>
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<tr>
<td>AEE 505</td>
<td>Trends and Issues in Agricultural and Extension Education</td>
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<td>AEE 521</td>
<td>Program Planning in Agricultural and Extension Education</td>
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<td>AEE 522</td>
<td>Occupational Experience in Agriculture</td>
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<td>AEE 523</td>
<td>Adult Education in Agriculture</td>
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<td>AEE 524</td>
<td>Coordinating the High School Agricultural Education Program</td>
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<td>AEE 526</td>
<td>Information Technologies in Agricultural and Extension Education</td>
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<td>AEE 535</td>
<td>Teaching Agriculture in Secondary Schools</td>
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<td>AEE 545</td>
<td>Methods of Change in Agricultural and Human Sciences</td>
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<tr>
<td>AEE 550</td>
<td>Leadership Theory</td>
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</tbody>
</table>

Faculty

Full Professors
Koralalage Sunil Upali Jayaratne
Barbara Kirby

Associate Professors
Jackie Bruce
Travis Dale Park
Wendy J. Warner

Assistant Professors
Joseph L. Donaldson
Misty D. Lambert
Katherine McKee
Joy Morgan

Agricultural & Extension Education (Minor)

Plan Requirements

- If Master’s student, select 3 elective courses totaling 9 credit hours
- If Doctoral student, select 4 elective courses totaling 12 credit hours

Elective Courses

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<td>AEE 501</td>
<td>Foundations Of Agricultural and Extension Education</td>
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<td>AEE 503</td>
<td>Youth Program Management</td>
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<td>AEE 505</td>
<td>Trends and Issues in Agricultural and Extension Education</td>
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<td>Leadership Theory</td>
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AEE 560 Organizational and Administrative Leadership in Agricultural and Extension Educa 3
AEE 565 Community Leadership 3
AEE 577 Evaluation in Agricultural and Extension Education 3
AEE 578 Scientific Inquiry in Agricultural and Extension Education 3
AEE 595 Special Topics in Agricultural and Extension Education 1-6
AEE 620 Special Problems in Agricultural and Extension Education 1-6
AEE 641 Practicum In Agricultural and Extension Education 1-6
AEE 705 International Agricultural Development 3
AEE 735 Effective Teaching in Agriculture and Life Sciences 3
AEE 777 Qualitative Research Methods in the Agricultural & Life Sciences 3

Faculty
Full Professors
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Barbara Kirby

Associate Professors
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Wendy J. Warner

Assistant Professors
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Misty D. Lambert
Katherine McKee
Joy Morgan

Agricultural and Extension Education (Certificate)
The Department of Agricultural and Extension Education offers a Graduate Certificate in Agricultural and Extension Education. The program focuses on developing knowledge and skills needed to be effective teachers of agriculture in the public schools and community colleges or to work as an educator with the Cooperative Extension Service or in other non-formal educational settings such as public gardens, nature centers and in international development.

Admissions
Students apply online by visiting the Graduate School’s website and completing an ApplyYourself online application. Students currently in a graduate degree program should contact the program director for information regarding adding the certificate program to an existing degree program.

Requirements
The certificate program involves completion of 15 credit hours and the preparation of a professional portfolio. The career goals of the student will determine which sequence of courses to take.

Plan Requirements
The Graduate Certificate in Agricultural and Extension Education is divided into two focuses: Agricultural Education and Extension Education.

Certificates earned will be distributed as: “Graduate Certificate in Agricultural Education and Extension Education” without focus area specifications.

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<td>AEE 503</td>
<td>Youth Program Management</td>
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<td>AEE 522</td>
<td>Occupational Experience in Agriculture</td>
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Agricultural Education focus

Extension Education focus

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Total Hours 15

Animal Science
Animal science offers an opportunity for training in a diversity of basic sciences and the integration of such knowledge into the framework of a living system. Students can major in animal science or co-major in animal science and one of the following disciplines: biochemistry, genomics, genetics, microbiology, nutrition, physiology or statistics. Students can also concentrate in management and production areas.

Admission Requirements
Factors considered for admission include: grade point average, scores on the GRE, undergraduate courses, experiences, statement of interest, and
letters of recommendation. In addition, a member of the Animal Science Graduate Faculty must be willing to serve as the applicant’s advisor for the M.S. program.

**Master of Science**

A minimum of 30 credit hours, including 18 hours of graduate level course work in the degree program, is required. Students also complete and defend a thesis based on their research. The minor is optional. If a student selects a minor, the advisory committee must include a member from the minor field.

**Master of Animal Science**

The non-thesis Master of Animal Science (MR) degree (Option B) requires a minimum of 36 credit hours, 19 credits of core courses and 17 credits of elective courses. Additional information regarding core courses and elective course requirements is on the Animal Science Graduate Program (https://cals.ncsu.edu/animal-science/students/graduate/) web site. The MR degree program is also offered through distance education.

**Student Financial Support**

A limited number of research and teaching assistantships are available through the department and are awarded on a competitive basis. Students are also supported by research grant funds awarded to faculty members. The total support package includes health insurance, tuition, and a stipend. Students applying for assistantships should apply by January 31 for fall admission.

**Other Relevant Information**

To provide an opportunity for students to develop their teaching skills, graduate students in a program that includes a thesis are required to assist in the departmental teaching program regardless of source of financial support. All graduate students in the Department of Animal Science who are mentored by departmental graduate faculty members are required to teach a minimum of one semester during their M.S. program.

**Degrees**

- Animal Science (MR) (p. 77)
- Animal Science (MS) (p. 83)
- Animal Science (Minor) (p. 84)

**Faculty**

**Full Professors**

Glen William Almond
Joan Eisemann
Kenneth L. Esbenshade
Charlotte E. Farin
Vivek Fellner
William Lucas Flowers IV
Fikret Isik
Sung Woo Kim
Duane K. Larick
Hsiao-Ching Liu
Christian Maltecca
Melissa Schuster Merrill
Jeannette A. Moore
Jack Odle
Shannon Elizabeth Phillips
Jorge A. Piedrahita
Matt H. Poore
Miles T. See
Paul David Siciliano
Eric VanHeugten
Elizabeth B. Wilson

**Associate Professors**

Dana J. Hanson
Mark T. Knauer
Daniel Heath Poole
Korinn Edna Saker
Giuseppe Valacchi

**Assistant Professors**

Debora A. Esposito
Jonathan Paul Holt
Jicai Jiang
Michael Vadakekara Joseph
Casey C. Nestor
Carrie L. Pickworth
Xiaoqiu Wang
Stephanie Hill Ward

**Practice/Research/Teaching Professors**

Kimberly Dawn Ange-Van Heugten
Deidre Danielle Harmon
James B. Holland
Francesco Tiezzi Mazzoni Della Stella Ma
## Degree Requirements

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1. No more than two (2) credit hours of a seminar to be included in the 36 credit hour total.
2. Electives must differ from required coursework; only 6 hours can come from 400-level courses.

### ANS Elective Courses

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<td>MB 783</td>
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<td>NTR 500</td>
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<td>Applied Ruminant Nutrition</td>
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<td>Lactation, Milk, and Nutrition</td>
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<td>Exercise Nutrition</td>
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<td>NTR 701</td>
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<td>Vitamin Metabolism</td>
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<td>NTR 708</td>
<td>Energy Metabolism</td>
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<td>NTR 764</td>
<td>Advances in Gastrointestinal Pathophysiology</td>
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<td>NTR 775</td>
<td>Mineral Metabolism</td>
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<td>Comparative Reproductive Physiology and Biotechnology</td>
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<td>PHY 780</td>
<td>Mammalian Endocrinology</td>
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</tbody>
</table>
### Poultry Science
- **PO 410** Production and Management of Game Birds in Confinement (3 credits)
- **PO 421** Commercial Egg Production (3 credits)
- **PO 424** Poultry Meat Production (3 credits)
- **PO 435** Poultry Incubation & Breeding (4 credits)
- **PO 524** Comparative Endocrinology (3 credits)
- **PO 566** Animal Cell Culture Techniques (2 credits)
- **PO 757** Comparative Immunology (3 credits)
- **PO 775** Mineral Metabolism (3 credits)

### Plant Pathology
- **PP 530** Agriculture, Ethics and the Environment (3 credits)

### Soil Science
- **SSC 440** Geographic Information Systems (GIS) in Soil Science and Agriculture (3 credits)
- **SSC 452** Soil Classification (4 credits)
- **SSC 461** Soil Physical Properties and Plant Growth (3 credits)
- **SSC 462** Soil-Crop Management Systems (3 credits)
- **SSC 470** Wetland Soils (3 credits)
- **SSC 532** Soil Microbiology (4 credits)
- **SSC 541** Soil Fertility (3 credits)
- **SSC 545** Remote Sensing Applications in Soil Science and Agriculture (3 credits)
- **SSC 551** Soil Morphology, Genesis and Classification (3 credits)
- **SSC 562** Environmental Applications Of Soil Science (3 credits)
- **SSC 570** Wetland Soils (3 credits)

### Statistics
- **ST 430** Introduction to Regression Analysis (3 credits)
- **ST 431** Introduction to Experimental Design (3 credits)
- **ST 432** Introduction to Survey Sampling (3 credits)
- **ST 435** Statistical Methods for Quality and Productivity Improvement (3 credits)
- **ST 445** Introduction to Statistical Computing and Data Management (3 credits)
- **ST 505** Applied Nonparametric Statistics (3 credits)
- **ST 506** Sampling Animal Populations (3 credits)
- **ST 511** Statistical Methods For Researchers I (3 credits)
- **ST 512** Statistical Methods For Researchers II (3 credits)
- **ST 520** Statistical Principles of Clinical Trials (3 credits)
- **ST 524** Statistics In Plant Science (3 credits)
- **ST 546** Probability and Stochastic Processes I (3 credits)
- **ST 708** Applied Least Squares (3 credits)
- **ST 711** Design Of Experiments (3 credits)
- **ST 715** Theory Of Sampling Applied To Survey Design (3 credits)
- **ST 721** Genetic Data Analysis (3 credits)
- **ST 730** Applied Time Series Analysis (3 credits)
- **ST 732** Longitudinal Data Analysis (3 credits)
- **ST 733** Spatial Statistics (3 credits)
- **ST 747** Probability and Stochastic Processes II (3 credits)
- **ST 748** Stochastic Differential Equations (3 credits)
- **ST 757** Quantitative Genetics Theory and Methods (3 credits)
- **ST 771** Biomathematics I (3 credits)
- **ST 772** Biomathematics II (3 credits)

### Toxicology
- **TOX 401** Principles of Toxicology (4 credits)
- **TOX 415** Environmental Toxicology and Chemistry (4 credits)
- **TOX 501** Principles of Toxicology (4 credits)
- **TOX 701** Fundamentals of Toxicology (3 credits)
- **TOX 704** Chemical Risk Assessment (1 credit)
- **TOX 710** Molecular and Biochemical Toxicology (3 credits)
- **TOX 715** Environmental Toxicology (3 credits)
- **TOX 727** Pesticide Behavior and Fate In the Environment (2 credits)
- **TOX 771** Cancer Biology (4 credits)

### Zoology
- **ZO 512** Animal Symbiosis (3 credits)
- **ZO 513** Comparative Physiology (3 credits)
- **ZO 522** Biological Clocks (3 credits)
- **ZO 524** Comparative Endocrinology (3 credits)
- **ZO 542** Herpetology (3 credits)
- **ZO 553** Principles Of Wildlife Science (3 credits)
- **ZO 582** Medical and Veterinary Entomology (3 credits)
- **ZO 790** Special Topics (1-6 credits)
- **ZO 791** Topics In Animal Behavior (3 credits)

### Additional Requirements
- 17 Credits [link](https://cals.ncsu.edu/animal-science/wp-content/uploads/sites/3/2018/05/MAS-Elective-Courses.pdf) of elective courses
- No more than two (2) credit hours of a seminar to be included in the 36 credit hour total
- A minimum of one full academic year or its equivalent in residence as a graduate student at the university
- The non-thesis Master of Animal Science degree requires a minimum of 36 credit hours, of which a minimum of 9 credits are in Animal Science courses at the 500 or above level
- Non-thesis programs may include no more than three (3) hours of independent student study credits of special topics project (ANS 610) in the minimum 36-credit program
- Research credit is not permitted in non-thesis programs, except upon approval by an associate dean of the Graduate School in cases where the student was initially enrolled in a thesis program but later transferred to a non-thesis program
- 400-level ANS courses are not permitted in a graduate plan of work
- No more than six (6) hours of 400-level courses from outside departments may be counted toward the 36-credit hour requirement
- Non-Thesis Masters Examination (ANS 690) credits may not be used to satisfy the 36-credit hour requirement
- Non-Thesis Masters Continuous Registration (ANS 688 and ANS 689) credits may NOT be used to satisfy the 36-credit hour requirement
- No more than three (3) credit hours of Masters supervised teaching (ANS 685) may be included in the minimum 36-credit hour program
- A graduate mentor (advisor) is required
- Mentor certification of a graduate plan of work and program completion
- Meet with the graduate mentor at last once per semester
• Complete the annual graduate student progress report
• Committee not required, oral examination not required
• The director of graduate programs (https://cals.ncsu.edu/animal-science/people/Joan/) and the Graduate School (https://grad.ncsu.edu/) must approve the graduate plan of work

Faculty

Full Professors
Glen William Almond
Joan Eisemann
Kenneth L. Esbenshade
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Vivek Fellner
William Lucas Flowers IV
Fikret Isik
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Jean-Marie Luginbuhl
Roger Lee McCraw
William M. Morrow
Richard M. Myers
Robert M. Petters
Odis Wayne Robison
Frank D. Sargent
Jerry Wayne Spears
Animal Science (MS)

Degree Requirements

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<th>Hours</th>
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<tr>
<td>ANS 601</td>
<td>Animal Science Seminar</td>
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<td>ANS 610</td>
<td>Topical Problems in Animal Science (Safety and Ethics in Animal Science)</td>
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<td>ANS 685</td>
<td>Master's Supervised Teaching</td>
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<td>ANS 695</td>
<td>Master's Thesis Research</td>
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<td>or ANS 693 Master's Supervised Research</td>
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Graduate Elective Courses 18
Select any 500 - 700 level courses determined in conjunction with the advisory committee.

Elective Courses 1
Select any "Elective Courses" determined in conjunction with the advisory committee.

Total Hours 30

1 Students may choose 8 credits in combination of: ANS 693 Master's Supervised Research/ANS 695 Master's Thesis Research, Seminar, ANS 685 Master's Supervised Teaching, and other elective graded courses.

Additional Requirements & Restrictions

- A minimum of one (1) full academic year or its equivalent in residence as a graduate student at the university
- A minimum of 30 semester hours of graduate work in the degree program, unless the specific program requires more hours, including a minimum of 18 hours of 500-700 level coursework
- No more than six (6) hours of 400-level courses can be counted toward the minimum 30-hour requirement, and they may not come from the major field
- No more than three (3) credit hours of Masters Supervised Teaching (ANS 685) can be included in the minimum 30-credit program
- No more than six hours of Thesis Research (ANS 693 Master’s Supervised Research/ANS 695 Master’s Thesis Research) in the minimum 30-hour program
- No more than two (2) credit hours of seminar (S/U graded) may be included in the minimum 30-credit hour program
- Masters Thesis Preparation (ANS 699) credits may not be used to satisfy the 30-credit hour requirement
- A thesis
- A departmental defense seminar
- A comprehensive oral examination

Faculty

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Animal Science (Minor)

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Lon Weidner Whitlow
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Kent A Gray
Jeffrey Alan Hansen
Justin W. Holl
Elizabeth A. Koutsos
Douglas Wyatt Newcom
Theo A. van Kempen

Animal Science (Minor)

Plan Requirements
Courses are determined in conjunction with an animal science faculty member on the graduate committee.

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<th>Code</th>
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<td>Select minimum of nine credit hours of animal science courses at the 500-level or 700-level</td>
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<td>One (1) credit hour of animal science seminar</td>
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1 Students must maintain a minimum 3.0 GPA for 500-level and 700-level courses.
2 Students may take additional animal science courses at the 600-level or 800-level.

Faculty

Full Professors
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Deidre Danielle Harmon

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Lon Weidner Whitlow
Charles Michael Williams

Adjunct Faculty
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Kent A Gray
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Justin W. Holl
Animal Science and Poultry Science

A doctoral degree in Animal Science and Poultry Science with a concentration in either Animal Science or Poultry Science is offered. Specific course requirements are flexible and each student's program is developed in consultation with their Ph.D. advisory committee. The minor is optional but if a minor is included, external faculty representation is required on the advisory committee.

There are two curriculum codes for the Animal Science and Poultry Science doctoral degree program. If a student is interested in a program concentration in Animal Science, the appropriate curriculum code for the admissions application is ANA. If the student is interested in a program concentration in Poultry Science, the appropriate curriculum code for the admissions application is ANP. If the appropriate curriculum code is not selected, it will delay the department's receipt of the applicant's information from the Graduate School.

Note: The Master's programs in Animal Science or Poultry Science are administered independently by each department.

Animal Science Concentration (ANA)

Admission Requirements
Factors considered for admission include: grade point average, scores on the GRE, undergraduate and graduate courses, experiences, statement of interest, and letters of recommendation. In addition, a member of the Department of Animal Science Graduate Faculty must be willing to serve as the applicant's advisor.

Student Financial Support
The Department of Animal Science offers a limited number of research and teaching assistantships that are awarded on a competitive basis. Students are also supported by research grant funds awarded to faculty members. The total support package includes health insurance, tuition, and a stipend. Students applying for these assistantships should apply by January 31 for fall admission.

Other Relevant Information
To provide an opportunity for students to develop their teaching skills, graduate students are required to assist in the departmental teaching program regardless of source of financial support. All graduate students in the Department of Animal Science who are mentored by departmental graduate faculty members are required to teach a minimum of one semester during their Ph.D. program.

Click on Graduate Courses - Animal Science (p. 88) for current course information.

Poultry Science Concentration (ANP)
Click on Graduate Courses - Poultry Science (p. 89) for current course information.

Degrees
PhD
- Animal Science & Poultry Science (PhD) Animal Science Concentration (p. 88)
- Animal Science & Poultry Science (PhD) Poultry Science Concentration (p. 89)

Minor
No results were found.

Faculty
Full Professors
Glen William Almond
Kenneth E. Anderson
Christopher M. Ashwell
Donna K. Carver
Patricia Ann Curtis
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Joan Eisemann
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Animal Science & Poultry Science (PhD) Animal Science Concentration

Degree Requirements

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<td>ANS 810</td>
<td>Topical Problems in Animal Science</td>
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Faculty

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- Glen William Almond
- Kenneth E. Anderson
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Zehava Uni
Christopher J. Williams
Michael John Wineland

Animal Science & Poultry Science (PhD) Poultry Science Concentration

Degree Requirements

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<td>BCH 451</td>
<td>Principles of Biochemistry</td>
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<td>“Graduate Electives / Research Courses” that will be applied to reach 72 credit hours will be determined in conjunction with the advisory committee.</td>
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<td>Students are encouraged to choose these courses from the “Graduate Elective Courses” and “Graduate Research Courses” listed below</td>
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Graduate Electives

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<td></td>
<td>Students are encouraged to select from the courses below:</td>
<td></td>
</tr>
<tr>
<td>PO 504</td>
<td>Avian Anatomy and Physiology</td>
<td>4</td>
</tr>
<tr>
<td>PO 506</td>
<td>Physiological Aspects of Poultry Management</td>
<td>3</td>
</tr>
<tr>
<td>PO 510</td>
<td>Poultry Product Safety: An On-Farm Model</td>
<td>3</td>
</tr>
<tr>
<td>PO 515</td>
<td>Comparative Nutrition</td>
<td>3</td>
</tr>
<tr>
<td>PO 524</td>
<td>Comparative Endocrinology</td>
<td>3</td>
</tr>
</tbody>
</table>
FM 525    Feed Manufacturing Technology   3
PO 533    Poultry Processing and Products   3
FM 580    Feed and Ingredient Quality Assurance   3
PO 590    Special Problems in Poultry Science   1-6
FM 790    Advanced Feed Formulation   3
IMM 757   Comparative Immunology   3

Graduate Research Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>PO 893</td>
<td>Doctoral Supervised Research</td>
<td>1-9</td>
</tr>
<tr>
<td>PO 895</td>
<td>Doctoral Dissertation Research</td>
<td>1-9</td>
</tr>
<tr>
<td>PO 899</td>
<td>Doctoral Dissertation Preparation</td>
<td>1-9</td>
</tr>
</tbody>
</table>

Students are encouraged to choose from the following courses:

Faculty

Full Professors

Glen William Almond
Kenneth E. Anderson
Christopher M. Ashwell
Donna K. Carver
Patricia Ann Curtis
Frank W. Edens
Joan Eisemann
Kenneth L. Esbenshade
Charlotte E. Farin
Vivek Fellner
Peter R. Ferket
Williams Lucas Flowers, IV
Jesse Lee Grimes
Sung Woo Kim
Matthew D. Koci
Duane K. Larick
Hsiao-Ching Liu
Christian Maltecca
Melissa Schuster Merrill
Paul Edward Modziak
Jeannette A. Moore
Jack Odle
Edgar Orlando Oviedo-Rondon
James N. Petitte

Associate Professors

Robert Byron Beckstead
Dana J. Hanson
Mark T. Knauer
Daniel Heath Poole
Korinn Edna Saker
Giuseppe Valacchi

Assistant Professors

Deborah A. Esposito
Adam Charles Fahrenholz
Jonathan Paul Holt
Jicai Jiang
Michael Vadakekara Joseph
Casey C. Nestor
Carrie L. Pickworth
Mahmoud Ahmed Nabil Ahmed Naguib Sharara
Xiaoqiu Wang
Stephanie Hill Ward

Practice/Research/Teaching Professors

Kimberly Dawn Ange-Van Heugten
Deidre Danielle Harmon
Francesco Tiezzi Mazzoni Della Stella Ma
Shweta Trivedi
Lin Xi

Emeritus Faculty

Brenda P. Alston-Mills
Biochemistry

Biochemistry as a discipline serves a pivotal role in advancing research in the Life Sciences. Through a combination of coursework, seminars, and original research, you will complete a Graduate degree and acquire the skills needed to become an independent research scientist. Our major research training areas emphasize:

- Structural and Analytical Biochemistry
- Molecular and Systems Biology
- Metabolism and Disease

**Brief Overview of Programs**

- The accelerated Bachelor’s / Master’s Degree (ABM) is a 5-year dual degree program intended for undergraduate majors who wish to continue beyond the B.S. degree and receive additional training at the graduate level. Interested students who meet the minimum University GPA requirement are typically accepted into the program at the end of their junior year of undergraduate study. The Master's degree obtained after 5 years may be a Master's of Biochemistry (non-thesis) or a Master's of Science (thesis research) depending upon the selection made by the student.
- The Master's of Biochemistry is a non-thesis alternative to the Master's of Science degree in Biochemistry for students wishing to emphasize course work rather than thesis research. The Master’s of Biochemistry is a terminal graduate degree and is not appropriate for students intending to pursue a Ph.D. program.
- The Master’s of Science is a research degree that prepares students in Biochemistry for Ph.D. studies or provides training for technical employment.
- The objective of the Ph.D. program is to prepare students for careers as researchers primarily in academic, industrial, or government research environments.

**Admission Requirements**

Students entering the graduate program in biochemistry should have a bachelor's degree in biochemistry, chemistry or a related physical or biological science, including undergraduate courses in organic chemistry, calculus, physics and physical chemistry, as well as biochemistry/molecular biology. Applicants with a strong record of undergraduate research activity or with practical experience in a professional scientific setting are particularly encouraged to apply. Reporting of GRE scores is strongly encouraged.
ABM Specific Admission Requirements

- a minimum of seventy-five credit hours in their undergraduate programs, including credits earned from advanced placement, but prior to the completion of their bachelor’s.
- a minimum overall undergraduate grade point average (GPA) of 3.500 at NC State at the time of admission into the ABM program.
- (This GPA must be maintained throughout their undergraduate program to remain in the ABM program.)
- receive a grade of B or better in the double counted graduate-level courses (500 or 700 level) while maintaining a 3.50 GPA.
- (Courses with a grade of B- or below cannot be double counted between the two degrees.)
- maintain a 3.50 or better Biochemistry Major GPA.
- be positioned to complete the BS degree requirements by the end of their fourth year, and formally apply for admission to the Graduate School.
- one letter of recommendation from the proposed faculty mentor, indicating the qualifications of the student and willingness to serve as the Master’s advisor.

Degrees

- Biochemistry (MR) (p. 92)
- Biochemistry (MS) (p. 94)
- Biochemistry (PhD) (p. 95)
- Biochemistry (Minor) (p. 96)

Faculty

Full Professors

Joe Barycki
Dennis Brown
Linda Kay Hanley-Bowdoin
John Mackenzie
Eric S. Miller
Melanie Simpson

Associate Professors

Colleen Jennifer Doherty
Michael B. Goshe
Charles C. Hardin
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Joseph Stephan Kahn
James Arthur Knopp
Earl S. Maxwell
William Laubach Miller
James W. Moyer
Ron Ross Sederoff
Harold E. Swaisgood
Elizabeth C. Theil
Paul L. Wollenzien

Adjunct Faculty

Davis Fernandes Ferreira
Jason Locasale
Michael Milburn
Whitney Stutts
Peter Thompson

Biochemistry (MR)

Master’s Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCH 701</td>
<td>Macromolecular Structure</td>
<td>13</td>
</tr>
<tr>
<td>BCH 703</td>
<td>Macromolecular Synthesis and Regulation</td>
<td></td>
</tr>
<tr>
<td>BCH 705</td>
<td>Molecular Biology Of the Cell</td>
<td></td>
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</table>
BCH 801 Seminar in Biochemistry

**Elective Courses**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCH 555</td>
<td>Proteins and Molecular Mechanisms</td>
<td>3</td>
</tr>
<tr>
<td>BCH 590</td>
<td>Special Topics in Biochemistry</td>
<td>1-6</td>
</tr>
<tr>
<td>BCH 770</td>
<td>Enzyme Kinetics and Mechanisms</td>
<td>3</td>
</tr>
<tr>
<td>BCH 760</td>
<td>Protein Crystallography and Macromolecular Modeling</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB 414</td>
<td>Microbial Metabolic Regulation</td>
<td>3</td>
</tr>
<tr>
<td>MB 505</td>
<td>Food Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>PB 580</td>
<td>Introduction to Plant Biotechnology</td>
<td>3</td>
</tr>
<tr>
<td>PB 595</td>
<td>Special Topics Botany</td>
<td>1-6</td>
</tr>
<tr>
<td>HS 701</td>
<td>Plant Metabolism</td>
<td>1</td>
</tr>
<tr>
<td>MB 725</td>
<td>Fermentation Microbiology</td>
<td>3</td>
</tr>
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</table>

**Food, Bioprocessing and Nutrition Science**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTR 419</td>
<td>Human Nutrition and Chronic Disease</td>
<td>3</td>
</tr>
<tr>
<td>NTR 500</td>
<td>Principles of Human Nutrition</td>
<td>3</td>
</tr>
<tr>
<td>NTR 501</td>
<td>Advanced Nutrition and Metabolism</td>
<td>3</td>
</tr>
<tr>
<td>NTR 510</td>
<td>Maternal and Infant Nutrition</td>
<td>3</td>
</tr>
<tr>
<td>NTR 555</td>
<td>Exercise Nutrition</td>
<td>3</td>
</tr>
<tr>
<td>NTR 557</td>
<td>Nutraceuticals and Functional Foods</td>
<td>3</td>
</tr>
<tr>
<td>NTR 785</td>
<td>Digestion and Metabolism in Ruminants</td>
<td>3</td>
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</table>

**Physiology**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY 503</td>
<td>General Physiology I</td>
<td>3</td>
</tr>
<tr>
<td>PHY 504</td>
<td>General Physiology II</td>
<td>3</td>
</tr>
<tr>
<td>PHY 780</td>
<td>Mammalian Endocrinology</td>
<td>3</td>
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</tbody>
</table>

**Animal Science**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANS/BCH 571</td>
<td>Regulation of Metabolism</td>
<td>3</td>
</tr>
<tr>
<td>ANS 701</td>
<td>Protein and Amino Acid Metabolism</td>
<td>3</td>
</tr>
<tr>
<td>ANS 709</td>
<td>Energy Metabolism</td>
<td>3</td>
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</table>

**Prestige Poultry Science**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO 504</td>
<td>Avian Anatomy and Physiology</td>
<td>4</td>
</tr>
</tbody>
</table>

**Total Hours**

- 1 Every semester for 2 years, 4 credit hours total; 1/semester
- 2 Students may choose other courses approved in conjunction with the academic committee

**Elective Courses**

- Select courses from any category below

  **Molecular and Structural Biochemistry**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCH 555</td>
<td>Proteins and Molecular Mechanisms</td>
<td>3</td>
</tr>
<tr>
<td>BCH 590</td>
<td>Special Topics in Biochemistry</td>
<td>1-6</td>
</tr>
<tr>
<td>BCH 770</td>
<td>Enzyme Kinetics and Mechanisms</td>
<td>3</td>
</tr>
<tr>
<td>BCH 760</td>
<td>Protein Crystallography and Macromolecular Modeling</td>
<td>3</td>
</tr>
</tbody>
</table>

  **Plant and Microbial Biology**

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</thead>
<tbody>
<tr>
<td>MB 414</td>
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<tr>
<td>HS 701</td>
<td>Plant Metabolism</td>
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</tr>
<tr>
<td>MB 725</td>
<td>Fermentation Microbiology</td>
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  **Food, Bioprocessing and Nutrition Science**

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<tr>
<td>NTR 785</td>
<td>Digestion and Metabolism in Ruminants</td>
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</table>

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<tbody>
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<td>PHY 780</td>
<td>Mammalian Endocrinology</td>
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<table>
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<tr>
<th>Code</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>ANS/BCH 571</td>
<td>Regulation of Metabolism</td>
<td>3</td>
</tr>
<tr>
<td>ANS 701</td>
<td>Protein and Amino Acid Metabolism</td>
<td>3</td>
</tr>
<tr>
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<td>Energy Metabolism</td>
<td>3</td>
</tr>
</tbody>
</table>

  **Prestige Poultry Science**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO 504</td>
<td>Avian Anatomy and Physiology</td>
<td>4</td>
</tr>
</tbody>
</table>

**Additional Requirements**

- Successful completion of the Master's degree requires a minimum of 30 credit hours.
- At least 24 credit hours of letter-graded courses ("A," "B," "C," etc.) must be included in the program.

**Faculty**

**Full Professors**

- Joe Barycki
- Dennis Brown
- Linda Kay Hanley-Bowdoin
- John Mackenzie
- Eric S. Miller
- Melanie Simpson

**Associate Professors**

- Colleen Jennifer Doherty
- Michael B. Goshe
- Charles C. Hardin
- Flora Meilleur
- Robert B. Rose
- Guozhou Xu

**Assistant Professors**

- Abdulkerim Eroglu
- Arion Kennedy
- Xiaojing Liu
- Rubén Rellán Álvarez

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- Raquel Hernandez
- David G. Presutti
- Paul Douglas Swartz

**Emeritus Faculty**

- Cynthia L. Hemenway
- Horace R. Horton
- Joseph Stephan Kahn
- James Arthur Knopp
- Earl S. Maxwell
- William Laubach Miller
- James W. Moyer
# Biochemistry (MS)

## Master of Science Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCH 701</td>
<td>Macromolecular Structure</td>
<td>3</td>
</tr>
<tr>
<td>BCH 703</td>
<td>Macromolecular Synthesis and Regulation</td>
<td>3</td>
</tr>
<tr>
<td>BCH 705</td>
<td>Molecular Biology Of the Cell</td>
<td>3</td>
</tr>
<tr>
<td>BCH 801</td>
<td>Seminar In Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>BCH 552</td>
<td>Experimental Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>BCH 553</td>
<td>Biochemistry of Gene Expression</td>
<td>3</td>
</tr>
<tr>
<td>BCH 555</td>
<td>Proteins and Molecular Mechanisms</td>
<td>3</td>
</tr>
<tr>
<td>BCH 560</td>
<td>Molecular Biology for Teachers</td>
<td>3</td>
</tr>
<tr>
<td>BCH 571</td>
<td>Regulation of Metabolism</td>
<td>3</td>
</tr>
<tr>
<td>BCH 590</td>
<td>Special Topics in Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>BCH 701</td>
<td>Macromolecular Structure</td>
<td>3</td>
</tr>
<tr>
<td>BCH 703</td>
<td>Macromolecular Synthesis and Regulation</td>
<td>3</td>
</tr>
<tr>
<td>BCH 705</td>
<td>Molecular Biology Of the Cell</td>
<td>3</td>
</tr>
<tr>
<td>BCH 710</td>
<td>Biological Scanning Electron Microscopy</td>
<td>3</td>
</tr>
<tr>
<td>BCH 751</td>
<td>Biophysical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>BCH 760</td>
<td>Protein Crystallography and Macromolecular Modeling</td>
<td>3</td>
</tr>
</tbody>
</table>

## Elective Courses

Select at least three courses below:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCH 552</td>
<td>Experimental Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>BCH 553</td>
<td>Biochemistry of Gene Expression</td>
<td>3</td>
</tr>
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<tr>
<td>BCH 760</td>
<td>Protein Crystallography and Macromolecular Modeling</td>
<td>3</td>
</tr>
</tbody>
</table>

## Additional Requirements

- Successful completion of the M.S. degree requires a minimum of 30 credit hours.
- At least 18 credit hours of letter-graded courses (“A,” “B,” “C”, etc.) must be included in the program.

# Accelerated Bachelor's/Master's Degree Requirements

In addition to the standard University and Biochemistry requirements for a B.S. in Biochemistry, students must complete 30 credit hours at the graduate level for the Master’s degree component. This is accomplished as outlined below:

## Undergraduate Core Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCH 552</td>
<td>Experimental Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>BCH 553</td>
<td>Biochemistry of Gene Expression</td>
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<td>BCH 560</td>
<td>Molecular Biology for Teachers</td>
<td>3</td>
</tr>
<tr>
<td>BCH 571</td>
<td>Regulation of Metabolism</td>
<td>3</td>
</tr>
<tr>
<td>BCH 590</td>
<td>Special Topics in Biochemistry</td>
<td>3</td>
</tr>
</tbody>
</table>

## 400-level Courses with a 500-level Counterpart

- BCH 701 Macromolecular Structure
- BCH 703 Macromolecular Synthesis and Regulation
- BCH 705 Molecular Biology Of the Cell

Select one additional course:

- GN 701 Molecular Genetics
- BCH/GN 761 Advanced Molecular Biology Of the Cell
- MB 714 Microbial Metabolic Regulation
- MB 718 Introductory Virology
- PO 757 Comparative Immunology

## Master's Thesis Research

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>BCH 685</td>
<td>Master's Supervised Teaching</td>
<td>3</td>
</tr>
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<td>BCH 693</td>
<td>Master's Supervised Research</td>
<td>3</td>
</tr>
<tr>
<td>BCH 695</td>
<td>Master's Thesis Research</td>
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</tr>
</tbody>
</table>

## Total Hours

30

1. Indicates courses double counted for both Bachelor's and Master's degree
2. Students may choose other courses approved in conjunction with the academic committee

## 400/500-Level Courses

Select two courses listed below:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH 463/563</td>
<td>Molecular Origins of Life</td>
<td>3</td>
</tr>
<tr>
<td>BIO 488/588</td>
<td>Neurobiology</td>
<td>3</td>
</tr>
<tr>
<td>GN 441/541</td>
<td>Human and Biomedical Genetics</td>
<td>3</td>
</tr>
</tbody>
</table>
Faculty
Full Professors
Joe Barycki
Dennis Brown
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John Mackenzie
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Practice/Research/Teaching Professors
Jose Trinidad Ascencio-Ibanez
Raquel Hernandez
David G. Presutti
Paul Douglas Swartz

Emeritus Faculty
Cynthia L. Hemenway
Horace R. Horton
Joseph Stephan Kahn
James Arthur Knopp
Earl S. Maxwell
William Laubach Miller
James W. Moyer

Biochemistry (PhD)
Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCH 701</td>
<td>Macromolecular Structure (First semester - Fall)</td>
<td>30</td>
</tr>
<tr>
<td>BCH 703</td>
<td>Macromolecular Synthesis and Regulation (Second Semester - Spring)</td>
<td></td>
</tr>
<tr>
<td>BCH 705</td>
<td>Molecular Biology Of the Cell (Third Semester - Fall)</td>
<td></td>
</tr>
<tr>
<td>BCH 801</td>
<td>Seminar In Biochemistry ¹</td>
<td></td>
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<tr>
<td>BCH 870</td>
<td>Laboratory Rotations (First semester - Fall) ²</td>
<td></td>
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<tr>
<td>BCH 810</td>
<td>Special Topics (First semester - Fall)</td>
<td></td>
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<tr>
<td>BCH 815</td>
<td>Advanced Special Topics (Second Semester - Spring)</td>
<td></td>
</tr>
<tr>
<td>BCH 895</td>
<td>Doctoral Dissertation Research ³</td>
<td></td>
</tr>
</tbody>
</table>

Biochemistry / Related Course | 3
Select 1 advanced course in biochemistry or related approved in conjunction with the academic committee

Additional Courses | 39
*Additional Courses* are approved in conjunction with the academic committee to meet 72 total hours ³

Total Hours | 72
1 Every semester for 4 years, 8 credit hours total; 1/semester
2 First semester in program - except for targeted students
3 add to reach 72 credit hours

Additional Requirements
• Successful completion of the Ph.D. degree requires a minimum of 72 credit hours.
• At least 18 credit hours of formal coursework must be included in the program.

Faculty
Full Professors
Ron Ross Sederoff
Harold E. Swaisgood
Elizabeth C. Theil
Paul L. Wollenzien

Adjunct Faculty
Davis Fernandes Ferreira
Jason Locasale
Michael Milburn
Whitney Stutts
Peter Thompson
Biochemistry (Minor)

Plan Requirements

- 9 (MS student) or 12 (PhD student) credit hours

Faculty

Full Professors

Dennis Brown
Linda Kay Hanley-Bowdoin
John Mackenzie
Eric S. Miller
Melanie Simpson

Associate Professors

Colleen Jennifer Doherty
Michael B. Goshe
Charles C. Hardin
Flora Meilleur
Robert B. Rose
Guozhou Xu

Assistant Professors

Abdulkerim Eroglu
Arion Kennedy
Xiaojing Liu
Rubén Rellán Álvarez

Practice/Research/Teaching Professors

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Peter Thompson

Biochemistry (Minor)

Plan Requirements

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Arion Kennedy
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Rubén Rellán Álvarez

Practice/Research/Teaching Professors

Jose Trinidad Ascencio-Ibanez
Raquel Hernandez
Degrees

- Biological and Agricultural Engineering (MR) (p. 98)
- Biological and Agricultural Engineering (MS) (p. 99)
- Biological and Agricultural Engineering (MS) Systems Analysis Concentration (p. 99)
- Biological and Agricultural Engineering (PhD) (p. 100)
- Biological and Agricultural Engineering (PhD) Systems Analysis Concentration (p. 101)

Faculty

Full Professors
- Michael D. Boyette
- Michael R. Burchell II
- Jay Jiayang Cheng
- Mari S. Chinn
- Garey Alton Fox
- Scott A. Hale
- William F. Hunt III
- Lingjuan Wang Li
- Gary T. Roberson
- Sanjay Bikram Shah
- Mohamed A. Youssef
- Wenqiao Yuan

Associate Professors
- Francois Philippe Birgand
- John J. Classen
- Barbara A. Doll
- Steven George Hall
- Praveen Kolar

Assistant Professors
- Celso Francisco Castro Bolinaga
- Grant H. Ellington
- Lucie S. G. Guertault
- Daniela Jones
- Chad Ashley Poole
- Natalie G. Nelson Sagues
- Chadi Sayde

Admission Requirements

A baccalaureate in biological or agricultural engineering or other engineering discipline (GPA > 2.8) is the preferred prerequisite for admission. Those with a strong academic background in the physical or biological sciences may also be admitted with a requirement for undergraduate work in math, physics, chemistry and basic engineering courses. In the case of applicants with Master's degrees, a Master's GPA of at least 3.2 is required for admission to the PhD. Exceptions to the overall undergraduate GPA requirements may be made for cases where performance in the major or during the last two years was at or above the 3.00 level.

Applicants who do not have an engineering background, but have earned a degree in an appropriate science discipline may be admitted to the Systems Analysis Concentration in the MS or PhD program without completing the engineering prerequisites.

GRE scores are required for all applicants. A faculty review committee will admit the best-qualified applicants.
Faculty

Full Professors
Michael D. Boyette
Michael R. Burchell II
Jay Jiayang Cheng
Mari S. Chinn
Garey Alton Fox
Scott A. Hale
William F. Hunt III
Lingjuan Wang Li
Gary T. Roberson
Sanjay Bikram Shah
Mohamed A. Youssef
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Barbara A. Doll
Steven George Hall
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Chad Ashley Poole
Natalie G. Nelson Sagues
Chadi Sayde
Mahmoud A. N. A. N. Sharara
Jason Kellam Ward
Sierra Young

Practice/Research/Teaching Professors
Otto DeBruhl Simmons III

Biological and Agricultural Engineering (MR)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td></td>
<td>BAE Courses</td>
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<tr>
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<td></td>
</tr>
<tr>
<td></td>
<td>Mathematics / Statistics / Biomathematics Course</td>
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<tr>
<td></td>
<td>The &quot;Mathematics / Statistics / Biomathematics Course&quot; is determined in conjunction with the academic committee</td>
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<td></td>
<td>Elective Courses</td>
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<tr>
<td></td>
<td>&quot;Elective Courses&quot; are determined in conjunction with the academic committee to meet the 30 total credit hours</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Hours</td>
<td>30</td>
</tr>
</tbody>
</table>

Additional Requirements
- 20/30 hours must come from 500 level and above
- maximum 6 hours S/U graded courses
Emeritus Faculty
George Maynard Chescheir III
Robert O. Evans Jr.
Garry L. Grabow
Rodney L. Huffman
Gregory Donald Jennings
Richard W. Skaggs
Jean Spooner
Larry F. Stikeleather
Daniel H. Willits

Adjunct Professors
Christopher R Daubert
Ratna Rani Sharma

Biological and Agricultural Engineering (MS)

Faculty

Full Professors
Michael D. Boyette
Michael R. Burchell II
Jay Jiayang Cheng
Mari S. Chinn
Garey Alton Fox
Scott A. Hale
William F. Hunt III
Lingjuan Wang Li
Gary T. Roberson
Sanjay Bikram Shah
Mohamed A. Youssef
Wenqiao Yuan

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John J. Classen
Barbara A. Doll
Steven George Hall

Praveen Kolar

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Natalie G. Nelson Sagues
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Sierra Young

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Otto DeBruhl Simmons III

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Richard W. Skaggs
Jean Spooner
Larry F. Stikeleather
Daniel H. Willits

Adjunct Professors
Christopher R Daubert
Ratna Rani Sharma

Biological and Agricultural Engineering (MS) Systems Analysis Concentration

Concentration Electives

<table>
<thead>
<tr>
<th>Code</th>
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<tr>
<td>BAE 501</td>
<td>Sensors and Controls</td>
<td>3</td>
</tr>
</tbody>
</table>

A minimum of 6 hours of elective courses must be taken from the following courses:
Faculty

Full Professors

Michael D. Boyette
Michael R. Burchell II
Jay Jiayang Cheng
Mari S. Chinn
Garey Alton Fox
Scott A. Hale
William F. Hunt III
Lingjuan Wang Li
Gary T. Roberson
Sanjay Bikram Shah
Mohamed A. Youssef
Wenqiao Yuan

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Gregory Donald Jennings
Richard W. Skaggs
Jean Spooner
Larry F. Stikeleather
Daniel H. Willits

Adjunct Professors

Christopher R Daubert
Ratna Rani Sharma

Biological and Agricultural Engineering (PhD)

Faculty

Full Professors

Michael D. Boyette
Michael R. Burchell II
Jay Jiayang Cheng
Mari S. Chinn
Garey Alton Fox
Scott A. Hale
William F. Hunt III
Lingjuan Wang Li
Gary T. Roberson
Sanjay Bikram Shah
Mohamed A. Youssef
Wenqiao Yuan

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Barbara A. Doll
Steven George Hall
Praveen Kolar

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Jason Kellam Ward
Sierra Young

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Rodney L. Huffman
Gregory Donald Jennings
Richard W. Skaggs
Jean Spooner
Larry F. Stikeleather
Daniel H. Willits

Adjunct Professors

Christopher R Daubert
Ratna Rani Sharma

Biological and Agricultural Engineering (PhD)
Adjunct Professors
Christopher R Daubert
Ratna Rani Sharma

Biological and Agricultural Engineering (PhD) Systems Analysis Concentration

Concentration Elective Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>BAE 501</td>
<td>Sensors and Controls</td>
<td>3</td>
</tr>
<tr>
<td>BAE 442/542</td>
<td>SAS Advanced Analytics for Agriculture, Food, and Life Sciences Data (pending Admin Board approval 2020)</td>
<td>3</td>
</tr>
<tr>
<td>BAE 565</td>
<td>Environmental and Agricultural Analytics and Modeling</td>
<td>3</td>
</tr>
<tr>
<td>GIS 715</td>
<td>Geovisualization</td>
<td>3</td>
</tr>
<tr>
<td>GN 758</td>
<td>Microbial Genetics &amp; Genomics</td>
<td>3</td>
</tr>
<tr>
<td>ISE 754</td>
<td>Logistics Engineering</td>
<td>3</td>
</tr>
<tr>
<td>MB 714</td>
<td>Microbial Metabolic Regulation</td>
<td>3</td>
</tr>
<tr>
<td>OR 719</td>
<td>Vector Space Methods in System Optimization</td>
<td>3</td>
</tr>
</tbody>
</table>

Students must select a minimum of two courses from the following:

Faculty
Full Professors
Michael D. Boyette
Michael R. Burchell II
Jay Jiayang Cheng
Mari S. Chinn
Garey Alton Fox
Scott A. Hale
William F. Hunt III
Lingjuan Wang Li
Gary T. Roberson
Sanjay Bikram Shah
Mohamed A. Youssef
Wenqiao Yuan

Associate Professors
Francois Philippe Birgand
John J. Classen
Barbara A. Doll

Emeritus Faculty
George Maynard Chescheir III
Robert O. Evans Jr.
Garry L. Grabow
Rodney L. Huffman
Gregory Donald Jennings
Richard W. Skaggs
Jean Spooner
Larry F. Stikeleather
Daniel H. Willits

Practice/Research/Teaching Professors
Otto DeBruhl Simmons III
Areas of study include: cell biology, physiology, ecology, evolution, behavior, and fisheries, wildlife and conservation biology. Specializations within these areas include developmental biology, neurobiology, genomics, invertebrate biology, animal reproduction, biorhythms, behavioral ecology, community ecology, population ecology, conservation biology, fisheries ecology, wildlife field studies, aquaculture and others.

Application Deadlines
To guarantee consideration for funding, applications should be complete by the following dates: for Fall Semester admission both U.S. and international applicants should have their application materials completed by January 15; for Spring Semester the deadline is October 15 for U.S. applicants and international applicants. Please note that it typically requires four to six weeks from the date of your request until transcripts and letters of recommendation reach us. Applications received after the dates listed above will still be considered until the Graduate School deadlines (June 25 and November 25 for U.S. applicants, March 1 and July 15 for international applicants); however, opportunities for funding may be limited (note that the Biology Graduate Program does not accept M.S. and Ph.D. students without support).

Admission Requirements
It is important that you identify a potential faculty adviser, as this will greatly increase your chance of admission to NCSU’s Biology Graduate Program. Although all applications are made available to faculty advisers for review, a graduate student will not be admitted to the Biology Program for graduate studies unless the prospective student has identified a faculty adviser. Once a faculty adviser has requested review of a prospective student, the application is then evaluated with regard to the applicant’s potential for success in graduate school. The admissions process involves consideration of the ability of our program to accommodate students.

Successful applicants usually have a Bachelor’s degree in Biological Sciences or a related field with at least an overall B average and a minimum number of courses in biology (and related fields) and supporting fields (6 in biology, 4 in chemistry, 2 in physics, and 2 in mathematics). In addition to the applicant’s grades and coursework, we consider relevant experience (e.g., through internships, research experiences, volunteer or paid work, and publications), statement of interest, and letters of recommendation. GRE scores are not required. We expect applicants for the MS degree to have at least a 3.0 GPA, and applicants for the PhD degree to have at least a 3.2 GPA. Research experience is highly recommended.

Master’s Degree Requirements
AEC 502 and PHI 816 (or equivalent) are required. No more than six hours of temporary courses (AEC 624, BIO 624, INB 624, BIO 824) or two hours of departmental seminar can be included in the 30-hour requirement for the M.S. Six hours of research credits (INB 695) resulting in a thesis are required. A minor (usually 9-10 hours) is optional. Other requirements may be imposed by the advisor.

Doctoral Degree Requirements
AEC 502 and PHI 816 (or equivalent) are required. A student’s advisory committee recommends appropriate courses which will provide a strong foundation in the student’s area of interest. A minimum of 10 hours of research (INB 895) leading to a dissertation is required. A minor (usually 9-10 hours) is optional. Other requirements may be imposed by the advisor.

Concentrations
Students in all Biology Degree Programs must select a Concentration. Concentrations include Aquaculture and Aquatic Sciences, Molecular, Cellular and Developmental Biology, Ecology and Evolution, Forensic Sciences, Integrative Biology, Physiology and Behavior, and Zoology.
Consult the Biology Graduate Program Handbook for Concentration-specific requirements.

**Student Financial Support**
Graduate teaching and research assistantships are available to well-qualified M.R., M.S. and Ph.D. students.

**Other Relevant Information**
Excellent research facilities, equipment and computers are available. Off-campus research is conducted at the Pamlico Aquaculture Field Laboratory, research and extension centers in Eastern and Western North Carolina, the Center for Marine Science and Technology in Morehead City, and at facilities of state and federal agencies and private organizations. Field work can be conducted at nearby natural areas and laboratory work at various state and federal laboratories associated with the department, nationally, and internationally. For additional information see the Biology Graduate Program web pages: [https://cals.ncsu.edu/applied-ecology/students/graduate/biology/](https://cals.ncsu.edu/applied-ecology/students/graduate/biology/) and [https://bio.sciences.ncsu.edu/graduate/graduate-programs/Biology](https://bio.sciences.ncsu.edu/graduate/graduate-programs/Biology/).

**Degrees**
- Biology (MR) (p. 104)
- Biology (MS) (p. 106)
- Biology (PhD) (p. 109)

**Full Professors**
David Derek Aday
Betty L. Black
Russell J. Borski
David Buchwalter
Jeffrey A. Buckel
Ignazio Carbone
Jaime A. Collazo
William Gregory Cope
Harry Valentine Daniels III
Robert R. Dunn
David B. Eggleston
John R. Godwin
Kevin Gross
Craig A. Harms
Jeffrey M. Hinshaw
Rebecca Elizabeth Irwin
Thomas J. Kwak
Thomas M. Losordo
Carolyn Jane Mattingly
Heather B. Patisaul
Luis Alonso Ramirez-Ulate
Ann Helen Ross
Mary Higby Schweitzer
David R. Tarpy

**Associate Professors**
Scott M. Belcher
Adam Hartstone-Rose
Randall Brian Langerhans
John Edward Meitzen
Nanette M. Nascone-Yoder
Marianne Niedzlek-Feaver
Antonio Planchar
Reade Bruce Roberts

**Assistant Professors**
Jie Cao
Kurt Marsden
Jamian Krishna Pacifici
Seema Nayan Sheth
Caitlin Suzanne Smukowski Heil
Bradley William Taylor
Christopher Scott Walker
Elsa Youngsteadt

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Louis Broaddus Daniel III
Miles Dean Engell
Miriam G. Ferzli
Jesse Robert Fischer
Terry Allen Gates
William Miller Johnstone III
Jane L. Lubischer
Erin Alison McKenney
Emeritus Faculty

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Billy J. Copeland
Frederick T. Corbin
Phillip D. Doerr
William C. Grant
Robert M. Grossfeld
Thurman L. Grove
Harold F. Heatwole
Joseph E. Hightower
Richard A. Lancia
Richard L. Noble
Kenneth H. Pollock
James Alan Rice Jr.
John F. Roberts
Damian Shea
Theodore R. Simons
Herbert A. Underwood
John G. Vandenbergh
Thomas G. Wolcott

Adjunct Professors

Robert R. Anholt
Tyler Ray Black
Arthur E. Bogan
John G. Boreman Jr.
David T. Cobb
Louis Broaddus Daniel III
Mitchell J. Eaton

Biology (MR)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td></td>
<td><strong>Core Courses</strong></td>
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<tr>
<td>AEC 502</td>
<td>Introduction to Biological Research</td>
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</tr>
<tr>
<td>PHI 816</td>
<td>Introduction to Research Ethics (or equivalent ethics course)</td>
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</tr>
<tr>
<td></td>
<td><strong>Additional Coursework</strong></td>
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<tr>
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<td>The additional courses that will be applied to reach 30 credit hours will be determined in conjunction with the academic committee based on academic and job interests</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total Hours</strong></td>
<td>30</td>
</tr>
</tbody>
</table>

Full Professors

David Derek Aday
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David Buchwalter
Jeffrey A. Buckel
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David B. Eggleston
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Mary Higby Schweitzer
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John Edward Meitzen
Nanette M. Nascone-Yoder
Marianne Niedzlek-Feaver
Antonio Planchart
Reade Bruce Roberts

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Seema Nayan Sheth
Caitlin Suzanne Smukowski Heil
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Elsa Youngsteadt

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Miriam G. Ferzli
Jesse Robert Fischer
Terry Allen Gates
William Miller Johnstone III
Jane L. Lubischer
Erin Alison McKenney
Lisa M. Paciulli
Lisa D. Parks
Martha Burford Reiskind
Damian Shea
Adrian Alan Smith
Lindsay E. Zanno

__Emeritus Faculty__

Peter T. Bromley
Billy J. Copeland
Frederick T. Corbin
Phillip D. Doerr
William C. Grant
Robert M. Grossfeld
Thurman L. Grove
Harold F. Heatwole
Joseph E. Hightower
Richard A. Lancia
Richard L. Noble
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James Alan Rice Jr.
John F. Roberts
Damian Shea
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Herbert A. Underwood
John G. Vandenbergh
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Tyler Ray Black
Arthur E. Bogan
John G. Boreman Jr.
David T. Cobb
Louis Broaddus Daniel III
Mitchell J. Eaton
John Jeffrey Govoni
Nicholas M. Haddad
Andrew Bittinger Heckert
Ryan J. Heise
Corinne J. Kendall
Reid W. Laney
Trudy F. MacKay
Alexa J. McKerrow
Gerard McMahon
James Adiel Morris Jr.
Rowland M. Shelley
Kyle W. Shertzer
Adrian Alan Smith
Seth Patrick Stapleton
Bryan Lynn Stuart
Adam J. Terando

Biology (MS)

Degree Requirements
Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: “Master of Science in Biology” without track specifications.

Additional Courses are determined in conjunction with the academic committee to meet the 30 total hours

Total Hours 30

1 Students may take PHI 816 Introduction to Research Ethics or equivalent to meet this requirement.

Aquaculture and Aquatic Sciences Track

<table>
<thead>
<tr>
<th>Code</th>
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<td>Quantitative Requirement</td>
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<td>Select one of the following courses:</td>
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<tr>
<td>ST 511</td>
<td>Statistical Methods For Researchers I</td>
<td></td>
</tr>
<tr>
<td>ST 512</td>
<td>Statistical Methods For Researchers II</td>
<td></td>
</tr>
<tr>
<td>BIT 815</td>
<td>Advanced Special Topics</td>
<td></td>
</tr>
<tr>
<td>AEC 510</td>
<td>Machine Learning Approaches in Biological Sciences</td>
<td></td>
</tr>
<tr>
<td>ST 505</td>
<td>Applied Nonparametric Statistics</td>
<td></td>
</tr>
<tr>
<td>BMA 567</td>
<td>Modeling of Biological Systems</td>
<td></td>
</tr>
</tbody>
</table>

Restricted Elective 3

Select one of the following courses:

- AEC/ENT 509 Biology of Aquatic Insects
- AEC 515 Fish Physiology
- AEC 519 Freshwater Ecology
- AEC 624 Advanced Fisheries Science
- AEC 592 Special Topics in Applied Ecology (Management of Small Impoundments)
- AEC 592 Special Topics in Applied Ecology (Aquatic Plant Ecology)
- AEC 592 Special Topics in Applied Ecology (Advanced Biology of Fishes)
- AEC 624 Advanced Fisheries Science
- AEC 710 Sampling Animal Populations
- AEC 726 Quantitative Fisheries Management
- BMA 772 Biomathematics II
- FW 511 Human Dimensions of Wildlife and Fisheries
- MEA 549 Principles of Biological Oceanography
- NR 595 Special Topics in Natural Resources
- TOX 715 Environmental Toxicology
- ZO 524 Comparative Endocrinology

Total Hours 6

2 BIT 815 or any Bioinformatics course determined in conjunction with the academic committee.

Molecular, Cellular and Developmental Biology Track

<table>
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<th>Code</th>
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<td>Quantitative Biology Requirement</td>
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<tr>
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<tr>
<td>ST 511</td>
<td>Statistical Methods For Researchers I</td>
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<tr>
<td>ST 512</td>
<td>Statistical Methods For Researchers II</td>
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<tr>
<td>BIT 815</td>
<td>Advanced Special Topics</td>
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<tr>
<td>AEC 510</td>
<td>Machine Learning Approaches in Biological Sciences</td>
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Total Hours 3
Biotechnology Requirement  4
Select one course from the following:

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<tr>
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<td>Topical Problems (Capstone Course in Molecular, Cellular, and Developmental Biology)</td>
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<td>Molecular Genetics</td>
</tr>
<tr>
<td>GN 702</td>
<td>Cellular and Developmental Genetics</td>
</tr>
<tr>
<td>GN 750</td>
<td>Developmental Genetics</td>
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Restricted Electives  3
Select one of the following courses determined in conjunction with the academic committee based on thesis research

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<tr>
<td>BIT 510</td>
<td>Core Technologies in Molecular and Cellular Biology</td>
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<td>BIT 595</td>
<td>Special Topics</td>
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Total Hours  10

Ecology and Evolution Track

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<tr>
<td>ST 511</td>
<td>Statistical Methods For Researchers I</td>
</tr>
<tr>
<td>or ST 512</td>
<td>Statistical Methods For Researchers II</td>
</tr>
<tr>
<td>AEC 510</td>
<td>Machine Learning Approaches in Biological Sciences</td>
</tr>
<tr>
<td>ST 505</td>
<td>Applied Nonparametric Statistics</td>
</tr>
<tr>
<td>BMA 567</td>
<td>Modeling of Biological Systems</td>
</tr>
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</table>

Ecology or Evolution Requirement  3
Select one of the following courses from "Ecology" or "Evolution"

Ecology

<table>
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<tr>
<th>Code</th>
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<tbody>
<tr>
<td>AEC 503</td>
<td>Foundations of Ecology</td>
</tr>
<tr>
<td>AEC 519</td>
<td>Freshwater Ecology</td>
</tr>
<tr>
<td>AEC 718</td>
<td>Community Ecology</td>
</tr>
<tr>
<td>AEC 761</td>
<td>Conservation and Climate Science</td>
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<td>BIO/BMA 560</td>
<td>Population Ecology</td>
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<td>MEA 752</td>
<td>Marine Plankton Ecology</td>
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Evolution

<table>
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<tbody>
<tr>
<td>BIO 570</td>
<td>Evolutionary Ecology</td>
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<tr>
<td>ENT 591</td>
<td>Special Topics In Entomology</td>
</tr>
<tr>
<td>GN 703</td>
<td>Population and Quantitative Genetics</td>
</tr>
<tr>
<td>GN 713</td>
<td>Quantitative Genetics and Breeding</td>
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<td>GN 740</td>
<td>Evolutionary Genetics</td>
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<tr>
<td>GN 757</td>
<td>Quantitative Genetics Theory and Methods</td>
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<tr>
<td>PB 503</td>
<td>Systematic Botany</td>
</tr>
<tr>
<td>PB 545</td>
<td>Paleobotany</td>
</tr>
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Total Hours  9

Other Requirements

- Every student is required to complete training logs. Many of the modules can be completed while taking the BIO 520 course. Please contact the Forensic Sciences Concentration Chair for additional information.
- Students are also required to start the Training Case Record Form after their first year and/or after taking BIO 520, whichever comes first. Please contact the Forensic Sciences Concentration Chair for additional information.
- Forensic Anthropology Society of Europe Level II Certification is strongly recommended but not required- costs associated with this exam are the student’s responsibility.

Integrative Biology Track

This concentration is open to MS and PhD students who do not fit academically within the other Biology concentrations, or who integrate across multiple concentrations. Coursework is determined in consultation with your PhD mentor and committee and is approved by the DGP.

Full Professors

David Derek Aday
Betty L. Black
Russell J. Borski
David Buchwalter
Jeffrey A. Buckel
Ignazio Carbone
Jaime A. Collazo
William Gregory Cope
Harry Valentine Daniels III
Robert R. Dunn
David B. Eggleston
John R. Godwin
Kevin Gross
Craig A. Harms
Jeffrey M. Hinshaw
Rebecca Elizabeth Irwin
Thomas J. Kwak
Thomas M. Losordo
Carolyn Jane Mattingly
Heather B. Patisaul
Luis Alonso Ramirez-Ulate
Ann Helen Ross
Mary Higby Schweitzer
David R. Tarpy

Kurt Marsden
Jamian Krishna Pacifici
Seema Nayan Sheth
Caitlin Suzanne Smukowski Heil
Bradley William Taylor
Christopher Scott Walker
Elsa Youngsteadt

Practice/Research/Teaching Professors
Jennifer L. Campbell
Louis Broaddus Daniel III
Miles Dean Engell
Miriam G. Ferzli
Jesse Robert Fischer
Terry Allen Gates
William Miller Johnstone III
Jane L. Lubischer
Erin Alison McKenney
Lisa M. Paciulli
Lisa D. Parks
Martha Burford Reiskind
Damian Shea
Adrian Alan Smith
Lindsay E. Zanno

Emeritus Faculty
Peter T. Bromley
Billy J. Copeland
Frederick T. Corbin
Phillip D. Doerr
William C. Grant
Robert M. Grossfeld
Thurman L. Grove
Harold F. Heatwole
Joseph E. Hightower
Richard A. Lancia

Associate Professors
Scott M. Belcher
Adam Hartstone-Rose
Randall Brian Langerhans
John Edward Meitzen
Nanette M. Nascone-Yoder
Marianne Niedzlek-Feaver
Antonio Planchart
Reade Bruce Roberts

Assistant Professors
Jie Cao
Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: “Doctor of Philosophy in Biology” without track specifications.

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<th>Code</th>
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<td>Core Courses</td>
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<tr>
<td></td>
<td>AEC 502</td>
<td>Introduction to Biological Research</td>
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<tr>
<td></td>
<td>PHI 816</td>
<td>Introduction to Research Ethics (or equivalent ethics course)</td>
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<td></td>
<td>Additional Courses</td>
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Additional Courses are determined in conjunction with the academic committee to meet the 72 total hours

Total Hours 72

1 Students may take PHI 816 Introduction to Research Ethics or equivalent to meet this requirement.

Aquaculture and Aquatic Sciences Track

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<tr>
<td></td>
<td>Select one of the following courses:</td>
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<td></td>
<td>ST 511, ST 512</td>
<td>Statistical Methods For Researchers I or II</td>
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<td></td>
<td>BIT 815</td>
<td>Advanced Special Topics</td>
</tr>
<tr>
<td></td>
<td>AEC 510</td>
<td>Machine Learning Approaches in Biological Sciences</td>
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<tr>
<td></td>
<td>ST 505</td>
<td>Applied Nonparametric Statistics</td>
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<tr>
<td></td>
<td>BMA 567</td>
<td>Modeling of Biological Systems</td>
</tr>
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<td></td>
<td>Restricted Elective</td>
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<tr>
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<td>Fish Physiology</td>
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<tr>
<td></td>
<td>AEC 519</td>
<td>Freshwater Ecology</td>
</tr>
<tr>
<td></td>
<td>AEC 624</td>
<td>Advanced Fisheries Science</td>
</tr>
<tr>
<td></td>
<td>AEC 592</td>
<td>Special Topics in Applied Ecology (Management of Small Impoundments)</td>
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<td></td>
<td>AEC 592</td>
<td>Special Topics in Applied Ecology (Aquatic Plant Ecology)</td>
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<td></td>
<td>AEC 592</td>
<td>Special Topics in Applied Ecology (Advanced Biology of Fishes)</td>
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<tr>
<td></td>
<td>AEC 624</td>
<td>Advanced Fisheries Science</td>
</tr>
<tr>
<td></td>
<td>AEC 710</td>
<td>Sampling Animal Populations</td>
</tr>
<tr>
<td></td>
<td>AEC 726</td>
<td>Quantitative Fisheries Management</td>
</tr>
<tr>
<td></td>
<td>BMA 772</td>
<td>Biomathematics II</td>
</tr>
<tr>
<td></td>
<td>FW 511</td>
<td>Human Dimensions of Wildlife and Fisheries</td>
</tr>
<tr>
<td></td>
<td>MEA 549</td>
<td>Principles of Biological Oceanography</td>
</tr>
<tr>
<td></td>
<td>NR 595</td>
<td>Special Topics in Natural Resources</td>
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<tr>
<td></td>
<td>TOX 751</td>
<td>Environmental Toxicology</td>
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<tr>
<td></td>
<td>ZO 524</td>
<td>Comparative Endocrinology</td>
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Total Hours 9
BIT 815 or any Bioinformatics course determined in conjunction with the academic committee.

### Molecular, Cellular and Developmental Biology Track

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<td>or ST 512</td>
<td>Statistical Methods For Researchers II</td>
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<td>BIT 815</td>
<td>Advanced Special Topics ²</td>
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</tr>
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<td>AEC 510</td>
<td>Machine Learning Approaches in Biological Sciences</td>
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<tr>
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<td>Topical Problems (Capstone Course in Molecular, Cellular, and Developmental Biology)</td>
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<td>Cellular and Developmental Genetics</td>
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<td>GN 750</td>
<td>Developmental Genetics</td>
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**Total Hours**: 10

² BIT 815 or any Bioinformatics course determined in conjunction with the academic committee.

### Ecology and Evolution Track

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<tr>
<td>or ST 512</td>
<td>Statistical Methods For Researchers II</td>
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<td>AEC 510</td>
<td>Machine Learning Approaches in Biological Sciences</td>
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<td>Applied Nonparametric Statistics</td>
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<td>BMA 567</td>
<td>Modeling of Biological Systems</td>
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<tr>
<td></td>
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<tr>
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**Total Hours**: 17

² BIT 815 or any Bioinformatics course determined in conjunction with the academic committee.

### Forensic Sciences Track

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<td>AEC 515</td>
<td>Fish Physiology</td>
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<tr>
<td>AEC 624</td>
<td>Advanced Fisheries Science</td>
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<tr>
<td></td>
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<td>BIO 520</td>
<td>Skeletal Biological Laboratory Methods in Human Identification &amp; Cold Cases</td>
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<td>Forensic Sciences Seminar</td>
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**Total Hours**: 17

### Other Requirements

- Every student is required to complete training logs. Many of the modules can be completed while taking the BIO 520 course. Please contact the Forensic Sciences Concentration Chair for additional information.
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### Physiology and Behavior Track

<table>
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<tr>
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**Total Hours**: 17

² BIT 815 or any Bioinformatics course determined in conjunction with the academic committee.
<table>
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<td>MEA 549</td>
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<td>Special Topics in Natural Resources</td>
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<td>Environmental Toxicology</td>
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<tr>
<td>ZO 524</td>
<td>Comparative Endocrinology</td>
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</tbody>
</table>

**Additional Courses 63**

Additional courses are determined in conjunction with the academic committee to meet the 72 total hours.

**Total Hours 72**

1 Students may take PHI 816 Introduction to Research Ethics or equivalent to meet this requirement.

### Integrative Biology Track

This concentration is open to MS and PhD students who do not fit academically within the other Biology concentrations, or who integrate across multiple concentrations. Coursework is determined in consultation with your PhD mentor and committee and is approved by the DGP.

### Full Professors

- David Derek Aday
- Betty L. Black
- Russell J. Borski
- David Buchwalter
- Jeffrey A. Buckel
- Ignazio Carbone
- Jaime A. Collazo
- William Gregory Cope
- Harry Valentine Daniels III
- Robert R. Dunn
- David B. Eggleston
- John R. Godwin
- Kevin Gross
- Craig A. Harms
- Jeffrey M. Hinshaw
- Rebecca Elizabeth Irwin
- Thomas J. Kwak
- Thomas M. Losordo
- Carolyn Jane Mattingly
- Heather B. Patisaul
- Luis Alonso Ramirez-Ulate
- Ann Helen Ross
- Mary Higby Schweitzer
- David R. Tarpy

### Associate Professors

- Scott M. Belcher
- Adam Hartstone-Rose
- Randall Brian Langerhans
- John Edward Meitzen
- Nanette M. Nascone-Yoder
- Marianne Niedzlek-Feaver
- Antonio Plancharth
- Reade Bruce Roberts

### Assistant Professors

- Jie Cao
- Kurt Marsden
- Jamian Krishna Pacifici
- Seema Nayan Sheth
- Caitlin Suzanne Smukowski Heil
- Bradley William Taylor
- Christopher Scott Walker
- Elsa Youngsteadt

### Practice/Research/Teaching Professors

- Jennifer L. Campbell
- Louis Broaddus Daniel III
- Miles Dean Engell
- Miriam G. Ferzli
- Jesse Robert Fischer
- Terry Allen Gates
- William Miller Johnstone III
- Jane L. Lubischer
- Erin Alison McKenney
- Lisa M. Paciulli
- Lisa D. Parks
- Martha Burford Reiskind
Crop Science

The Graduate Program in Crop Science revolves around our vision of being a world leader in Crop Science education and in the generation and application of knowledge required for economically and environmentally sustainable crop systems and products, as well as in developing land management strategies that protect the quality of North Carolina’s soil, water and air resources.

Our mission within the Graduate program is to develop future leaders in Crop Science with a focus on improving crop plants and products, devising effective and sustainable crop production systems and effective and sustainable management techniques in both agricultural and urban settings; and dissemination of crop science knowledge for the benefit of users and producers of food, feed, turf, biofuels and fiber in North Carolina, the nation and the world.

The specific program areas in which Graduate education focuses are crop management and physiology, plant breeding and genetics, weed science, alternative crops and pesticide fate and impact on the environment.

Entrance requirements for the Graduate program in Crop Science follow the NC State Graduate School guidelines. A minimum of a 3.0 GPA at the Baccalaureate or master’s level is required, although exceptions may be made for master’s applicants with a very strong GPA in science classes and/or their final two years, or with substantial post-baccalaureate work experience. Students accepted will typically have a bachelor’s or master’s degree in crop science, or closely related fields, with strong preparation in the biological and physical sciences. The Graduate Record Examination is also required but there is no minimum score on any of the sections.

Financial assistance in the form of a Graduate Assistantship is available for most of the students accepted into the program. However, funding is limited and positions are highly competitive within a major professor’s program area. It is recommended that applicants review the department’s faculty listing and communicate directly with faculty members who have similar interest to theirs.
Degrees
- Crop Science (MR) (p. 114)
- Crop Science (MS) (p. 115)
- Crop Science (PhD) (p. 116)
- Crop Science (Minor) (p. 118)

Faculty
Full Professors
Gina Brown-Guedira
Kent O. Burkey
Thomas E. Carter
Miguel S. Castillo
Guy D. Collins
Richard J. Cooper
Ralph E. Dewey
Keith L. Edmisten
Loren Ray Fisher
Major M. Goodman
Candace H. Haigler
Ronnie W. Heiniger
James B. Holland
David L. Jordan
Vasu Kuraparthy
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Ramon Gonzalez Leon Gonzalez
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Susana R. Milla-Lewis
Lori J. Unruh Snyder

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Rachel A. Vann

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David A. Danehower
James T. Green, Jr.
Harry D. Gross
Robert D. Keys
H. Michael Linker
Raymond C. Long
Jean-Marie Luginbuhl
Adjunct Professors
Thomas R. Sinclair

Crop Science (MR)

Degree Requirements

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<td>Special Problems</td>
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<td>ST 511</td>
<td>Statistical Methods For Researchers I (or equivalent)</td>
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<td></td>
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</table>

Total Hours: 36

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Gina Brown-Guedira
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J. Paul Mueller
Gerald F. Peedin
Rongda Qu
W. David Smith
Janet F. Spears
Harold T. Stalker, Jr.
Gene A. Sullivan
Donald L. Thompson
Jerome B. Weber
Arthur K. Weissinger
P. Randall Weisz

Earl A. Wernsman
A. Douglas Worsham
Johnny C. Wynne
Alan C. York

Adjunct Professors
Thomas R. Sinclair

Crop Science (MS)

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P. Randall Weisz
Earl A. Wernsman
A. Douglas Worsham
Johnny C. Wynne
Alan C. York

Adjunct Professors
Thomas R. Sinclair

Crop Science (PhD)

Degree Requirements
• Required: minimum of 72 credit hours

Faculty

Full Professors
Gina Brown-Guedira
Assistant Professors
Charles W. Cahoon
Jeffrey C. Dunne
Amanda M. Hulse-Kemp
Anna Locke
Angela R. Post
David H. Suchoff
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Ramon Gonzalo Leon Gonzalez
Matthew D. Krakowsky
Susana R. Milla-Lewis
Lori J. Unruh Snyder
Crop Science (Minor)

Plan Requirements

• 9 credit hours of 400+ level Crop Science courses

Faculty

Full Professors
Gina Brown-Guedira
Kent O. Burkey
Thomas E. Carter
Miguel S. Castillo
Guy D. Collins
Richard J. Cooper
Ralph E. Dewey
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Loren Ray Fisher
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Harold D. Coble
William K. Collins
Will A. Cope

Adjunct Professors
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J. Paul Murphy
Robert P. Patterson
Charles H. Peacock
S. Christopher Reberg-Horton
Robert J. Richardson
Thomas W. Ruffy Jr.
Michelle S. Schroeder-Moreno
Randy Wells
Fred H. Yelverton
Entomology

Course offerings or research facilities are available in the following areas: agricultural entomology, apiculture, aquatic entomology, behavior, biological control, chemical ecology, forest entomology, genetic pest management, host-plant resistance, insect ecology, insect transmission of plant pathogens, insect microbe interactions, medical and veterinary entomology, pest management, physiology, molecular biology, population genetics, insect symbiosis, urban ecology, urban entomology, systematics and toxicology.

Admission Requirements

Training in biology and appropriate courses in chemistry, biochemistry, mathematics and physics, is preferred. A "B" average (3.0 GPA) is required in biology courses and an overall 3.0 GPA during the last two years of the undergraduate program.

Master's Degree Requirements

A minimum of 30 credits are required for graduation. 9 credits of letter grade entomology courses plus 2 credits of entomology student seminars are also required. The student's advisory committee will meet with the student to identify an appropriate plan of course work.

Doctoral Degree Requirements

A minimum of 72 credits (18 may be transferred from a Master's degree) are required for graduation. For Ph.D. students, 9 credits of letter grade entomology courses plus 3 credits of entomology student seminars are required. The student's advisory committee will meet with the student to identify an appropriate plan of course work.

Student Financial Support

Graduate assistantships and other forms of aid are available to students as described in the Fellowships and Graduate Assistantships section of the Graduate Catalog.

Other Relevant Information

Full admission is permitted only after acceptable applicants have secured an advisor and appropriate financial support. All students are expected to begin their research as soon as possible.

Degrees

- Entomology (MR) (p. 120)
- Entomology (MS) (p. 121)
- Entomology (PhD) (p. 122)
- Entomology (PhD): Behavioral Biology Concentration (p. 123)
- Entomology (Minor) (p. 125)
- Genetic Engineering & Society (Minor) (p. 126)

Faculty

Full Professors

Rick Lynn Brandenburg
David Buchwalter
Wayne G. Buhler
Hannah J. Burrack
Robert R. Dunn
Steven D. Frank
Fred L. Gould
Rebecca Elizabeth Irwin
George G. Kennedy
Dominic Duane Reisig
Richard M. Roe
Coby J. Schal
Jules Silverman
Clyde E. Sorenson
David R. Tarpy
James F. Walgenbach
David W. Watson
Anna Elizabeth Whittfield
Brian M. Wiegmann

**Associate professors**
Marce D. Lorenzen
David B. Orr
Michael Hay Reiskind
Dorith Rotenberg

**Assistant Professors**
Zachary Steven Brown
Anders Schmidt Huseth
Aram Arshak Mikaelyan
Elsa Youngsteadt

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Ruediger C. Hillmann
John R. Meyer
Harry B. Moore Jr.
Herbert H. Neunzig
John F. Roberts
Robert L. Robertson

Kenneth A. Sorensen
Phillip S. Southern
Ronald Edwin Stinner
John W. VanDuyn
Charles Gerald Wright

**Adjunct Professors**
Nicholas M. Haddad

## Entomology (MR)

### Degree Requirement

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<th>Hours</th>
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<td>ENT 502</td>
<td>Insect Diversity</td>
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<tr>
<td>ENT 503</td>
<td>Insect Morphology and Physiology</td>
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<tr>
<td>ENT 504</td>
<td>Professional Development for Entomologists</td>
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<tr>
<td>ENT 506</td>
<td>Principles of Genetic Pest Management</td>
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<tr>
<td>ENT 509</td>
<td>Biology of Aquatic Insects</td>
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<tr>
<td>ENT 510</td>
<td>Writing Proposals in Agriculture, Biology, and Ecology</td>
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<tr>
<td>ENT 520</td>
<td>Insect Behavior</td>
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<td>ENT 526</td>
<td>Organic Agriculture: Principles and Practices</td>
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<td>ENT 550</td>
<td>Fundamentals of Arthropod Management</td>
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<tr>
<td>ENT 560</td>
<td>Techniques in Molecular Ecology and Evolution</td>
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<tr>
<td>ENT 582</td>
<td>Medical and Veterinary Entomology</td>
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<td>ENT 591</td>
<td>Special Topics in Entomology</td>
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<td>ENT 726</td>
<td>Biological Control of Insects and Weeds</td>
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<td>Ecology of Soil Ecosystems</td>
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<td>ENT 731</td>
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<td>ENT 762</td>
<td>Insect Pest Management in Agricultural Crops</td>
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</tr>
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</table>

**Faculty**

**Full Professors**
Rick Lynn Brandenburg
David Buchwalter
Wayne G. Buhler
Hannah J. Burrack
Robert R. Dunn
Steven D. Frank
Fred L. Gould
Rebecca Elizabeth Irwin
George G. Kennedy
Dominic Duane Reisig
Richard M. Roe
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Nicholas M. Haddad

Entomology (MS)

Degree Requirements

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Seminar Courses

Seminar course must be repeated to fulfill 2 credit hours

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</tr>
</tbody>
</table>
Additional Courses
Additional Courses are determined in conjunction with the academic committee to meet the 30 total hours

Total Hours 30

Faculty
Full Professors
Rick Lynn Brandenburg
David Buchwalter
Wayne G. Buhler
Hannah J. Burrack
Robert R. Dunn
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Fred L. Gould
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Adjunct Professors
Nicholas M. Haddad

Entomology (PhD)

Degree Requirements

Required Courses

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<td>Fundamentals of Arthropod Management</td>
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</table>
ENT 560  Techniques in Molecular Ecology and Evolution
ENT 582  Medical and Veterinary Entomology
ENT 591  Special Topics In Entomology
ENT 726  Biological Control of Insects and Weeds
ENT 727  Ecology of Soil Ecosystems
ENT 731  Insect Ecology
ENT 762  Insect Pest Management In Agricultural Crops
ENT 791  Special Topics In Entomology

Seminar Courses
Seminar course must be repeated to fulfill 3 credit hours
ENT 601  Seminar
or ENT 801  Seminar

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<th>Code</th>
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Faculty

Full Professors
Rick Lynn Brandenburg
David Buchwalter
Wayne G. Buhler
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Fred L. Gould
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James D. Harper
Ruediger C. Hillmann
John R. Meyer
Harry B. Moore Jr.
Herbert H. Neunzig
John F. Roberts
Robert L. Robertson
Kenneth A. Sorensen
Phillip S. Southern
Ronald Edwin Stinner
John W. VanDuyn
Charles Gerald Wright

Adjunct Professors
Nicholas M. Haddad

Entomology (PhD): Behavioral Biology Concentration

David B. Orr
Michael Hay Reiskind
Dorith Rotenberg
Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<td>ENT 502</td>
<td>Insect Diversity</td>
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<tr>
<td>ENT 503</td>
<td>Insect Morphology and Physiology</td>
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<tr>
<td>ENT 504</td>
<td>Professional Development for Entomologists</td>
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<tr>
<td>ENT 506</td>
<td>Principles of Genetic Pest Management</td>
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<tr>
<td>ENT 509</td>
<td>Biology of Aquatic Insects</td>
<td></td>
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<tr>
<td>ENT 510</td>
<td>Writing Proposals in Agriculture, Biology, and Ecology</td>
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<tr>
<td>ENT 520</td>
<td>Insect Behavior</td>
<td></td>
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<tr>
<td>ENT 526</td>
<td>Organic Agriculture: Principles and Practices</td>
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<td>ENT 560</td>
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<td>Medical and Veterinary Entomology</td>
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<td>ENT 591</td>
<td>Special Topics In Entomology</td>
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<td>ENT 726</td>
<td>Biological Control of Insects and Weeds</td>
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<td>Ecology of Soil Ecosystems</td>
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<td>Insect Ecology</td>
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<td>Insect Pest Management In Agricultural Crops</td>
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<td>Special Topics In Entomology</td>
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<td>ENT 601</td>
<td>Seminar</td>
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<tr>
<td>or ENT 801</td>
<td>Seminar</td>
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<td>Total Hours</td>
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</table>

Faculty

**Full Professors**

- Rick Lynn Brandenburg
- David Buchwalter
- Wayne G. Buhler
- Hannah J. Burrack
- Robert R. Dunn
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- Richard M. Roe

- Coby J. Schal
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- David R. Tarpy
- James F. Walgenbach
- David W. Watson
- Anna Elizabeth Whitfield
- Brian M. Wiegmann

**Associate professors**

- Marce D. Lorenzen
- David B. Orr
- Michael Hay Reiskind
- Dorith Rotenberg

**Assistant Professors**

- Zachary Steven Brown
- Anders Schmidt Huseth
- Aram Arshak Mikaelyan
- Elsa Youngsteadt

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Phillip S. Southern
Ronald Edwin Stinner
John W. VanDuyn
Charles Gerald Wright

Adjunct Professors
Nicholas M. Haddad

Entomology (Minor)

Plan Requirements

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Entomology Courses

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<td>Insect Morphology and Physiology</td>
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<td>ENT 504</td>
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<td>ENT 506</td>
<td>Principles of Genetic Pest Management</td>
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<td>ENT 509</td>
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<td>ENT 560</td>
<td>Techniques in Molecular Ecology and Evolution</td>
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<td>Medical and Veterinary Entomology</td>
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<td>ENT 591</td>
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<td>ENT 601</td>
<td>Seminar</td>
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<td>ENT 604</td>
<td>Insect Natural History and Field Ecology</td>
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<td>ENT 620</td>
<td>Special Problems</td>
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<tr>
<td>ENT 641</td>
<td>Agricultural Entomology Practicum</td>
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<td>ENT 726</td>
<td>Biological Control of Insects and Weeds</td>
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<tr>
<td>ENT 727</td>
<td>Ecology of Soil Ecosystems</td>
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<td>ENT 731</td>
<td>Insect Ecology</td>
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<td>ENT 762</td>
<td>Insect Pest Management In Agricultural Crops</td>
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<td>ENT 791</td>
<td>Special Topics In Entomology</td>
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<tr>
<td>ENT 801</td>
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<td>ENT 804</td>
<td>Insect Natural History and Field Ecology</td>
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<td>ENT 820</td>
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<td>ENT 841</td>
<td>Agricultural Entomology Practicum</td>
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</tbody>
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Faculty

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Emeritus Faculty
Charles Smith Apperson
Jack S. Bacheler
Participants in the minor will learn the basic concepts and principles underlying genetic engineering and the methods used for evaluating the technology's social, cultural and environmental dimensions. The graduate minor is available to students pursuing either an MS or a Ph.D. degree.

Requirements

In order to complete the minor, coursework must be taken in relevant areas of natural sciences and the humanities and social sciences. 9 credit hours from a list of approved courses (see below) are required, 6 of which must be two of the core GES courses. The remaining 3 credit hours must be fulfilled by a course from the list of approved courses that are outside the students' home discipline. A grade of B or higher must be achieved in each course counted towards the minor. In addition, a student must have a GES faculty member on his or her committee (see GES program homepage (https://research.ncsu.edu/ges/) for a list of the GES faculty), and this faculty member should be from a discipline other than the student’s major, ensuring that there is representation from both humanities/social science and natural science.

The choice of courses must be consistent with the interdisciplinary outlook of this minor, namely that students will learn the basic concepts and principles underlying genetic engineering and the methods used for evaluating the technology's social, cultural and environmental dimensions. The minor representative will be responsible for ensuring that the courses taken are appropriate and balance the student's major. Students in the biological sciences will be encouraged to take hands-on courses, such as those offered by the BIT program.

Plan Requirements

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<td>GES/COM/HI 508</td>
<td>Emerging Technologies and Society</td>
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<tr>
<td>GES 591</td>
<td>Special Topics in Genetic Engineering and Society (Governance, Systems &amp; Modeling)</td>
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<td>GES 591</td>
<td>Special Topics in Genetic Engineering and Society (Genetic Engineering for Sustainable Crop Development)</td>
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Select one additional course below:

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<td>ANT 550</td>
<td>Culture, Ecology, and Sustainable Living</td>
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<td>BIT 410/510</td>
<td>Manipulation of Recombinant DNA</td>
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<td>COM 536</td>
<td>Environmental Communication</td>
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<td>ECG 540</td>
<td>Economic Development</td>
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<td>ENG 515</td>
<td>Rhetoric Of Science and Technology</td>
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<td>FW 411/511</td>
<td>Human Dimensions of Wildlife and Fisheries</td>
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<td>GN 735</td>
<td>Functional Genomics</td>
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<td>HI 540</td>
<td>American Environmental History</td>
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<td>HI 581</td>
<td>History of the Life Sciences</td>
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<td>HI 585</td>
<td>History of American Technology</td>
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<tr>
<td>NR 571</td>
<td>Current Issues in Natural Resource Policy</td>
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<tr>
<td>REL 571</td>
<td>Darwinism and Christianity</td>
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<td>PA 598/798</td>
<td>Special Topics in Public Administration (Science and Technology Policy)</td>
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<td>PHI 475/575</td>
<td>Ethical Theory</td>
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<td>PSY 757</td>
<td>Innovation and Technology</td>
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<tr>
<td>ST 590</td>
<td>Special Topics (Bioinformatics I/II)</td>
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Total Hours                                          12

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Full Professors

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Harry B. Moore Jr.
Herbert H. Neunzig
John F. Roberts
Robert L. Robertson
Kenneth A. Sorensen
Phillip S. Southern
Ronald Edwin Stinner
John W. VanDuyn
Charles Gerald Wright

Adjunct Professors
Nicholas M. Haddad

Food Science

The department's professional activities include teaching, research, and extension functions. The program provides an educational, research, and informational center in food science for North Carolina and the nation. The department also houses two research centers, the Southeast Dairy Foods Research Center and the Center for Advanced Processing and Packaging Studies. Course offerings and research opportunities are available in the following areas: chemistry-biochemistry, engineering, microbiology, nutrition and processing technology. The strategic directions of the faculty and staff are in the areas of: food safety and foodborne disease prevention; food manufacturing and entrepreneurship; instructional innovation and effectiveness; and, foods for health and well-being.

Admissions Requirements
To be admitted, a student should be a graduate of an accredited program in food science or the equivalent. Graduates of other majors can be admitted but will have additional course requirements. The best qualified applicants will be accepted up to the number of spaces that are available for new students. We only recommend admission to the M.S. or Ph.D. degree if a member of our research faculty is willing to advise the student's research. Applications from qualified candidates will be reviewed by faculty seeking research students; conversely applicants may contact faculty whose research specialty is of interest to inquire about available positions. Admission to the Master of Food Science will be based on the qualifications of the applicants.

Master's Degree Requirements
A Master's program must include courses from at least two of the following categories: chemistry-biochemistry, engineering, microbiology, nutrition and processing technology. The M. S. in Food Science requires 30 credit hours of course work and research. The Master of Food Science requires 36 credit hours of course work, including an independent project and professional skills.
Doctoral Degree Requirements
A doctoral program must include courses from at least three of the categories listed above (or equivalent courses at another university). Total course credits will vary depending on the needs of the student and the requirements of the Graduate School. All doctoral students are required to pass a departmentally administered written preliminary exam, designed to evaluate a Ph.D. student’s general knowledge and comprehension of food science.

Student Financial Support
Graduate assistantships and other forms of student aid available to students in this program are described elsewhere in the Graduate Catalog. Admission does not guarantee availability of financial support.

Other Relevant Information
Students are encouraged to make personal contact with individual faculty whose research program is of interest to them. Information describing each faculty member’s program is available at our website (http://ncsu.edu/foodscience/).

Degrees
• Food Science (MR) (p. 129)
• Food Science (MS) (p. 131)
• Food Science (PhD) (p. 132)
• Food Science (Minor) (p. 134)

Faculty
Full Professors
Jonathan C. Allen
Kenneth E. Anderson
Rodolphe Barrangou
Frederick Breidt
Benjamin James Chapman
Patricia Ann Curtis
Lisa Louise Dean
Mary Anne Drake
Mario Giovanni Ferruzzi
Scott A. Hale
Hosni Moustafa Hassan
Lee-Ann Jaykus
Sophia Kathariou
Saad A. Khan
Duane K. Larick
Mary Ann Lila
Richard Linton
K. P. Sandeep
Muquarrab Quresh
John Douglas Sheppard

Associate Professors
Ilenys Muniz Perez Diaz
April Fogleman
Lora Suzanne Goodell
Dana J. Hanson
Gabriel Keith Harris
Suzanne Dunn Johanningsmeier
Colin David Kay
Slavko Komarnytsky
Andrew Peter Neilson
Clinton Dale Stevenson

Assistant Professors
Alexander Vladimirovich Chouljenko
Natalie Kathleen Cooke
Marvin Leonel Moncada Reyes
Deepti Arvind Salvi
Ondulla Tyvette Toomer
Haotian Zheng

Practice/Research/Teaching Professors
Josip Simunovic
Fernanda Bottaro de Oliveira Santos

Emeritus Faculty
Sarah Liberman Ash
Leonard W. Aurand
Hershell R. Ball Jr
Leon Carl Boyd
Roy E. Carawan
Daniel E Carroll Jr
George L. Catignani
Edward Allen Foegeding
Food Science (MR)

Degree Requirements

<table>
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<td>Core Courses</td>
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<tr>
<td>FS 620</td>
<td>Special Problems In Food Science</td>
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<tr>
<td>or FS 693</td>
<td>Master's Supervised Research</td>
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<tr>
<td>FS 780</td>
<td>Seminar In Food Science</td>
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*Select courses from at least two categories listed under "Core Courses" below*

**Elective Courses**

Select a minimum of six courses of 500- to 700-level courses approved in conjunction with the academic committee – see "Elective Courses" listed below

**Total Hours**

**Core Courses**

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<td></td>
<td><strong>Engineering</strong></td>
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<td>FS 741</td>
<td>Thermal Processing of Foods</td>
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<tr>
<td></td>
<td><strong>Microbiology</strong></td>
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<td>FS 540</td>
<td>Food Safety and Public Health</td>
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<td>FS 725</td>
<td>Fermentation Microbiology</td>
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<td></td>
<td><strong>Nutrition</strong></td>
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<tr>
<td>FS 501</td>
<td>Advanced Nutrition and Metabolism</td>
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<td>FS 555</td>
<td>Exercise Nutrition</td>
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<td>NTR 701</td>
<td>Protein and Amino Acid Metabolism</td>
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<td>NTR 706</td>
<td>Vitamin Metabolism</td>
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<td>NTR 708</td>
<td>Energy Metabolism</td>
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<td>NTR 775</td>
<td>Mineral Metabolism</td>
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<td><strong>Processing Technology</strong></td>
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<td>FS 516</td>
<td>Quality Control in Food and Bioprocessing</td>
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<td>FS 522</td>
<td>Food Packaging</td>
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<td>FS 530</td>
<td>Post-Harvest Food Safety</td>
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<td>FS 535</td>
<td>Food Safety Management Systems</td>
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<td>FS 751</td>
<td>Food Ingredient Technology In Product</td>
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<td></td>
<td><strong>General Food Science</strong></td>
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<td>FS 520</td>
<td>Pre-Harvest Food Safety</td>
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<tr>
<td>FS 526</td>
<td>Upstream Biomanufacturing Laboratory</td>
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<td>FS 580</td>
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<td>FS 780</td>
<td>Seminar In Food Science</td>
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*Additional courses may be selected in conjunction with the academic committee*

**Elective Courses**

**Title**

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<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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Kenneth R. Swartzel
Van-Den Truong
### Food Science (MS)

#### Degree Requirements

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<td>FS 695</td>
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Select courses from at least two categories listed under "Core Courses" below

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<th>Code</th>
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<td><strong>Elective Courses</strong></td>
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Select a minimum of six courses of 500- to 700-level courses approved in conjunction with the academic committee – see "Elective Courses" listed below

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<td>FS 562</td>
<td>Postharvest Physiology</td>
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<tr>
<td>FS 580</td>
<td>Professional Development in Food Safety</td>
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**Total Hours**: 30

#### Core Courses

Select courses from at least two categories below:

- **Chemistry-Biochemistry**
  - FS 567 Sensory Analysis of Foods 3

- **Engineering**
  - FS 741 Thermal Processing of Foods 3

- **Microbiology**
  - FS 540 Food Safety and Public Health 3
  - FS 725 Fermentation Microbiology 3

- **Nutrition**
  - FS 501 Advanced Nutrition and Metabolism 3
  - FS 555 Exercise Nutrition 3
  - NTR 701 Protein and Amino Acid Metabolism 3
  - NTR 706 Vitamin Metabolism 3

### Elective Courses

Select a minimum of three courses listed below:

Additional courses may be selected in conjunction with the academic committee

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<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>FS 562</td>
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<td>FS 580</td>
<td>Professional Development in Food Safety</td>
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</tr>
</tbody>
</table>

#### Faculty

**Full Professors**

- Jonathan C. Allen
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Donn R. Ward

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Alejandro Amezquita
Pablo Marcelo Coronel
Christopher R. Daubert
Jack Parker Davis
Brian E. Farkas
Tawanda Muzhingi
Shengmin Sang
Ratna Rani Sharma
Richard C. Theuer

Food Science (PhD)

Degree Requirements

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Select one Research Ethics Course approved in conjunction with the academic committee

**Elective Courses**

Select a minimum of six courses of 500- to 700-level courses approved in conjunction with the academic committee – see "Elective Courses" listed below

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<th>Code</th>
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**Core Courses**

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<td></td>
<td><strong>Chemistry-Biochemistry</strong></td>
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<td></td>
<td><strong>Engineering</strong></td>
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<td>Thermal Processing of Foods</td>
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<td></td>
<td><strong>Microbiology</strong></td>
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<td>Food Safety and Public Health</td>
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<td>Fermentation Microbiology</td>
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<td>NTR 701</td>
<td>Protein and Amino Acid Metabolism</td>
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<td>Food Safety Management Systems</td>
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**Elective Courses**

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<td>FS 526</td>
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<tr>
<td>FS 580</td>
<td>Professional Development and Ethics in Food Safety</td>
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**Food Science (Minor)**

**Plan Requirements**

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<td>FS 505</td>
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<td>FS 516</td>
<td>Quality Control in Food and Bioprocessing</td>
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<td>FS 520</td>
<td>Pre-Harvest Food Safety</td>
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<td>FS 521</td>
<td>Food Preservation</td>
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<td>FS 522</td>
<td>Food Packaging</td>
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</tr>
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Horticultural Science

The Department offers graduate programs leading to the Master of Horticultural Science (non-thesis), Master of Science (thesis) and Doctor of Philosophy (thesis) degrees. Completion of the respective requirements normally takes 2 to 2 ½ years for the Masters and 3 to 3 ½ years for the Doctor of Philosophy. Studies may be oriented to floriculture, ornamental and landscape horticulture, pomology (fruit crops) or olericulture (vegetables). A variety of areas for study and research are available: plant physiology, breeding and genetics, herbicide physiology, nutrition, propagation, plant molecular biology and biotechnology, genomics, growth regulators, postharvest physiology, sustainable and organic agriculture, fruits, vegetables, floriculture, woody ornamentals, and landscape horticulture.

Facilities for graduate studies include 40,500 square feet of greenhouse space; the University Phytotron (available for controlled environmental studies on horticultural crops); 19 well-equipped laboratories; 14 controlled temperature storage rooms, an extensive collection of plant materials, both living and preserved; and a variety of climates and soils from coast to mountains in North Carolina on eighteen outlying research stations.

Admission to The Graduate School and the Department is competitive. Admission is usually limited to students with a grade point average of 3.00 or higher. Horticultural Science candidates should have completed course work in physics, mathematics (preferably calculus and statistics), chemistry, biochemistry, soils, plant pathology, genetics, plant physiology, entomology, genomics/bioinformatics, botany/plant biology, cellular biology, molecular biology and several courses in horticulture. Landscape Horticulture candidates should have a complete landscape design background. An applicant deficient in course work may be admitted on a provisional basis until the deficiency is made up. Applicants must provide the basic Graduate Record Examination (GRE) scores, three letters of reference, an unofficial transcript for each previous degree, a personal statement and resume/CV. Applicants from other countries must also furnish evidence of proficiency in English (TOEFL or IELTS). IELTS test date must be no older than two years (24 months) prior to the beginning of the requested entry term.

Financial assistance in the form of a Graduate Assistantship may be available for students accepted into the program. However, funding is limited and positions are highly competitive within a major professor’s program area. You should contact the faculty within the department that are working in your area of interest to inquire about assistantship availability. Students must have a confirmed advisor for admission to the program.

Degrees

- Horticultural Science (MR) (p. 137)
- Horticultural Science (MS) (p. 138)
- Horticultural Science (PhD) (p. 139)
- Horticultural Science (Certificate) (p. 141)
- Horticultural Science (Minor) (p. 139)

Faculty

Full Professors
Lucy K. Bradley
Wayne G. Buhler
Nancy G. Creamer
John Martin Dole
Gina E. Fernandez
William Carl Fonteno III
Christopher Gunter
Julia L. Kornegay
David W. Monks
Joseph C. Neal
Penelope M Perkins-Veazie
Thomas G. Ranney
Jonathan R. Schultheis
Todd Craig Wehner
Brian E Whipker
George C. Yencho

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Barbara Fair
Brian Eugene Jackson
Katherine Mary Jennings
Helen Tyler Kraus
Anthony V. Lebude
Dilip Raj Panthee
Michael L. Parker
Julieta Trevino Sherk
Anne McCombe Spafford

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Ricardo Hernandez
Mark Hoffmann
Massimo Iorizzo
Thomas Matthew Kon
Wusheng Liu

Practice/Research/Teaching Professors
Danesha Gita Seth Carley
Rebecca Diane Dunning

Horticultural Science (MR)

Degree Requirements

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<tr>
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<th>Title</th>
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<td>ST 511</td>
<td>Statistical Methods For Researchers I (^1)</td>
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<td>Statistical Methods For Researchers II (^1)</td>
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<tr>
<td>HS 703</td>
<td>Breeding Asexually Propagated Crops</td>
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<tr>
<td>HS 704</td>
<td>Plant Nomenclature</td>
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<tr>
<td>HS 705</td>
<td>Physiology Of Flowering</td>
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<td>HS 707</td>
<td>Environmental Stress Physiology</td>
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<tr>
<td>CS 717</td>
<td>Weed Management Systems</td>
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<tr>
<td>or HS 717</td>
<td>Weed Management Systems</td>
<td></td>
</tr>
<tr>
<td>CS 725</td>
<td>Pesticide Chemistry</td>
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<td>or HS 725</td>
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Additional Courses \(^3\)
Additional Courses are determined in conjunction with the academic committee to meet the 36 total hours

Total Hours 36

\(^1\) Students have the option to take courses equivalent to ST 511 and ST 512 determined in conjunction with the academic committee.

\(^2\) Core Courses are optional and may be substituted with courses determined in conjunction with the academic committee.

\(^3\) At least 18 of the 36 credit hours must be letter-graded coursework at the 500- and 700-levels.

Faculty

Full Professors
Lucy K. Bradley
Wayne G. Buhler
Nancy G. Creamer
John Martin Dole
Gina E. Fernandez
William Carl Fonteno III
Christopher Gunter
Julia L. Kornegay
David W. Monks
Joseph C. Neal
Penelope M Perkins-Veazie
Thomas G. Ranney
Jonathan R. Schultheis
Todd Craig Wehner
Brian E Whipker
George C. Yencho

Associate Professors
Jeanine M. Davis
Barbara Fair
Brian Eugene Jackson
Katherine Mary Jennings
Helen Tyler Kraus
Anthony V. Lebude
Dilip Raj Panthee
Michael L. Parker
Julieta Trevino Sherk
Anne McCombe Spafford
**Assistant Professors**

Hamid Ashrafi

Ricardo Hernandez

Mark Hoffmann

Massimo Iorizzo

Thomas Matthew Kon

Wusheng Liu

**Practice/Research/Teaching Professors**

Danesha Gita Seth Carley

Rebecca Diane Dunning

**Horticultural Science (MS)**

**Degree Requirements**

<table>
<thead>
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<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<td>ST 512</td>
<td>Statistical Methods For Researchers II</td>
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<td>Select four of the following courses:</td>
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<td>HS 703</td>
<td>Breeding Asexually Propagated Crops</td>
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<td>HS 704</td>
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<tr>
<td>HS 705</td>
<td>Physiology Of Flowering</td>
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<tr>
<td>HS 707</td>
<td>Environmental Stress Physiology</td>
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<tr>
<td>CS 717</td>
<td>Weed Management Systems</td>
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<td>or HS 717</td>
<td>Weed Management Systems</td>
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<tr>
<td>CS 725</td>
<td>Pesticide Chemistry</td>
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<td>or HS 725</td>
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<td>Additional Courses are determined in conjunction with the academic committee to meet the 30 total hours</td>
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**Total Hours** 26

1 Students have the option to take courses equivalent to ST 511 and ST 512 determined in conjunction with the academic committee.

2 The course credit hours must meet the following requirements: 20 credit hours at 500-700 level, 6 credit hours at 700 level, and 18 letter-graded credit hours.

**Faculty**

**Full Professors**

Lucy K. Bradley

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Mark Hoffmann

Massimo Iorizzo

Thomas Matthew Kon

Wusheng Liu

**Practice/Research/Teaching Professors**

Danesha Gita Seth Carley
Rebecca Diane Dunning

Horticultural Science (PhD)

Degree Requirements

<table>
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<tr>
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<td>Professional Presentation Skills in Horticultural Science</td>
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| Core Courses | 3 |
| Select three of the following courses: | |
| HS 703 | Breeding Asexually Propagated Crops | |
| HS 704 | Plant Nomenclature | |
| HS 705 | Physiology Of Flowering | |
| HS 707 | Environmental Stress Physiology | |
| HS 717 | Weed Management Systems | or CS 717 Weed Management Systems |
| HS 725 | Pesticide Chemistry | or CS 725 Pesticide Chemistry |

| Additional Courses | 64 |
| Additional Courses are determined in conjunction with the academic committee to meet the 72 total hours | |

Total Hours 72

1 Students must complete a minimum of 20 credit hours at 500 - 800-level courses; at least 18 credit hours must be letter-graded coursework.

Faculty

Full Professors

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Wayne G. Buhler
Nancy G. Creamer
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Ricardo Hernandez
Mark Hoffmann
Massimo Iorizzo
Thomas Matthew Kon
Wusheng Liu

Practice/Research/Teaching Professors

Danesha Gita Seth Carley
Rebecca Diane Dunning

Horticultural Science (Minor)

Plan Requirements

Master's Requirements

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<td>400+ Level HS Courses</td>
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<tr>
<td>500+ Level HS Courses</td>
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Total Hours 9

PhD Requirements

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<td>500+ Level HS Courses</td>
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Total Hours 9
## Horticultural Science Courses

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<td>Residential Landscaping</td>
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<td>HS 410</td>
<td>Community Food Systems</td>
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<tr>
<td>HS 411</td>
<td>Nursery Management</td>
<td>3</td>
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<tr>
<td>HS 416</td>
<td>Planting Design</td>
<td>4</td>
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<tr>
<td>HS 418</td>
<td>Digital Media Graphic for Landscape Designers</td>
<td>3</td>
</tr>
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<td>HS 420</td>
<td>Green Infrastructure</td>
<td>3</td>
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<td>HS 421</td>
<td>Temperate-Zone Tree Fruits: Physiology and Culture</td>
<td>3</td>
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<tr>
<td>HS 422</td>
<td>Small Fruit Production</td>
<td>3</td>
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<td>HS 423</td>
<td>Viticulture</td>
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<td>HS 428</td>
<td>Service-Learning in Urban Agriculture Systems</td>
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<td>HS 431</td>
<td>Vegetable Production</td>
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<td>HS 432</td>
<td>Introduction to Permaculture</td>
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<td>HS 433</td>
<td>Public Garden Administration</td>
<td>3</td>
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<tr>
<td>HS 440</td>
<td>Greenhouse Management</td>
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<td>HS 442</td>
<td>Floriculture Crop Production</td>
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<td>HS 451</td>
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<td>HS 462</td>
<td>Postharvest Physiology</td>
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<td>HS 471</td>
<td>Landscape Ecosystem Management</td>
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<td>HS 475</td>
<td>Horticulture Entrepreneurship</td>
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<td>HS 476</td>
<td>Crop Physiology and Production in Controlled Environments</td>
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<td>HS 480</td>
<td>Sustainable Food Production (capstone)</td>
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<td>HS 491</td>
<td>Sustainable Agriculture Entrepreneurship Study Abroad</td>
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<td>HS 492</td>
<td>Horticulture Internship</td>
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<td>HS 493</td>
<td>Research Experience in Horticultural Science</td>
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<td>Teaching Experience in Horticultural Science</td>
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<td>Experimental Courses in Horticultural Science</td>
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<td>HS 502</td>
<td>Plant Disease: Methods &amp; Diagnosis</td>
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<td>HS 516</td>
<td>Planting Design</td>
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<tr>
<td>HS 520</td>
<td>Green Infrastructure</td>
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<tr>
<td>HS 521</td>
<td>Temperate-Zone Tree Fruits: Physiology and Culture</td>
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<td>HS 523</td>
<td>Viticulture</td>
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<td>HS 532</td>
<td>Introduction to Permaculture</td>
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<td>HS 533</td>
<td>Public Garden Administration</td>
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<td>Plant Breeding Methods</td>
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<td>Environmental Nursery Production</td>
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<td>Plant Nutrition</td>
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<td>HS 562</td>
<td>Postharvest Physiology</td>
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<td>HS 576</td>
<td>Crop Physiology and Production in Controlled Environments</td>
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<td>HS 583</td>
<td>Advanced Floral Crop Production and Handling</td>
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<td>HS 590</td>
<td>Special Problems in Horticultural Science</td>
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<td>Professional Presentation Skills in Horticultural Science</td>
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<td>HS 610</td>
<td>Special Topics in Horticultural Science</td>
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<td>HS 615</td>
<td>Advanced Special Topics</td>
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<td>Non-Thesis Masters Continuous Registration - Half Time Registration</td>
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<td>HS 702</td>
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<td>Breeding Asexually Propagated Crops</td>
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<td>Physiology Of Flowering</td>
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<td>Fruit Development and Postharvest Physiology</td>
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<td>Weed Management Systems</td>
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<td>Molecular Biology In Plant Breeding</td>
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<td>HS 727</td>
<td>Pesticide Behavior and Fate In the Environment</td>
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<td>Herbicide Behavior In Plants</td>
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<td>HS 745</td>
<td>Quantitative Genetics In Plant Breeding</td>
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<td>Cytogenetics in Plant Breeding</td>
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<tr>
<td>HS 899</td>
<td>Doctoral Dissertation Preparation</td>
<td>1-9</td>
</tr>
</tbody>
</table>

### Faculty

#### Full Professors

- **Lucy K. Bradley**
- **Wayne G. Buhler**
- **Nancy G. Creamer**
- **John Martin Dole**
- **Gina E. Fernandez**
- **William Carl Fonteno III**
- **Christopher Gunter**
- **Julia L. Kornegay**
- **David W. Monks**
Horticultural Science (Certificate)

The Graduate Certificate is a non-degree, designed to increase personal knowledge and skills for current or future employment in the horticulture industry. Earning the Graduate Certificate requires completing a minimum of 15 credit hours (usually equaling 5 courses) of coursework. Courses may be taken either on-line or face-to-face.

Participants must hold a bachelor’s degree to enroll in this program. Graduate Certificate applicants should have majored in horticulture, crop science, plant science, or agricultural education with a concentration in plant science, or another closely related degree. Students may begin taking courses for the graduate certificate in Summer, Fall, or Spring. All graduate certificate course work must be completed within four years of enrollment.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
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<td>HS 502</td>
<td>Plant Disease: Methods &amp; Diagnosis</td>
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<td>HS 516</td>
<td>Planting Design</td>
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</tr>
<tr>
<td>HS 520</td>
<td>Green Infrastructure</td>
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<tr>
<td>HS 521</td>
<td>Temperate-Zone Tree Fruits: Physiology and Culture</td>
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<tr>
<td>HS 523</td>
<td>Viticulture</td>
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<tr>
<td>HS 532</td>
<td>Introduction to Permaculture</td>
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<td>HS 533</td>
<td>Public Garden Administration</td>
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<td>HS/CS 541</td>
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<td>Plant Nutrition</td>
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<td>HS 601</td>
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<td>Plant Nomenclature</td>
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<td>HS 705</td>
<td>Physiology Of Flowering</td>
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<td>HS 707</td>
<td>Environmental Stress Physiology</td>
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<tr>
<td>HS 717</td>
<td>Weed Management Systems</td>
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<td>HS 725</td>
<td>Pesticide Chemistry</td>
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<td>HS 727</td>
<td>Pesticide Behavior and Fate In the Environment</td>
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</table>

* Courses taught online
1 Students must take courses that meet the following requirements: must be at 500-level or higher, letter-graded, passed with a B or better
2 Students can select a maximum of 6 hours from the following subjects: ARE, AEE, BAE, CS, ENT, FS, PP, SCC; courses must be at 400-level or higher.
as foundational courses in microbiology, business management and molecular biology.

**Admission Requirements**

Applications are invited from individuals holding B.S. or M.S. degrees in the physical and life sciences. Applications should be received before May 1 to be considered for Fall semester admission. The Graduate Record Exam (GRE) is required and should be taken sufficiently early so that scores can be submitted and evaluated along with the application. Other requirements include all relevant transcripts, three letters of recommendation and a personal statement that describes the applicant’s career goals as well as why they are pursuing the MMB degree.

**Master’s Degree Requirements**

The Master of Microbial Biotechnology (MMB) degree requires 40 credit hours, including four semesters involvement in an Industry Case Studies course, as well as a summer industry internship. This program also can be combined with a Master of Business Administration (MBA) offered through the College of Management.

**Student Financial Support**

A limited number of full-time participants in the Master of Microbial Biotechnology program may be eligible for Teaching Assistantships. The number of TA positions available varies every semester and there are no guaranteed positions. Students in the MMB program should assume that they will self-fund their education.

**Degrees**

- Microbial Biotechnology (MR) (p. 142)

**Faculty**

**Full Professors**

Jose Bruno-Barcena
Amy Michele Grunden
Christine Hawkes
Michael Hyman
Scott M. Laster
Eric S. Miller

**Associate Professors**

Paul T. Hamilton

**Assistant Professors**

Manuel Kleiner

**Adjunct Faculty**

Jason Caplan

---

### Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
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<tr>
<td><strong>Microbiology / Science Core Courses</strong></td>
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<tr>
<td>Select two of the following courses:</td>
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<tr>
<td>MB 555</td>
<td>Microbial Biotechnology</td>
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<tr>
<td>MB 714</td>
<td>Microbial Metabolic Regulation (Recommended)</td>
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<tr>
<td>MB 751</td>
<td>Immunology</td>
<td></td>
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<tr>
<td>MB 758</td>
<td>Microbial Genetics &amp; Genomics</td>
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<tr>
<td>MB 590</td>
<td>Topical Problems (Environmental Microbiology and Biotechnology)</td>
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<tr>
<td>PB 580</td>
<td>Introduction to Plant Biotechnology</td>
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<td><strong>Science Elective</strong></td>
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<tr>
<td><strong>Internship Course</strong></td>
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<tr>
<td>MB 620</td>
<td>Special Problems</td>
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<tr>
<td><strong>Industrial Case Studies</strong></td>
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<tr>
<td>MB 585</td>
<td>Industry Case Studies in Microbial Biotechnology</td>
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<tr>
<td>MB 590</td>
<td>Topical Problems</td>
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<tr>
<td><strong>Biotechnology (BIT) / Biomanufacturing (BEC) Core Courses</strong></td>
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<tr>
<td>BIT 510</td>
<td>Core Technologies in Molecular and Cellular Biology</td>
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<td>BEC 540</td>
<td>Expression Systems in Biomanufacturing 1</td>
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<td><strong>BIT or BEC Electives</strong></td>
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<tr>
<td>Select two courses from “Biotechnology (BIT) and Biomanufacturing (BEC) Electives” listed below</td>
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<td><strong>Business Core Course</strong></td>
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<tr>
<td>MBA 585</td>
<td>Current Topics in BioSciences Management</td>
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<tr>
<td><strong>MBA Electives</strong></td>
<td></td>
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<tr>
<td>Select two courses from “Master of Business Administration (MBA Electives)” listed below</td>
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</tbody>
</table>

Total Hours 40-41

1. Incoming students may be able to opt out of this requirement if they can provide sufficient evidence that indicates basic experience and understanding of technologies including recombinant DNA procedures, gene expression, isolation and identification of nucleic acids and proteins. Evidence may include a letter from current or former supervisors and/or professors attesting that the applicant possesses at least basic understanding and experience. Applicants with doctoral training in a related area may opt out of BIT 510 OR BEC 540, with MMB approval.

### Science Electives

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select one course below</td>
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<tr>
<td>Biological and Agricultural Engineering (BAE)</td>
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<tr>
<td>BAE 525</td>
<td>Industrial Microbiology and Bioprocessing</td>
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<tr>
<td>BAE 528</td>
<td>Biomass to Renewable Energy Processes</td>
<td>3</td>
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<tr>
<td>Biochemistry (BCH)</td>
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<tr>
<td>BCH 553</td>
<td>Biochemistry of Gene Expression</td>
<td>3</td>
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<tr>
<td>BCH 555</td>
<td>Proteins and Molecular Mechanisms</td>
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<td>BCH 571</td>
<td>Regulation of Metabolism</td>
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</tr>
<tr>
<td>BCH 701</td>
<td>Macromolecular Structure</td>
<td>3</td>
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</table>
BCH 703 Macromolecular Synthesis and Regulation 3
BCH 705 Molecular Biology Of the Cell 3
BCH 751 Biophysical Chemistry 3

Comparative Biomedical Sciences (CBS)
CBS 565 Fundamentals of Biomedical Sciences 3

Food Science (FS)
FS 502 Chemistry of Food and Bioprocessed Materials 4
FS 553 Food Laws and Regulations 3

Genetics (GN)
GN 521 Molecular Genetics 3
GN 730 Fungal Genetics and Physiology 3
GN 735 Functional Genomics 3

Microbiology (MB)
MB 501 Biology of Plant Pathogens 3
MB 505 Food Microbiology 3
MB 532 Soil Microbiology 4
MB 575 Introduction to Mycology 4
MB 718 Introductory Virology 3
MB 725 Fermentation Microbiology 3
MB 730 Fungal Genetics and Physiology 3
MB 751 Immunology 3
MB 758 Microbial Genetics & Genomics 3
MB 774 Phycology 3

Plant Biology (PB)
PB 580 Introduction to Plant Biotechnology 3

Plant Pathology (PP)
PP 530 Agriculture, Ethics and the Environment 3

Statistics (ST)
ST 511 Statistical Methods For Researchers I 3
ST 512 Statistical Methods For Researchers II 3
ST 513 Statistics for Management I 3
ST 520 Statistical Principles of Clinical Trials 3

Toxicology (TOX)
TOX 515 Environmental Toxicology 4
TOX 710 Molecular and Biochemical Toxicology 3

Biotechnology (BIT) and Biomanufacturing (BEC) Electives

Select two courses below

Biotechnology (BIT)
BIT 501 Ethical Issues in Biotechnology 1
BIT 562 Gene Expression Analysis: Microarrays 2
BIT 563 Fermentation of Recombinant Microorganisms 2
BIT 564 Protein Purification 2
BIT 565 Real-time PCR Techniques 2
BIT 566 Animal Cell Culture Techniques 2
BIT 567 PCR and DNA Fingerprinting 2
BIT 568 Genome Mapping 2
BIT 569 RNA Purification and Analysis 2
BIT 581 Plant Transformation 2
BIT 595 Special Topics 1-6

Biomanufacturing (BEC)
MB 520 Fundamentals of Microbial Cell Biotransformations 2
BEC 532 Biological Processing Science 2
BEC 536 Introduction to Downstream Process Development 2
BEC 575 Global Regulatory Affairs for Medical Products 3
BEC 580 cGMP Fermentation Operations 2
BEC 585 cGMP Downstream Operations 2
BEC 595 Special Topics in Biomanufacturing 1-6

Master of Business Administration (MBA) Electives

Select two courses below

MBA 505 Essential Economics for Managers 2
MBA 530 Leading People 3
BUS 554 Project Management 3
MBA 555 Product Design and Development 4
MBA 570 Opportunity Evaluation and Value Creation 3
MBA 576 Technology Entrepreneurship and Commercialization I 3
MBA 577 Technology Entrepreneurship and Commercialization II 3
MBA 586 Legal, Regulatory and Ethical Issues in Life Science Industries 3
MBA 590 Special Topics In Business Management 1-6

Faculty

Full Professors
Jose Bruno-Barcena
Amy Michele Grunden
Christine Hawkes
Michael Hyman
Scott M. Laster
Eric S. Miller

Associate Professors
Paul T. Hamilton

Assistant Professors
Manuel Kleiner

Adjunct Faculty
Jason Caplan
Microbiology

Microbiology is an integral part of the life science and biotechnology disciplines across the North Carolina State University campus. The Microbiology Graduate Program involves research and education in laboratories and departments that form inter-disciplinary teams to address critical, global challenges for science and society. The MGP (http://harvest.cals.ncsu.edu/microbiology/) offers courses of study and research leading to the Ph.D., M.S., Master of Microbiology (M.M.) and Master of Microbial Biotechnology (M.M.B.) degrees.

The research-based degrees (M.S and Ph.D.) offered by the program are designed to prepare students for careers in academic, industrial or research institute settings. Course offerings for Microbiology research students focus on microbial genetics and physiology, bioprocessing and fermentation, biotechnology, virology, immunology and host-pathogen interactions. Research throughout the program is diverse, emphasizing most areas where microbes, viruses and systems biology have relevance to basic science and biotechnology. Research opportunities for students involve many areas of specialization including biofuels, bioremediation, environmental microbiology, antibiotic resistance, extremophiles, bacterial pathogens, probiotics, developmental epigenetics, bacteriophages, inflammation modulation and viral pathogenesis; the list is long and broad. Financial support for study towards Ph.D. and M.S. degrees is limited, but can be available in the form of teaching/research assistantships and competitive fellowships.

The non-research-based Masters of Microbial Biotechnology (MMB) is a Professional Science Masters degree that combines concentrations in Microbiology, Business and Biotechnology. This degree is specifically designed to prepare students for positions in the biotechnology, biopharmaceutical and agribusiness industries. The program includes courses that involve semester-long interactions with local biotechnology companies as well as foundational courses in microbiology, business management and molecular biology. The M.M. degree is a rigorous non-thesis degree that is designed for students who want a higher degree in microbiology but do not want to conduct research or are unable to commit to the time demands of a research degree. Many students in the M.M. program either work for local employers or are interested in subsequent applications to professional schools. Financial support is extremely limited for either M.M.B or M. M. students.

Admission Requirements

Applications are invited from individuals holding B.S. or M.S. degrees in the physical and life sciences. Applications should be received in the department before January 15 to be considered for Fall semester admission. The Graduate Record Exam (GRE) is required and should be taken sufficiently early so that scores can be submitted and evaluated along with the application. Other requirements include all relevant transcripts, three letters of recommendation and a personal statement that describes the applicant's academic and career goals as well as their area of interest.

Master's Degree Requirements

The Master of Science (M.S.) requires 30 credit hours, of which 18 must be graded, a written thesis and at least one semester of laboratory teaching experience. The Master of Microbial Biotechnology (M.M.B.; http://harvest.cals.ncsu.edu/master-of-microbial-biotechnology/mmb/) degree requires 40 credit hours and four semesters involvement in an Industry Case Studies course, as well as a summer industry internship. This program also can be combined with a Master of Business Administration (M.B.A.) offered through the College of Management. The Master of Microbiology (M.M.) requires 30 credit hours, of which 18 must be graded, but has no requirement for a written thesis or laboratory instruction.

Doctoral Degree Requirements

The Ph.D. program (http://harvest.cals.ncsu.edu/microbiology/) is designed for individuals desiring to pursue careers in research and/or teaching. Prospective Ph.D. and M.S. students should become aware of departmental research programs and faculty so that an area of specialization is indicated in the application materials (personal statement). A faculty dissertation advisor and laboratory research program are confirmed at admission or by the end of the first semester. In conjunction with the advisor, the student establishes a four-member faculty advisory committee to guide the research and academic program. At least one semester of teaching assistance / experience is required. A preliminary examination is held soon after completing the second year of study, and the final examination includes a seminar presented by the candidate that is open to the university community.

Student Financial Support

All Ph.D. and M.S. applications to the Microbiology Graduate Program are considered for available assistantships. For highly qualified students, supplemental funds are frequently available. There is limited funding available for international students given the structure of the NC State University Graduate Student Support Plan.

Degrees

- Microbiology (MR) (p. 145)
- Microbiology (MS) (p. 147)
- Microbiology (PhD) (p. 148)
- Microbiology (Minor) (p. 150)

Faculty

Full Professors

Prema Arasu
Rodolphe Barrangou
Frederick Breidt
Dennis T. Brown
James W. Brown
Susan B. Carson
Mari S. Chinn
Marc A. Cubeta
Robert R. Dunn
Frederick J. Fuller
Amy Michele Grunden
Hosni Moustafa Hassan
Christine Veronica Hawkes
Shuijin Hu
Michael Hyman
Lee-Ann Jaykus
Sophia Kathariou
Robert M. Kelly
Matthew D. Koci
Scott M. Laster
Hsiao-Ching Liu
John M. Mackenzie Jr.
Eric S. Miller
Ian T. Petty
Barbara Sherry
Siddhartha Thakur
Jeffrey A. Yoder

**Associate Professors**

Jose Manuel Bruno-Barcena
Nicolas Emile Buchler
Jonathan E. Fogle
Reza A. Ghiladi
Paul T. Hamilton
Megan E. Jacob
Cristina Lanzas
Jonathan W. Olson
Joshua Glenn Pierce
Frank Scholle
Michael L. Sikes
Robert G. Upchurch
Gavin John Williams

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Wei-Chen Chang
Nathan Crook

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Ilenys Muniz Perez Diaz
Casey Michelle Theriot

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Gerald Hugh Elkan
Michael Carl Flickinger
Todd Robert Klaenhammer
Wesley Edwin Kloos
Geraldine Luginbuhl
Paul E. Omdorff
Leo W. Parks
Jason C. Shih

**Adjunct Faculty**

James M. Ligon
Scott Harold Shore
Daniel van der Leie

**Microbiology (MR)**

**Degree Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
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<tbody>
<tr>
<td>Core Courses</td>
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</table>

Select at least four of the following courses:

- MB 535 Bacterial Pathogenesis
- MB 714 Microbial Metabolic Regulation
- MB 718 Introductory Virology
- MB 751 Immunology
- MB 758 Microbial Genetics & Genomics

**Elective Courses**

“Elective Courses” are determined in conjunction with the academic committee to meet the 30 total hours

**Additional Requirements**

- An annual “Graduate Student Progress” evaluation form is completed by the student with his/her advisor and submitted to the Director of Graduate Programs (DGP)
• An overall grade point average of at least 3.00 on graduate course work at NCSU is required

Faculty

Full Professors
Prema Arasu
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Dennis T. Brown
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Mari S. Chinn
Marc A. Cubeta
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Megan E. Jacob
Cristina Lanzas
Jonathan W. Olson
Joshua Glenn Pierce
Frank Scholle
Michael L. Sikes
Robert G. Upchurch
Gavin John Williams

Adjunct Faculty
James M. Ligon
Microbiology (MS)

Degree Requirements

Students may choose from the Microbiology course tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: “Master of Science in Microbiology” without focus area track specifications.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>MB 590</td>
<td>Topical Problems (Professional Development)</td>
<td>1-3</td>
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<tr>
<td>MB 695</td>
<td>Master’s Thesis Research (6 credits minimum)</td>
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</table>

Microbiology Courses

See “Microbiology Courses” listed below

Professional Development course

“Professional Development Course” is determined in conjunction with the academic committee

Elective Courses

See “Elective Courses” listed below

Total Hours 30

Microbiology Courses

The field of Microbiology includes several specialized disciplines such as bacterial physiology, microbial genomics and metagenomics, microbiomes, environmental microbiology, immunology, host-pathogen interactions, molecular genetics and virology. At NC State, M.S. students can take courses that represent, and focus on, the various disciplines of Microbiology. Example courses, fitting into two microbiology “tracks” or focus areas are:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>MB 520</td>
<td>Fundamentals of Microbial Cell Biotransformations</td>
<td>2</td>
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<td>MB 532</td>
<td>Soil Microbiology</td>
<td>4</td>
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<tr>
<td>MB 555</td>
<td>Microbial Biotechnology</td>
<td>3</td>
</tr>
<tr>
<td>MB 590</td>
<td>Topical Problems</td>
<td>1-3</td>
</tr>
<tr>
<td>MB 505</td>
<td>Food Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>MB 714</td>
<td>Microbial Metabolic Regulation</td>
<td>3</td>
</tr>
<tr>
<td>MB 725</td>
<td>Fermentation Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>MB 758</td>
<td>Microbial Genetics &amp; Genomics</td>
<td>3</td>
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</table>

Host-Pathogen Interactions Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>MB 535</td>
<td>Bacterial Pathogenesis</td>
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</tr>
<tr>
<td>MB 718</td>
<td>Introductory Virology</td>
<td>3</td>
</tr>
<tr>
<td>MB 751</td>
<td>Immunology</td>
<td>3</td>
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<tr>
<td>BCH 553</td>
<td>Biochemistry of Gene Expression</td>
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<td>BCH 705</td>
<td>Molecular Biology Of the Cell</td>
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<td>BMA 771/772</td>
<td>Biomathematics I</td>
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<td>CBS 712</td>
<td>Reproductive Management and Disease in Domestic Animals</td>
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<td>ENT 582</td>
<td>Medical and Veterinary Entomology</td>
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<td>PP 707</td>
<td>Plant Microbe Interactions</td>
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</tr>
<tr>
<td>ST 511/512</td>
<td>Statistical Methods For Researchers I</td>
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Elective Courses

Selection of elective courses is done by the student, in consultation with and approval by the advisory committee.

<table>
<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>BAE 525</td>
<td>Industrial Microbiology and Bioprocessing</td>
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<tr>
<td>BCH 553</td>
<td>Biochemistry of Gene Expression</td>
<td>3</td>
</tr>
<tr>
<td>BCH 701</td>
<td>Macromolecular Structure</td>
<td>3</td>
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<tr>
<td>BCH 703</td>
<td>Macromolecular Synthesis and Regulation</td>
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</tr>
<tr>
<td>BCH 705</td>
<td>Molecular Biology Of the Cell</td>
<td>3</td>
</tr>
<tr>
<td>BIT 510</td>
<td>Core Technologies in Molecular and Cellular Biology</td>
<td>4</td>
</tr>
<tr>
<td>BIT 595</td>
<td>Special Topics</td>
<td>1-6</td>
</tr>
<tr>
<td>GN 701</td>
<td>Molecular Genetics</td>
<td>3</td>
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<td>GN 735</td>
<td>Functional Genomics</td>
<td>3</td>
</tr>
<tr>
<td>GN 850</td>
<td>Professionalism and Ethics</td>
<td>1</td>
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<tr>
<td>MB/PP 730</td>
<td>Fungal Genetics and Physiology</td>
<td>3</td>
</tr>
<tr>
<td>MB 610</td>
<td>Special Topics Microbiology</td>
<td>1-6</td>
</tr>
<tr>
<td>MB 620</td>
<td>Special Problems</td>
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<tr>
<td>MB 601/801</td>
<td>Seminar</td>
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<tr>
<td>MB 690/890</td>
<td>Master's Examination</td>
<td>1-9</td>
</tr>
<tr>
<td>MB 695/895</td>
<td>Master's Thesis Research</td>
<td>1-9</td>
</tr>
<tr>
<td>MB/IMM 783</td>
<td>Advanced Immunology</td>
<td>3</td>
</tr>
<tr>
<td>MB 790</td>
<td>Topical Problems (Practical Digital Imaging)</td>
<td>1-3</td>
</tr>
</tbody>
</table>

Additional Requirements

• 18 credits must be graded
• All graduate students must maintain a minimum cumulative grade point average of 3.0
• The program is completed upon submission of a thesis and completion of all credit requirements

Faculty

Full Professors

Prema Arasu
Rodolphe Barrangou
Frederick Breidt
Dennis T. Brown
James W. Brown
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Geraldine Luginbuhl
Paul E. Orndorff
Leo W. Parks
Jason C. Shih

Adjunct Faculty
James M. Ligon
Scott Harold Shore
Daniel van der Lelie

Microbiology (PhD)
Degree Requirements
Students may choose from the Microbiology course tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: "Doctor of Philosophy in Microbiology" without focus area track specifications.

<table>
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<tr>
<td>MB 801</td>
<td>Seminar</td>
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</tr>
<tr>
<td>MB 870</td>
<td>Doctoral Lab Rotations</td>
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</table>
Microbiology Courses

For the Ph.D., 12 MB graded graduate credits must be taken. These courses can be chosen for breadth in microbiology or may focus on a sub-discipline of microbiology. Example courses fitting into two microbiology “tracks” or focus areas are:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB 520</td>
<td>Fundamentals of Microbial Cell Biotransformations</td>
<td>2</td>
</tr>
<tr>
<td>MB 532</td>
<td>Soil Microbiology</td>
<td>4</td>
</tr>
<tr>
<td>MB 555</td>
<td>Microbial Biotechnology</td>
<td>3</td>
</tr>
<tr>
<td>MB 590</td>
<td>Topical Problems</td>
<td>1-3</td>
</tr>
<tr>
<td>MB 505</td>
<td>Food Microbiology</td>
<td>3</td>
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<tr>
<td>MB 714</td>
<td>Microbial Metabolic Regulation</td>
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<td>MB 725</td>
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<td>Microbial Genetics &amp; Genomics</td>
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<tr>
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</tr>
<tr>
<td>MB 751</td>
<td>Immunology</td>
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<tr>
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<tr>
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<td>Molecular Biology Of the Cell</td>
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<tr>
<td>BMA 771/772</td>
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<tr>
<td>CBS 712</td>
<td>Reproductive Management and Disease in Domestic Animals</td>
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<tr>
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<td>PP 707</td>
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<td>ST 511/512</td>
<td>Statistical Methods For Researchers I</td>
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Host-Pathogen Interactions Track

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<td>PP 707</td>
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<tr>
<td>ST 511/512</td>
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Elective Courses

Selection of elective courses is done by the student, in consultation with and approval by the advisory committee.

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<th>Code</th>
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<td>BCH 701</td>
<td>Macromolecular Structure</td>
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<td>BIT 510</td>
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<tr>
<td>BIT 595</td>
<td>Special Topics</td>
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Additional Requirements

- 12 MB credits must be graded
- All graduate students must maintain a minimum cumulative grade point average of 3.0

Faculty

Full Professors

- Prema Arasu
- Rodolphe Barrangou
- Frederick Breidt
- Dennis T. Brown
- James W. Brown
- Susan B. Carson
- Mari S. Chinn
- Marc A. Cubeta
- Robert R. Dunn
- Frederick J. Fuller
- Amy Michele Grunden
- Hosni Moustafa Hassan
- Christine Veronica Hawkes
- Shuijin Hu
- Michael Hyman
- Lee-Ann Jaykus
- Sophia Kathariou
- Robert M. Kelly
- Matthew D. Koci
- Scott M. Laster
- Hsiao-Ching Liu
- John M. Mackenzie Jr.
Microbiology (Minor)

Eric S. Miller
Ian T. Petty
Barbara Sherry
Siddhartha Thakur
Jeffrey A. Yoder

Associate Professors
Jose Manuel Bruno-Barcena
Nicolas Emile Buchler
Jonathan E. Fogle
Reza A. Ghiladi
Paul T. Hamilton
Megan E. Jacob
Cristina Lanzas
Jonathan W. Olson
Joshua Glenn Pierce
Frank Scholle
Michael L. Sikes
Robert G. Upchurch
Gavin John Williams

Assistant Professors
Oliver Baars
Benjamin John Callahan
Wei-Chen Chang
Nathan Crook
Angela Rose Harris
Manuel Kleiner
Ryan William Paerl
Ilenys Muniz Perez Diaz
Casey Michelle Theriot

Emeritus Faculty
Paul Edward Bishop
James W. Brown
Walter J. Dobrogosz
Gerald Hugh Eikan

Michael Carl Flickinger
Todd Robert Klaenhammer
Wesley Edwin Kloos
Geraldine Luginbuhl
Paul E. Omdorff
Leo W. Parks
Jason C. Shih

Adjunct Faculty
James M. Ligon
Scott Harold Shore
Daniel van der Lelie

Microbiology (Minor)

Plan Requirements

<table>
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</table>

“Microbiology Courses” are approved in conjunction with the academic committee to meet the 6 total hours

Total Hours 6

Faculty

Full Professors
Prema Arasu
Rodolphe Barrangou
Frederick Breidt
Dennis T. Brown
James W. Brown
Susan B. Carson
Mari S. Chinn
Marc A. Cubeta
Robert R. Dunn
Frederick J. Fuller
Amy Michele Grunden
Hosni Moustafa Hassan
Christine Veronica Hawkes
Shuijin Hu
Michael Hyman

Lee-Ann Jaykus
The Interdepartmental Nutrition Program consists of faculty from multiple departments, including: Animal Science; Agricultural and Human Sciences; Food, Bioprocessing, and Nutrition Sciences; Horticultural Science; Molecular and Structural Biochemistry; and the Prestage Department of Poultry Science. Students reside and conduct research in one of these departments under the direction of an appropriate advisor. Research in the nutrition program may be conducted with a variety of species and at various levels, such as molecular, cell, whole animal, and human communities. Research programs are primarily in the area of nutritional biochemistry, experimental animal nutrition (e.g. horses, ruminants, swine, poultry, rodents, and other species), or community nutrition and public health. Graduates find employment in academia, government, industry, and non-profit organizations, or continue their education in medical and allied health fields.

Admission Requirement
To be considered for admission, a student should have a B.S. or M.S degree, preferably in a science-related area. Additionally, applicants must have course work in biology and organic chemistry to be considered for admission. Students for M.S. or Ph.D. should contact and be recommended by a prospective major faculty advisor in their area of interest prior to final admission. Applicants to the Master of Nutrition should indicate their preferences for: on-campus or Distance Education delivery; an emphasis in animal, poultry, or food science (human) nutrition; core science or Professional Science Masters (PSM); and within the PSM, Feed Science or Human Nutrition.
Master’s Degree Requirements
A minimum of 30 course credit hours, including a thesis is required for M.S., 36 for Master of Nutrition. The Master of Nutrition has options for all course delivery by Distance Education, with emphases in Feed Science or Human Nutrition, and an option for course work that qualifies as a Professional Science Master’s degree.

Doctoral Degree Requirements
A minimum of 72 credit hours, including a dissertation for Ph.D. Students must complete core courses, including: Energy Metabolism, Protein and Amino Acid Metabolism, Vitamin Metabolism, and Mineral Metabolism.

Student Financial Support
Assistantships and fellowships may be available for M.S. and Ph.D. students on a competitive basis from the departments in which the advisor resides. Admission does not guarantee availability of financial support.

Degrees
- Nutrition (MR) (p. 153)
- Nutrition (MS) (p. 155)
- Nutrition (PhD) (p. 156)
- Nutrition (Minor) (p. 158)

Faculty

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<tr>
<td>PO</td>
<td>Prestige Poultry Science</td>
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Full Professors
Jonathan C. Allen (FBNS)
Kenneth E Anderson (PO)
Patricia C. Dunn (AHS)
Joan Eisemann (ANS)
Vivek Fellner (ANS)
Peter R. Ferket (PO)
Mario Ferruzzi (FBNS)
Jesse Lee Grimes (PO)
Sung Woo Kim (ANS)
Mary Ann Lila (FBNS)

Christian Maltecca (ANS)
Jeannette A. Moore (ANS)
Paul Edward Mozdziak (PO)
Jack Odle (ANS)
Edgar Orlando Oviedo-Rondon (PO)
Shannon Elizabeth Phillips (ANS)
Matt H. Poore (ANS)
Muquarrab Quresh (FBNS-USDA)
Paul David Siciliano (ANS)
Eric VanHeugten (ANS)

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April Fogleman (FBNS)
Suzie Goodell (FBNS)
Gabriel Keith Harris (FBNS)
Lindsey Haynes-Maslow (AHS)
Collin Kay (FBNS)
Slavko Komarnytsky (FBNS)
Andrew Neilson (FBNS)
Giuseppe Valachhi (ANS)

Assistant Professors
Kimberly Ange-VanHeugten (ANS)
Natalie Cooke (FBNS)
Kerim Eroglu (BCH)
Massimo Iorizzo (HS)
Arion Kennedy (BCH)
Carrie Pickworth (ANS)
Ondulla Toomer (FBNS-USDA)

Emeritus Faculty
Brenda P Alston-Mills
Sarah Liberman Ash
Leonard W. Aurand
Leon Carl Boyd
Leonard S Bull
NC State University

Edward V. Caruolo
George L. Catignani
Warren J Croom Jr
Jimmy Dale Garlich
Winston Murry Hagler
Raymond W. Harvey
William L Johnson
James R. Jones
James Arthur Knopp
Carolyn Jean Lackey
Jean-Marie Luginbuhl
Jacquelyn W. McClelland
Steven J. Schwartz
Jason C. Shih
Harold E. Swaisgood
Van-Den Truong
Lon Weidner Whitlow

Nutrition (MR)

Master's Degree Requirements

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<tr>
<td>BCH 451</td>
<td>Principles of Biochemistry</td>
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<td>BCH 453/553</td>
<td>Biochemistry of Gene Expression</td>
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Core Courses

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<tr>
<td>BCH 553</td>
<td>Biochemistry of Gene Expression</td>
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<td>BCH 571</td>
<td>Regulation of Metabolism</td>
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<td>NTR 500</td>
<td>Principles of Human Nutrition</td>
<td>3</td>
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<td>NTR 501</td>
<td>Advanced Nutrition and Metabolism</td>
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<tr>
<td>NTR 510</td>
<td>Maternal and Infant Nutrition</td>
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Elective Courses

Select a minimum of eight credits from "Core Courses" listed below

Total Hours 8

No more than 6 credit hours can be taken at the 400-level.

Professional Science Master's Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>BCH 451</td>
<td>Principles of Biochemistry</td>
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<td>BCH 453/553</td>
<td>Biochemistry of Gene Expression</td>
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<td>NTR 501</td>
<td>Advanced Nutrition and Metabolism</td>
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Core Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>BCH 553</td>
<td>Biochemistry of Gene Expression</td>
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<td>Regulation of Metabolism</td>
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<tr>
<td>NTR 510</td>
<td>Maternal and Infant Nutrition</td>
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</table>

Elective Courses

Select a minimum of three courses from the following:

Total Hours 1

No more than 6 credit hours can be taken at the 400-level.
NTR 501 Advanced Nutrition and Metabolism 3
NTR 510 Maternal and Infant Nutrition 3
NTR 515 Comparative Nutrition 3
NTR 521 Life Cycle Nutrition 3
NTR 525 Feed Manufacturing Technology 3
NTR 550 Applied Ruminant Nutrition 3
NTR 554 Lactation, Milk, and Nutrition 3
NTR 555 Exercise Nutrition 3
NTR 557 Nutraceuticals and Functional Foods 3
NTR 561 Equine Nutrition 3
NTR 565 Advanced Canine and Feline Nutrition 3
NTR 594 Special Topics in Nutrition 1-6
NTR 701 Protein and Amino Acid Metabolism 3
NTR 706 Vitamin Metabolism 3
NTR 708 Energy Metabolism 3
NTR 764 Advances in Gastrointestinal Pathophysiology 3
NTR 775 Mineral Metabolism 3
NTR 785 Digestion and Metabolism in Ruminants 3
NTR 790 Advanced Feed Formulation 3
NTR 794 Special Topics in Nutrition 1-6

PSM Courses

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<td>FS 553</td>
<td>Food Laws and Regulations</td>
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<td>COM 521</td>
<td>Communication and Globalization</td>
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<td>COM 525</td>
<td>Group/Team Communication</td>
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<td>COM 527</td>
<td>Seminar in Organizational Conflict Management</td>
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<td>COM 530</td>
<td>Interpersonal Communication in Science and Technology Organizations</td>
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<td>BUS 501</td>
<td>Strategic Management Foundations</td>
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<td>MBA 541</td>
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<td>Technology Entrepreneurship and Commercialization II</td>
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Select at least three of the following courses: 1

1 The “PSM Courses” list is not an exclusive list. Students can take any number of courses that relate to business, communication, or regulatory matters determined in conjunction with the academic committee.

**Faculty**

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<td>AHS</td>
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**Full Professors**

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Kenneth E Anderson (PO)
Patricia C. Dunn (PO)
Joan Eisemann (AHS)
Vivek Fellner (ANS)
Peter R. Ferket (PO)
Mario Ferruzzi (FBNS)
Jesse Lee Grimes (PO)
Sung Woo Kim (ANS)
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Shannon Elizabeth Phillips (ANS)
Matt H. Poore (ANS)
Muquarrab Quresh (FBNS-USDA)
Paul David Siciliano (ANS)
Eric VanHeugten (ANS)

**Associate Professors**

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April Fogleman (FBNS)
Suzie Goodell (FBNS)
Gabriel Keith Harris (FBNS)
Lindsey Haynes-Maslow (AHS)
Collin Kay (FBNS)
Slavko Komarnytsky (FBNS)
Andrew Neilson (FBNS)
Giuseppe Valachhi (ANS)

**Assistant Professors**

Kimberly Ange-VanHeugten (ANS)
Nutrition (MS)

Degree Requirements

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<td>BCH 453/553</td>
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or BCH 571 Regulation of Metabolism

**Master of Science Core Courses**

Select at least eight credits from "Core Courses" listed below

**Elective Courses**

"Elective Courses" that will be applied to reach 30 credit hours will be determined in conjunction with the academic committee

**Thesis**

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**Total Hours**: 30

1. No more than 6 credit hours can be taken at the 400-level.

**Core Courses**

<table>
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<tr>
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**Full Professors**

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Patricia C. Dunn (AHS)
Joan Eisemann (ANS)
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Shannon Elizabeth Phillips (ANS)
Matt H. Poore (ANS)
Muquarrab Quresh (FBNS-USDA)
Paul David Siciliano (ANS)
Eric VanHeugten (ANS)

**Associate Professors**

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Andrew Neilson (FBNS)
Giuseppe Valachhi (ANS)

**Assistant Professors**

Kimberly Ange-VanHeugten (ANS)
Natalie Cooke (FBNS)
Kerim Eroglu (BCH)
Massimo Iorizzo (HS)
Arion Kennedy (BCH)
Carrie Pickworth (ANS)
Ondulla Toomer (FBNS-USDA)

**Emeritus Faculty**

Brenda P Alston-Mills
Sarah Liberman Ash
Leonard W. Aurand
Leon Carl Boyd
Leonard S Bull
Edward V. Caruolo
George L. Catignani
Warren J Croom Jr
Jimmy Dale Garlich
Winston Murry Hagler
Raymond W. Harvey
William L Johnson
James R. Jones
James Arthur Knopp
Carolyn Jean Lackey
Jean-Marie Luginbuhl
Jacquelyn W. McClelland
Steven J. Schwartz
Jason C. Shih
Harold E. Swaisgood
Van-Den Truong
Lon Weidner Whitlow

**Nutrition (PhD)**

**Degree Requirements**

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<tr>
<td>or BCH 571</td>
<td>Regulation of Metabolism</td>
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<tr>
<td>NTR 701</td>
<td>Protein and Amino Acid Metabolism</td>
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<tr>
<td>NTR 706</td>
<td>Vitamin Metabolism</td>
<td></td>
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<td>NTR 708</td>
<td>Energy Metabolism</td>
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<tr>
<td>NTR 775</td>
<td>Mineral Metabolism</td>
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The “Non-NTR 700-level Course” will be determined in conjunction with the academic committee.

Select at least two courses from “Core Courses” listed below.

Elective Courses

“Elective Courses” that will be applied to reach 72 credit hours will be determined in conjunction with the academic committee.

Total Hours 72

Faculty

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Full Professors

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Assistant Professors

Kimberly Ange-VanHeugten (ANS)
Natalie Cooke (FBNS)
Kerim Eroglu (BCH)
Master's Core Courses

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<td>Regulation of Metabolism</td>
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<td>NTR 410/410</td>
<td>Maternal and Infant Nutrition</td>
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<tr>
<td>NTR 415/415</td>
<td>Comparative Nutrition</td>
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<td>NTR 419</td>
<td>Human Nutrition and Chronic Disease</td>
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</tr>
<tr>
<td>NTR 420</td>
<td>Applied Nutrition Education</td>
<td>3</td>
</tr>
<tr>
<td>NTR 421/521</td>
<td>Life Cycle Nutrition</td>
<td>3</td>
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<tr>
<td>NTR 425/525</td>
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<td>3</td>
</tr>
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<td>NTR 550</td>
<td>Applied Ruminant Nutrition</td>
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<td>NTR 565</td>
<td>Advanced Canine and Feline Nutrition</td>
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<tr>
<td>NTR 594</td>
<td>Special Topics in Nutrition</td>
<td>1-6</td>
</tr>
<tr>
<td>NTR 701</td>
<td>Protein and Amino Acid Metabolism</td>
<td>3</td>
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<tr>
<td>NTR 706</td>
<td>Vitamin Metabolism</td>
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<tr>
<td>NTR 708</td>
<td>Energy Metabolism</td>
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<tr>
<td>NTR 775</td>
<td>Mineral Metabolism</td>
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<td>NTR 790</td>
<td>Advanced Feed Formulation</td>
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<tr>
<td>NTR 794</td>
<td>Special Topics in Nutrition</td>
<td>1-6</td>
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* No more than three hours of 400-level coursework can be applied toward the 8 total hours

Doctor of Philosophy Minor

Master's Core Courses

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<tr>
<td>NTR 501</td>
<td>Advanced Nutrition and Metabolism</td>
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Total Hours 15
NC State University

NTR 510  Maternal and Infant Nutrition  3
NTR 515  Comparative Nutrition  3
NTR 521  Life Cycle Nutrition  3
NTR 525  Feed Manufacturing Technology  3
NTR 550  Applied Ruminant Nutrition  3
NTR 554  Lactation, Milk, and Nutrition  3
NTR 555  Exercise Nutrition  3
NTR 557  Nutraceuticals and Functional Foods  3
NTR 561  Equine Nutrition  3
NTR 565  Advanced Canine and Feline Nutrition  3
NTR 594  Special Topics in Nutrition  1-6
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NTR 706  Vitamin Metabolism  3
NTR 708  Energy Metabolism  3
NTR 764  Advances in Gastrointestinal Pathophysiology  3
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NTR 794  Special Topics in Nutrition  1-6

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Full Professors
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Sarah Liberman Ash
Leonard W. Aurand
Leon Carl Boyd
Leonard S Bull
Edward V. Caruolo
George L. Catignani
Warren J Croom Jr
Jimmy Dale Garlich
Physiology

The Physiology Graduate Program is an interdisciplinary and interdepartmental program comprising faculty drawn from across the University. An advanced degree in Physiology is highly valued by the scientific community and can lead to careers in research and teaching in academia, industry and government laboratories, public policy and consulting. Research is carried out using a variety of model organisms, laboratory and companion and agriculturally important species.

Admission Requirements

Students entering the graduate program in Physiology should have a Bachelor's degree in a related biological or physical science. Undergraduate courses should include Physiology, Biochemistry, Organic Chemistry, Calculus, and Physics. Each application package will be screened by the Admissions Committee. Factors considered for admission include: grade point average (3.0 is required for regular admission), GRE scores, undergraduate courses, letters of recommendation, and the willingness of a member of the Graduate Physiology faculty to serve as the applicant’s advisor.

Master’s Degree Requirements

All Master’s students are required to complete PHY 503, PHY 504, BCH 553, and a one-credit hour course in research ethics. Master of Science Degree: For a Master of Science degree a minimum of 30 semester hours of graduate work in the degree program is required including a minimum of 20 hours of course work at the 500-800 level. On average, the M.S. degree takes two to three years to complete. Master of Physiology Degree: The non-thesis Master’s degree (Master of Physiology) requires a total of 36 credits. The median time to degree completion is 1.75 years or less.

Student Financial Support

Financial assistance for qualified students in the form of research assistantships, fellowships and traineeships is available through participating departments only and not through the Physiology program for thesis-based students only.

Other Relevant Information

Graduate students enrolled as Physiology majors are housed in the department of their major professor and may participate in departmental activities.

Recommended Courses Normally Included in Programs of Study for the M.S Degree and the Non-Thesis MOP Program

Other recommended/supporting courses are available through many departments, e.g. Animal Science, Biochemistry, Biomathematics, Biotechnology, Cell Biology, Comparative Biomedical Sciences, Entomology, Genetics, Immunology, Microbiology, Nutrition, Pharmacology, Poultry Science, Psychology, Statistics, and Toxicology, and may be included for consideration in the plan of work.

Degrees

- Physiology (MR) (p. 161)
- Physiology (MS) (p. 162)
- Physiology (Minor) (p. 163)

Faculty

Full Professors

Glen William Almond
Kenneth E. Anderson
Christopher M. Ashwell
Betty L. Black
Anthony T. Blikslager
Russell J. Borski
Patricia Ann Curtis
David C. Dorman
Frank W. Edens
Kenneth L. Esbenshade
Charlotte E. Farin
William Lucas Flowers IV
John E. Gadsby
Troy Ghashghaei
Jody L. Gookin
Sung Woo Kim
Matthew D. Koci
Hsiao-Ching Liu
Christian Maltecca
Kathryn Montgome Meurs
Paul Edward Mozdziak
Jack Odle
Heather Patisaual
James N. Petite
Robert M. Petters
Shannon Elizabeth Phillips
Richard M. Roe
Paul David Siciliano
Geoffrey W. Smith
Jeffrey A. Yoder

**Associate Professors**
Luke B. Borst
Babetta Ann Breuhaus
Jose Manuel Bruno-Barcena
John Edward Meitzen
Marianne Niedzlek-Feaver
Marcelo Rodriguez-Puebla

**Practice/Research/Teaching Professors**
Elaine B. Bohorquez
Hanna Gracz
Jane L. Lubischer
Shweta Trivedi

**Emeritus Faculty**
Talmage T. Brown Jr.
Warren J. Croom Jr.
Robert M. Grossfeld
Harold F. Heatwole
Thomas E. Levere
John F. Roberts
Malcolm C. Roberts
Thomas David Siopes
Herbert A. Underwood

Steven Paul Washburn
Michael David Whitacre
Thomas G. Wolcott

**Physiology (MR)**

**Degree Requirements**

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<td>Introduction to Research Ethics</td>
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*Elective Courses” that will be applied to reach 36 credit hours will be determined in conjunction with the academic committee

Total Hours 36

**Faculty**

**Full Professors**
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William Lucas Flowers IV
John E. Gadsby
Troy Ghashghaei
Jody L. Gookin
Sung Woo Kim
Matthew D. Koci
Hsiao-Ching Liu
Physiology (MS)

Degree Requirements

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<td>BCH 553</td>
<td>Biochemistry of Gene Expression</td>
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**Ethics in Research Course**

Select one of the following courses:

- BIT 501 Ethical Issues in Biotechnology
- CBS 662 Professional Conduct in Biomedical Research
- PHI 816 Introduction to Research Ethics

**Elective Courses**

"Elective Courses" that will be applied to reach 36 credit hours will be determined in conjunction with the academic committee

Total Hours 36

Faculty

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- Glen William Almond
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- John E. Gadsby
- Troy Ghashghaei
- Jody L. Gookin
- Sung Woo Kim
- Matthew D. Koci
- Hsiao-Ching Liu
**Physiology (Minor)**

**Plan Requirements**

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</tbody>
</table>

**Additional Course**

Students may choose “Additional Course” from a department outside Physiology approved in conjunction with the academic committee

Total Hours 12

**Additional Requirements**

Minor representative must be from the Physiology Faculty and the representative must be identified before the preliminary exam and the Minor representative must participate in the preliminary examination (as well as the final examination).

**Faculty**

**Full Professors**

Glen William Almond

Kenneth E. Anderson

Christopher M. Ashwell

Betty L. Black

Anthony T. Blikslager

Russell J. Borski

Patricia Ann Curtis

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John E. Gadsby

Troy Ghashghaei

Jody L. Gookin

Sung Woo Kim

Matthew D. Koci

Hsiao-Ching Liu
Course offerings or research facilities are available in the following areas: plant cell biology, cellular imaging, cellulose biology, cellular signaling, plant development, plant hormones, epigenetics, plant systems biology, plant genetic engineering, transgene regulation and silencing, stress biology, chemical genomics, plant gravitational genomics, phytochemistry, metabolic engineering, plant-microbe interactions, aquatic ecology, toxic dinoflagellates, endangered species, plant community ecology, physiological ecology, tropical ecology, evolutionary ecology, paleobotany, plant systematics, evolution of flowering plants, and ethnobotany.

Admission Requirements

Students entering the graduate program in plant biology should have a bachelor's degree in plant biology or a related undergraduate program that includes biological, physical and mathematical science training including undergraduate courses in organic chemistry, calculus and genetics, as well as biology. All applications are screened by a departmental committee, and the best qualified applicants will be accepted until all available spaces are filled.

Master's and Doctoral Degree Requirements

The M.S. requires a total of 30 credit hours (20 of the 30 credit hours must be from 500-, 600-, 700/800-level courses; 18 credit hours must be letter graded); the Master of Plant Biology requires a total of 36 credit hours. The Ph.D. requires a total of 72 credit hours. Two core courses (Functional Plant Biology and either Plant Functional Ecology or Systematic Botany) are required. Other requirements include: a Plant Biology Colloquium, Plant Anatomy, an additional plant biology course, a graduate statistics course, a graduate ethics course, a thesis (for the Ph.D. and M.S., but not the Master of Plant Biology), a comprehensive examination (Ph.D.), oral thesis defense and a one-semester teaching responsibility per degree. Students must maintain a "B" average in all course work.

Other Relevant Information

Graduate research and teaching assistantships and tuition remission information are available from the department. New students supported by departmental research/teaching assistantships may elect to rotate through three laboratories during their first semester. At the end of the semester, they will choose a laboratory for their research activities consistent with their interests and available research projects. Provisions are available for cooperative research in more than one laboratory. Graduate students are expected to attend and participate in the seminar program every semester they are in residence. The department participates in training grants in biotechnology.

Degrees

- Plant Biology (MR) (p. 165)
- Plant Biology (MS) (p. 166)
• Plant Biology (PhD) (p. 167)
• Plant Biology (Minor) (p. 169)

Full Professors
Jose Miguel Alonso
Richard L. Blanton
Kent Oliver Burkey
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James W. Hardin
Walter Webb Heck
Rongda Qu
Jon M. Stucky
Judith F. Thomas
C. Gerald VanDyke
Thomas R. Wentworth

Plant Biology (MR)

Degree Requirements

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<td>PB 513</td>
<td>Plant Anatomy</td>
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<td>PB 570</td>
<td>Plant Functional Ecology</td>
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<tr>
<td>or PB 503</td>
<td>Systematic Botany</td>
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<tr>
<td>PB 824</td>
<td>Topical Problems (Plant Biology Colloquium)</td>
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<tr>
<td>ST 511</td>
<td>Statistical Methods For Researchers I</td>
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<tr>
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<td>Introduction to Research Ethics (or equivalent ethics course)</td>
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<tr>
<td>PB 685</td>
<td>Master's Supervised Teaching</td>
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<td>Master's Supervised Research</td>
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<td></td>
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</table>
Additional Courses are determined in conjunction with the academic committee to meet the 36 total hours

Total Hours
36

1 The course must be taken for a letter grade.
2 "Plant Biology Course" is determined in conjunction with the academic committee

Additional Requirements

M.R. degree students complete the required courses and other courses for 36 total credit hours (at the 500 level or above); 18 hours must be letter-grade. They must also complete a project (and register for 6 hours of PB 693 related to the project) and pass a comprehensive oral exam on general plant biology.

Full Professors

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Plant Biology (MS)

Degree Requirements

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**Teaching / Research Courses**

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<td>Master's Supervised Teaching</td>
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<td>PB 693</td>
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**Plant Biology Course**

Select one PB prefix course ²

**Additional Courses**

Additional Courses are determined in conjunction with the academic committee to meet the 30 total hours

**Total Hours**

30

¹ The course must be taken for a letter grade.

² “Plant Biology Course” is determined in conjunction with the academic committee

**Additional Requirements**

M.S. degree students complete the required courses and other courses for 30 total credit hours (at the 500 level or above); 18 hours must be letter-graded. They must also complete and defend a thesis.

**Full Professors**

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**Plant Biology (PhD)**
Degree Requirements

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<td>or PB 503</td>
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Plant Biology Course

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Select one PB prefix course 2

Additional Courses

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<td>Additional Courses</td>
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</table>

Additional Courses are determined in conjunction with the academic committee to meet the 30 total hours.

Total Hours 72

1 The course must be taken for a letter grade.
2 “Plant Biology Course” is determined in conjunction with the academic committee.

Additional Requirements

Ph.D. degree students complete the required courses and other courses for 72 total credit hours (at the 500 level or above). They must also pass a written and oral preliminary exam, and defend a dissertation.

Full Professors

Jose Miguel Alonso
Richard L. Blanton
Kent Oliver Burkey
Joann M. Burkholder
Susan B. Carson
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Linda Kay Hanley-Bowdoin
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Walter Webb Heck
Rongda Qu
## Plant Biology (Minor)

### Plan Requirements

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<td>or PB 503</td>
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Total Hours: 12

* “Plant Biology Courses” must be above the 500-level with a grade of a B or above

### Full Professors

- Jose Miguel Alonso
- Richard L. Blanton
- Kent Oliver Burkey
- Joann M. Burkholder
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- Robert Graham Franks
- Amy Michele Grunden
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- Thomas W. Rufty Jr.
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- Heike Inge Ada Sederoff
- William F. Thompson
- Ross W. Whetten
- Qiuyun Xiang

### Associate professors

- Deyu Xie
- Tzung Fu Hsieh
- Slavko Komarnytsky
- Alexander Krings
- Xu Li
- Terri A. Long
- Marcela Pierce
- Rosangela Sozzani
- Anna N. Stepanova

### Assistant professors

- Colleen Jennifer Doherty
- Seema Nayan Sheth

### Practice/Research/Teaching Professors

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- Judith F. Thomas
- C. Gerald VanDyke
- Thomas R. Wentworth
Plant Pathology

Plant pathology researches and extends knowledge to solve plant disease problems by focusing on plant-pathogen interactions at the genomic, cellular, organismal, and ecological levels. Approaches include disease management, epidemiology, molecular biology and host-parasite interactions. Focus areas are bacteriology, bioinfomatics, functional genomics, mycology, nematology, virology, soil-borne pathogens and mechanisms of pathogenesis, and host resistance.

Admission Requirements

The general application procedures of the Graduate School noted at the beginning of this section are followed. The Plant Pathology Graduate Program does NOT require the GRE. A detailed statement of applicant interests and goals in plant pathology is very helpful for the admissions committee.

Master's Degree Requirements

There is a core curriculum of a minimum of 12 credit hours that includes PP 501, PP 502, PP 506, PP 707, and PP 601. The core should be supplemented with a minimum of 18 credit hours in courses at the 500 or higher level, which support the focus of the study. Students serve as teaching assistants for one course.

Doctoral Degree Requirements

Students entering the Ph.D. degree program are expected to take the core curriculum outlined for the Master's degree or have had the equivalent at another institution. Additionally, Ph.D. students must include a departmental-approved ethics course, two credits PP 801, and at least two other 700-level Plant Pathology courses. Ph.D. students serve as teaching assistants for two courses.

Student Financial Support

A limited number of half-time assistantships are available on a competitive basis. Benefits include in-state tuition, out-of-state tuition and health insurance as covered under the Graduate School's Graduate Student Support Plan. Applicants are considered for assistantship support at time of application. Special supplements to assistantships are available on a competitive basis for outstanding students. Also, many faculty programs have research grant-funded or training grant-funded assistantships. Contact individual faculty regarding availability of research assistantships.

Other Relevant Information

Fully equipped and staffed laboratories for research are available in addition to greenhouse facilities and environmental growth chambers in the phytotron. Special facilities for experimental work on diseases under field conditions are available at 16 University and NC Department of Agriculture and Consumer Services-related locations throughout the state. Genomics facilities, microcomputers, library, mycological herbarium, digital imaging/graphics equipment programs, and an interdepartmental electron microscopy center are additional features available for the department.

Degrees

- Plant Pathology (MR) (p. 171)
- Plant Pathology (MS) (p. 172)

Faculty

Full Professors
Peter J. Balint-Kurti
David M. Bird
Ignazio Carbone
Christina Cowger
Marc A. Cubeta
Eric Lee Davis
Ralph A. Dean
Shuijin Hu
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Rebeca C. Rufty
Paul B. Shoemaker
Harvey Wesley Spurr
Turner Bond Sutton
Hedwig Hirschm Triantaphyllou
Robert G. Upchurch

Adjunct Faculty
Tim Sit

Plant Pathology (MR)

Degree Requirements

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<td>Plant Disease: Methods &amp; Diagnosis</td>
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<td>Epidemiology and Plant Disease Control</td>
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<td>PP 707</td>
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</table>

Additional Requirements
Select minimum of 6 credit hours graduate-level Plant Pathology courses approved in conjunction with the academic committee

Elective Courses

"Elective Courses" will be determined in conjunction with the academic committee

Total Hours 30

Faculty

Full Professors
Peter J. Balint-Kurti
David M. Bird
Ignazio Carbone
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Plant Pathology (MS)

Degree Requirements

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<td>PP 601</td>
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</table>

PP 685     Master's Supervised Teaching (minimum 1 credit hour teaching)
PP 685     Master's Supervised Teaching (maximum 6 credit hours thesis research)

Select a minimum six credit hours graduate-level Plant Pathology courses approved in conjunction with the academic committee

Total Hours 30

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Plant Pathology (PhD)

Degree Requirements

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Addtional Requirements

- PP 885 Doctoral Supervised Teaching (minimum 2 semesters teaching)
- Select a minimum 12 credit hours graduate-level Plant Pathology courses
- Select a minimum 6-12 credit hours 700-level or above Plant Pathology courses
- PP 801 Seminar In Plant Pathology (2 credit hours seminar)

Total Hours: 72

Faculty

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Harvey Wesley Spurr
Turner Bond Sutton
Hedwig Hirschm Triantaphyllou
Robert G. Upchurch

Adjunct Faculty
Tim Sit

Plant Pathology (Minor)
Plan Requirements
• 9 (MS student) or 12 (PhD student) credit hours

Faculty
Full Professors
Peter J. Balint-Kurti

David M. Bird
Ignazio Carbone
Christina Cowger
Marc A. Cubeta
Eric Lee Davis
Ralph A. Dean
Shuijin Hu
Steven Lommel
Frank John Louws
David S. Marshall
Peter Ojiambo
Charles H. Opperman
Jean B. Ristaino
David F. Ritchie
Howard D. Shew
Anna Elizabeth Whitfield

Associate Professors
James P. Kerns
Lina Maria Quesada
Dorith Rotenberg

Assistant Professors
Oliver Baars
Adrienne Marie Gorny
Alejandra Itzel Huerta Vazquez
David Alan Rasmussen
Lindsey Danielle Thiessen
Sara Michelle Villani

Practice/Research/Teaching Professors
Barbara B. Shew

Emeritus Faculty
Kenneth Barker
Durward F. Bateman
David M. Benson
Course offerings and research programs are comprehensive in the areas of physiology, nutrition, microbiology, molecular biology, biotechnology, food science, immunology, genetics, pathology, and toxicology. The demand for skilled workers with advanced training in poultry science is far greater than the supply. Opportunities exist for graduates in research and teaching in universities, government, and private industry.

Admission Requirements
Factors considered for admission include grade point average, strength of prior academic program, experience, letters of recommendation, and special skills or interests. GRE scores are required.

Master's Degree Requirements
While there are no specific course requirements for the master's degree in Poultry Science, most programs exceed the minimum 30 credit hours.

Doctoral Degree Requirements
See Animal Science and Poultry Science.

Student Financial Support
Both research and teaching assistantships are available on a competitive basis within the department. General requirements for these assistantships are as described in the Graduate Catalog. Other financial support may be available in the form of graduate stipend supplementation, research grant support, or out-of-state tuition waivers in accordance with the University's Graduate Student Support Plan.

Other Relevant Information
The Department of Poultry Science occupies modern facilities in Scott Hall, a three-story building on the main campus adjacent to the D.H. Hill Library. The department consists of about 20 faculty, approximately 40 support staff, 25 graduate students and postdoctoral associates, and 100 undergraduate students.

Degrees
- Poultry Science (MR) (p. 176)
- Poultry Science (MS) (p. 177)
- Poultry Science (Minor) (p. 178)
- Feed Science (Certificate) (p. 179)

Faculty
Full Professors
Kenneth E. Anderson
Christopher M. Ashwell
Donna K. Carver
Frank W. Edens
Peter R. Ferret
Jesse Lee Grimes
Hosni Moustafa Hassan
Matthew D. Koci
Paul Edward Mozdzia
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Ondulla Tyvette Toomer
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Jimmy Dale Garlich
Winston Murry Hagler
Gerald B. Havenstein
Brian W. Sheldon
Jason C. Shih
Thomas David Siopes
Charles Michael Williams

Poultry Science (MR)

Master's Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Required Courses</strong></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>PO 601</td>
<td>Seminar</td>
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</tr>
<tr>
<td>PO 685</td>
<td>Master's Supervised Teaching</td>
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</tr>
<tr>
<td>ST 511</td>
<td>Statistical Methods For Researchers I</td>
<td></td>
</tr>
<tr>
<td>or ST 512</td>
<td>Statistical Methods For Researchers II</td>
<td></td>
</tr>
<tr>
<td>BCH 451</td>
<td>Principles of Biochemistry</td>
<td></td>
</tr>
<tr>
<td>or BCH 553</td>
<td>Biochemistry of Gene Expression</td>
<td></td>
</tr>
</tbody>
</table>

**Elective Courses**

"Elective Courses" that will be applied to reach 36 credit hours will be determined in conjunction with the academic committee.

Students are encouraged to choose these courses from the "Graduate Elective Courses" listed below.

Total Hours 36

Elective Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students are encouraged to choose from the following courses:</td>
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</tr>
<tr>
<td>PO 504</td>
<td>Avian Anatomy and Physiology</td>
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<td>3</td>
</tr>
<tr>
<td>PO 510</td>
<td>Poultry Product Safety: An On-Farm Model</td>
<td>3</td>
</tr>
<tr>
<td>PO 515</td>
<td>Comparative Nutrition</td>
<td>3</td>
</tr>
<tr>
<td>PO 524</td>
<td>Comparative Endocrinology</td>
<td>3</td>
</tr>
<tr>
<td>FM 525</td>
<td>Feed Manufacturing Technology</td>
<td>3</td>
</tr>
<tr>
<td>PO 533</td>
<td>Poultry Processing and Products</td>
<td>3</td>
</tr>
<tr>
<td>FM 580</td>
<td>Feed and Ingredient Quality Assurance</td>
<td>3</td>
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<tr>
<td>PO 590</td>
<td>Special Problems in Poultry Science</td>
<td>1-6</td>
</tr>
<tr>
<td>FM 790</td>
<td>Advanced Feed Formulation</td>
<td>3</td>
</tr>
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<td>IMM 757</td>
<td>Comparative Immunology</td>
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Professional Science Master's Degree Requirements

<table>
<thead>
<tr>
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<th>Hours</th>
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<tr>
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<td>PO 620</td>
<td>Special Problems</td>
<td></td>
</tr>
<tr>
<td>PO 685</td>
<td>Master's Supervised Teaching</td>
<td></td>
</tr>
<tr>
<td>ST 511</td>
<td>Statistical Methods For Researchers I</td>
<td></td>
</tr>
<tr>
<td>or ST 512</td>
<td>Statistical Methods For Researchers II</td>
<td></td>
</tr>
<tr>
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<td>Principles of Biochemistry</td>
<td></td>
</tr>
<tr>
<td>or BCH 553</td>
<td>Biochemistry of Gene Expression</td>
<td></td>
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</table>

**Professional Development (PLUS) Courses**

Select a minimum of three courses from "Professional Development (PLUS) Courses" listed below.

Elective Courses

"Elective Courses" that will be applied to reach 36 credit hours will be determined in conjunction with the academic committee.

Students are encouraged to choose these courses from the "Graduate Elective Courses" listed below.

Total Hours 36

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>Students are encouraged to choose from the following courses:</td>
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<tr>
<td>BAE 578</td>
<td>Agricultural Waste Management</td>
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<tr>
<td>ST 513</td>
<td>Statistics for Management I</td>
<td>3</td>
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<tr>
<td>BUS 420</td>
<td>Financial Management of Corporations</td>
<td>3</td>
</tr>
<tr>
<td>BUS 460</td>
<td>Consumer Behavior</td>
<td>3</td>
</tr>
<tr>
<td>BUS 461</td>
<td>Channel and Retail Marketing</td>
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</tr>
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<td>BUS 462</td>
<td>Marketing Research</td>
<td>3</td>
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<td>BUS 464</td>
<td>International Marketing</td>
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</tr>
<tr>
<td>BUS 465</td>
<td>Traditional and Digital Brand Promotion</td>
<td>3</td>
</tr>
<tr>
<td>BUS 467</td>
<td>Product and Brand Management</td>
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</tr>
<tr>
<td>BUS 468</td>
<td>Marketing Strategy</td>
<td>3</td>
</tr>
<tr>
<td>BUS 472</td>
<td>Operations Planning and Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>BUS 473</td>
<td>Supply Chain Strategy</td>
<td>3</td>
</tr>
<tr>
<td>BUS 474</td>
<td>Logistics Management</td>
<td>3</td>
</tr>
<tr>
<td>BUS 475</td>
<td>Purchasing and Supply Management</td>
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</tr>
<tr>
<td>BUS 501</td>
<td>Strategic Management Foundations</td>
<td>3</td>
</tr>
<tr>
<td>BUS 590</td>
<td>Special Topics In Business Management</td>
<td>1-6</td>
</tr>
<tr>
<td>BUS 610</td>
<td>SP Topics Bus Mgmt</td>
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</tr>
<tr>
<td>COM 521</td>
<td>Communication and Globalization</td>
<td>3</td>
</tr>
<tr>
<td>COM 527</td>
<td>Seminar in Organizational Conflict Management</td>
<td>3</td>
</tr>
<tr>
<td>COM 530</td>
<td>Interpersonal Communication in Science and Technology Organizations</td>
<td>3</td>
</tr>
<tr>
<td>ST 751</td>
<td>Econometric Methods</td>
<td>3</td>
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<tr>
<td>FM 460</td>
<td>Feed Mill Operations and Leadership</td>
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<td>MBA 521</td>
<td>Advanced Corporate Finance</td>
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<td>MBA 530</td>
<td>Leading People</td>
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<td>MBA 541</td>
<td>Supply Management</td>
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<tr>
<td>MBA 542</td>
<td>Supply Chain Logistics</td>
<td>3</td>
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</tbody>
</table>
MBA 543 Planning and Control Systems 3
MBA 552 Data Engineering, Management and Warehousing 3
MBA 555 Product Design and Development 4
MBA 564 Business Relationship Management 3
MBA 576 Technology Entrepreneurship and Commercialization I 3
MBA 586 Legal, Regulatory and Ethical Issues in Life Science Industries 3
MBA 577 Technology Entrepreneurship and Commercialization II 3
MBA 610 Special Topics in Business Administration 1-6
PS 536 Global Environmental Law and Policy 3

Elective Courses

<table>
<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
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<td>PO 504</td>
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<td>3</td>
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<tr>
<td>PO 510</td>
<td>Poultry Product Safety: An On-Farm Model</td>
<td>3</td>
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<tr>
<td>PO 515</td>
<td>Comparative Nutrition</td>
<td>3</td>
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<tr>
<td>PO 524</td>
<td>Comparative Endocrinology</td>
<td>3</td>
</tr>
<tr>
<td>FM 525</td>
<td>Feed Manufacturing Technology</td>
<td>3</td>
</tr>
<tr>
<td>PO 533</td>
<td>Poultry Processing and Products</td>
<td>3</td>
</tr>
<tr>
<td>FM 580</td>
<td>Feed and Ingredient Quality Assurance</td>
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<td>PO 590</td>
<td>Special Problems in Poultry Science</td>
<td>1-6</td>
</tr>
<tr>
<td>FM 790</td>
<td>Advanced Problems in Animal Science</td>
<td>3</td>
</tr>
<tr>
<td>IMM 757</td>
<td>Comparative Immunology</td>
<td>3</td>
</tr>
</tbody>
</table>

Faculty

Full Professors

Kenneth E. Anderson
Christopher M. Ashwell
Donna K. Carver
Frank W. Edens
Peter R. Ferket
Jesse Lee Grimes
Hosni Moustafa Hassan
Matthew D. Koci
Paul Edward Mozdziak
Edgar Orlando Oviedo-Rondon
James N. Petitte

Assistant Professors

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Prafulla Regmi
Mahmoud A. N. A. N. Sharara
Ondulla Tyvette Toomer

Emeritus Faculty

Thomas A. Carter
Vern L. Christensen
Warren J. Croom Jr.
Jimmy Dale Garlich
Winston Murry Hagler
Gerald B. Havenstein
Brian W. Sheldon
Jason C. Shih
Thomas David Siopes
Charles Michael Williams

Poultry Science (MS)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Required Courses</strong></td>
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<td>PO 801</td>
<td>Graduate Seminar In Poultry Science</td>
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</tr>
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<td>PO 885</td>
<td>Doctoral Supervised Teaching</td>
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</tr>
<tr>
<td>ST 511</td>
<td>Statistical Methods For Researchers I</td>
<td></td>
</tr>
<tr>
<td>ST 512</td>
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<tr>
<td>BCH 451</td>
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<td></td>
</tr>
<tr>
<td>BCH 553</td>
<td>Biochemistry of Gene Expression</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Graduate Electives / Research Courses</strong></td>
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<tr>
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<td>“Graduate Electives / Research Courses” will be applied to reach 30 credit hours will be determined in conjunction with the academic committee</td>
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<tr>
<td></td>
<td>Students are encouraged to choose these courses from the “Graduate Elective Courses” and “Graduate Research Courses” listed below</td>
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<td><strong>Total Hours</strong></td>
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Elective Courses

<table>
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<tr>
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<th>Title</th>
<th>Hours</th>
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<td></td>
<td>Students are encouraged to choose from the following courses:</td>
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<tr>
<td>PO 510</td>
<td>Poultry Product Safety: An On-Farm Model</td>
<td>3</td>
</tr>
</tbody>
</table>
PO 515  Comparative Nutrition 3
PO 524  Comparative Endocrinology 3
FM 525  Feed Manufacturing Technology 3
PO 533  Poultry Processing and Products 3
FM 580  Feed and Ingredient Quality Assurance 3
PO 590  Special Problems in Poultry Science 1-6
FM 790  Advanced Feed Formulation 3
IMM 757  Comparative Immunology 3

Research Courses

<table>
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<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>PO 693</td>
<td>Master's Supervised Research</td>
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<tr>
<td>PO 695</td>
<td>Master's Thesis Research</td>
<td>1-9</td>
</tr>
<tr>
<td>PO 699</td>
<td>Master's Thesis Preparation</td>
<td>1-9</td>
</tr>
</tbody>
</table>

Faculty

Full Professors
Kenneth E. Anderson
Christopher M. Ashwell
Donna K. Carver
Frank W. Edens
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Gerald B. Havenstein
Brian W. Sheldon
Jason C. Shih
Thomas David Siopes
Charles Michael Williams

Poultry Science (Minor)

Plan Requirements

- 9 (MS student) or 12 (PhD student) credit hours

Poultry Science Graduate Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO 504</td>
<td>Avian Anatomy and Physiology</td>
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</tr>
<tr>
<td>PO 506</td>
<td>Physiological Aspects of Poultry Management</td>
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<td>PO 510</td>
<td>Poultry Product Safety: An On-Farm Model</td>
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<td>PO 515</td>
<td>Comparative Nutrition</td>
<td>3</td>
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<td>PO 524</td>
<td>Comparative Endocrinology</td>
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<td>PO 525</td>
<td>Feed Manufacturing Technology</td>
<td>3</td>
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<td>PO 533</td>
<td>Poultry Processing and Products</td>
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<td>PO 566</td>
<td>Animal Cell Culture Techniques</td>
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<td>PO 580</td>
<td>Feed and Ingredient Quality Assurance</td>
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<tr>
<td>PO 590</td>
<td>Special Problems in Poultry Science</td>
<td>1-6</td>
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<tr>
<td>PO 601</td>
<td>Seminar</td>
<td>1</td>
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<td>PO 620</td>
<td>Special Problems</td>
<td>1-6</td>
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<td>PO 757</td>
<td>Comparative Immunology</td>
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<td>PO 775</td>
<td>Mineral Metabolism</td>
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<td>Graduate Seminar In Poultry Science</td>
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<tr>
<td>PO 820</td>
<td>Special Problems In Poultry Science</td>
<td>1-6</td>
</tr>
</tbody>
</table>

Faculty

Full Professors
Kenneth E. Anderson
Christopher M. Ashwell
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Jesse Lee Grimes
Hosni Moustafa Hassan

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Prafulla Regmi
Mahmoud A. N. A. N. Sharara
Ondulla Tyvette Toomer

Emeritus Faculty
Thomas A. Carter
Feed Science (Certificate)

The Graduate Certificate Program in Feed Science is designed to prepare professionals or current degree program students to work in or alongside the animal food industry. The program will provide an advanced foundation in feed science technology, quality assurance and feed formulation, and feed industry leadership. The objectives of this program are for the student to acquire an understanding of the technical aspects of modern animal food manufacturing; food and ingredient quality assurance; animal food safety; feed industry regulations; facility operations, leadership, and safety; formulation; and generally how to apply technical skills to the challenges of the global animal food industry.

Admission Requirements

Applicants must have a BS/BA degree or equivalent four year degree in order to apply to the program. Individuals interested in this certificate program must contact the coordinator of the certificate program.

Program Requirements

A minimum of 12 credit hours from the prescribed list of courses and a grade of 'C-' or better in these courses is required to receive credit for the certificate. To receive a Graduate Certificate in Feed Science, a student must have a minimum 3.0 grade point average on all certificate course work. All course work must be registered through NC State University, transfer credit from other universities is not allowed. All work must be completed in four (4) calendar years, beginning from the time the application is approved by the Director of Graduate Programs.

Plan Requirements

<table>
<thead>
<tr>
<th>Code Courses</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>FM/ANS/NTR/PO 525</td>
<td>Feed Manufacturing Technology</td>
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</tr>
<tr>
<td>FM/PO 580</td>
<td>Feed and Ingredient Quality Assurance</td>
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</tr>
<tr>
<td>PO/ANS/NTR 515</td>
<td>Comparative Nutrition</td>
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Elective Courses

Select a minimum of one of the following courses: 3

<table>
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<tr>
<th>Code Courses</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>FM 460/PO 590</td>
<td>Feed Mill Operations and Leadership</td>
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</tr>
<tr>
<td>FM 490</td>
<td>Feed Science Seminar</td>
<td></td>
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<tr>
<td>FM 594</td>
<td>Advanced Feed Mill Practicum</td>
<td></td>
</tr>
<tr>
<td>FM/NTR 790</td>
<td>Advanced Feed Formulation</td>
<td></td>
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</tbody>
</table>

Total Hours 12

Soil Science

Soil scientists study and manage land and water resources to protect the environment and enhance agricultural productivity. Graduate education opportunities in soil science at NC State prepares students for careers with public and private organizations in soil, agricultural, environmental, and natural resource sciences. Our graduates find employment opportunities with private sector firms, government organizations, academia, and entrepreneurship.

You will have the opportunity to study and do research with world-class faculty in outstanding laboratory and field facilities. Graduate students may specialize in the following sub-disciplines: soil physics; soil chemistry; soil microbiology and biochemistry; soil fertility and plant nutrition; soil genesis, morphology and classification; and soil, water and land management and conservation. Students can also incorporate other disciplines into their work, presenting outstanding opportunities to focus on issues of interest.

Admission requirements: A minimum of a 3.0 GPA at the baccalaureate (BS) or master’s (MS) level is required. However, exceptions may be made for master’s applicants with a very strong GPA in science classes or their final two years, or with substantial post-baccalaureate work experience. Students accepted will typically have a BS or MS degree in soil science, or closely related fields, with strong preparation in the biological and physical sciences.

To ensure that all graduates are well founded in all aspects of soil sciences, students are expected to acquire competence through coursework in the following sub-disciplines (four for Master’s and all five
for Ph.D. programs): soil physics, soil chemistry, soil microbiology, soil genesis and classification, and soil fertility.

### Degrees

- Soil Science (MR) (p. 180)
- Soil Science (MS) (p. 181)
- Soil Science (PhD) (p. 182)
- Soil Science (Minor) (p. 184)

### Faculty

#### Full Professors

Aziz Amoozegar  
Stephen W. Broome  
David A. Crouse  
Owen W. Duckworth  
Alan J. Franzlubbers  
John L. Havlin  
Joshua L. Heltman  
Dean L. Hesterberg  
Richard A. McLaughlin  
Michael D. Mullen  
Deanna L. Osmond  
Wei Shi  
Michael J. Vepraskas

#### Associate Professors

Alexandria K. Graves  
Jeffrey G. White

#### Assistant Professors

Kevin Garcia  
Terrence G. Gardner  
Luciano C. Gatiboni  
Amy M. Johnson  
Stephanie B. Kulesza  
Matthew C. Ricker  
Alex L. Woodley

#### Emeritus Faculty

Stanley W. Buol

### Soil Science (MR)

#### Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<td>SSC 620</td>
<td>Special Problems</td>
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<td>4-7</td>
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<td>Soil Physics</td>
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<td>SSC 521</td>
<td>Soil Chemistry</td>
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<tr>
<td>SSC 532</td>
<td>Soil Microbiology</td>
<td></td>
</tr>
<tr>
<td>SSC 541</td>
<td>Soil Fertility</td>
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<tr>
<td>SSC 551</td>
<td>Soil Morphology, Genesis and Classification</td>
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1. Students can take no more than two credits of SSC 601 Seminar total.  
2. Students can take four to six credits of SSC 620 Special Problems.  
3. Students may have courses waived upon proving competency in the following coursework.
4 Students must take at least 18 hours of letter-graded course work – these must be NC State courses or inter-institutional courses (https://studentservices.ncsu.edu/your-classes/exchange-programs/inter-institutional-program/).

**Additional Requirements**

All Masters students must demonstrate competence in four of the five sub-disciplines listed below, and Doctoral students must demonstrate competency in all five.

- Soil Chemistry
- Soil Fertility and Plant Nutrition
- Soil Genesis and Classification
- Soil Microbiology and Biochemistry
- Soil Physics

The required competencies can be achieved by any combination of the following:

1. relevant course work from previous undergraduate and/or graduate degree programs;
2. prior professional experience in the major sub-discipline(s); and
3. graduate courses included in the student’s Plan of Work (POW) for their current degree program.

**Faculty**

**Full Professors**

Aziz Amoozegar

Stephen W. Broome

David A. Crouse

Owen W. Duckworth

Alan J. Franzlubbers

John L. Havlin

Joshua L. Heltman

Dean L. Hesterberg

Richard A. McLaughlin

Michael D. Mullen

Deanna L. Osmond

Wei Shi

Michael J. Vepraskas

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Maurice Cook

Fred Cox

Carl Crozier

George Cummings

J. Wendell Gilliam

Daniel Israel

Joseph Kleiss

David Lindbo

Gordon Miner

George C. Naderman Jr.

Wayne Robarge

Thomas J. Smyth

Richard Volk

Michael Wagger

Arthur Wollum

**Soil Science (MS)**

**Degree Requirements**

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<tr>
<th>Code</th>
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<td>SSC 693</td>
<td>Master's Supervised Research ³</td>
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<td>or SSC 695</td>
<td>Master's Thesis Research</td>
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<td>4-7</td>
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<tr>
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<tr>
<td>SSC 511</td>
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<td>SSC 532</td>
<td>Soil Microbiology</td>
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<td>SSC 541</td>
<td>Soil Fertility</td>
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<tr>
<td>SSC 551</td>
<td>Soil Morphology, Genesis and Classification</td>
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</tbody>
</table>
Undergraduate Courses 6
400-Level undergraduate courses from outside soil science will be determined in conjunction with the academic committee.

Elective Courses 18
“Elective Courses” will be determined in conjunction with the academic committee.

Total Hours 30
1. Students can take no more than two credits of SSC 601 Seminar total.
2. Students can take four to six credits of SSC 620 Special Problems.
3. Students are required to take a minimum of two credits and no more than six credits of SSC 693 Master’s Supervised Research or SSC 695 Master’s Thesis Research.
4. Students may have courses waived upon proving competency in the following coursework.
5. Students must take at least 18 hours of letter-graded course work – these must be NC State courses or inter-institutional courses (https://studentservices.ncsu.edu/your-classes/exchange-programs/inter-institutional-program/).

Additional Requirements
- Successful completion of a research problem
- Non-credit exit seminar
- Additional credit hours of seminar and research may be taken in addition to the required 30 credit hours to fulfill continuous registration requirements, but do not need to be listed on the POW

Faculty

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John L. Havlin
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Daniel Israel
Joseph Kleiss
David Lindbo
Gordon Miner
George C. Naderman Jr.
Wayne Robarge
Thomas J. Smyth
Richard Volk
Michael Wagger
Arthur Wollum

Soil Science (PhD)

Degree Requirements

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<th>Code</th>
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<td>SSC 801</td>
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<td>SSC 893</td>
<td>Doctoral Supervised Research ²</td>
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<tr>
<td>or SSC 895</td>
<td>Doctoral Dissertation Research</td>
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Core Courses 34

<table>
<thead>
<tr>
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<tr>
<td>SSC 511</td>
<td>Soil Physics</td>
</tr>
<tr>
<td>SSC 521</td>
<td>Soil Chemistry</td>
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</table>
SSC 532  Soil Microbiology
SSC 541  Soil Fertility
SSC 551  Soil Morphology, Genesis and Classification

Elective Courses  tbd

“Elective Course” will be determined in conjunction with the academic committee

Total Hours  72

1 Students must take at least one credit of SSC 801 Seminar.
2 Students are required to take a minimum of two credits of SSC 893 Doctoral Supervised Research or SSC 895 Doctoral Dissertation Research.

Additional Requirements
All Doctoral students must demonstrate competence in the five soil science sub-disciplines listed below.

• Soil Chemistry
• Soil Fertility and Plant Nutrition
• Soil Genesis and Classification
• Soil Microbiology and Biochemistry
• Soil Physics

The required competencies can be achieved by any combination of the following:

1. relevant course work from previous undergraduate and/or graduate degree programs;
2. prior professional experience in the major sub-discipline(s); and
3. graduate courses included in the student’s Plan of Work (POW) for their current degree program.

• Completion of at least 72 semester credit hours beyond the bachelor’s degree
  • If the student has an MS degree from another institution, a maximum of 18 hours of relevant graduate credit from that degree may be applied toward this minimum, upon the recommendation of the student’s Graduate Advisory Committee, and the minimum required will be 54 semester credit hours
  • If a student completes an MS degree at NC State and continues for a doctoral degree without a break in time, up to 36 relevant credit hours taken while in master’s status may be used to meet minimum requirements for the doctoral degree. If there is a break in time between completing the master’s (at NC State) and beginning the doctorate (at NC State), the allowance is limited to 18 hours. Either allowance may include those 400-level courses taken as an approved part of the MS degree.
• Completion of preliminary written and oral examinations must be completed within six calendar years from the date of admission
• Successful completion of an original research program
• Success completion of the final oral examination
• Completion of a non-credit exit seminar

Faculty
Full Professors
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Owen W. Duckworth
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John L. Havlin
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Fred Cox
Carl Crozier
George Cummings
J. Wendell Gilliam
Daniel Israel
Joseph Kleiss
David Lindbo
Soil Science (Minor)

Plan Requirements
• 3-4 courses in Soil Science (400-800 level)

Faculty
Full Professors
Aziz Amoozegar
Stephen W. Broome
David A. Crouse
Owen W. Duckworth
Alan J. Franzlubbers
John L. Havlin
Joshua L. Heitman
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Youth, Family, & Community Sciences

The Youth, Family & Community Sciences Program provides graduate study for current and emerging professionals in family life education, parent education, family life coaching, youth development, volunteer management, and community-based youth and family programs, or related careers. The demand for professionals to teach, administer, and create support systems for children, youth and families is increasing through Cooperative Extension programs, government agencies and initiatives, community-based non-profits, court systems, prisons, social service organizations, health care agencies/organizations, and schools.

The following distance-based graduate programs are available:
• Master of Science in Youth, Family, and Community Sciences (M.S. requires 36 total hours including a thesis)
• Master of Youth, Family, and Community Sciences (M.R. requires 30 hours and a culminating supervised professional experience)

Admission Requirements
Students apply through NC State via the normal Graduate School admissions procedures; applications are reviewed on Nov. 1, April 1, and July 1. All application materials must be submitted electronically (online); mailed or faxed materials are not accepted. Only complete
applications are reviewed. In addition to all Graduate School admission requirements, the Department requires three academic references, a personal statement of current/future career goals including how this program will help you reach your goals, and a 500-800 word academic writing sample that answers the following prompt: What is the role of family science in a diverse society? The Graduate School requires a 3.00 average (4.00 scale) in the undergraduate program. The most qualified applicants will be accepted up to the number of spaces that are available for new students. Exceptions to the minimum grade point average may be made for students with special backgrounds, abilities, circumstances, or interests.

Master’s Degree Requirements

The Master of Science in Youth, Family, and Community Sciences (M.S.) requires 36 hours culminating in a final oral examination and thesis approved by the student’s graduate committee. The Master of Youth, Family, and Community Sciences (M.R.) is a non-thesis degree that requires a total of 30 credit hours culminating in a capstone supervised professional experience. Both degree programs are built upon foundations of theory and application composed of four focus areas: (1) foundations of family life and youth development, (2) professional development and leadership, (3) research and methodological inquiry, and (4) content area concentration.

Student Financial Support

No financial aid/assistantships are available directly from the Department. Financial aid is available from the NC State Office of Financial Aid and on a competitive basis from the NC State Graduate School. Students seeking financial aid should contact the NC State Financial Aid Office directly.

Other Relevant Information

Distance course delivery methods include: totally asynchronous web-based classes, and synchronous Internet based classes. The M.R. and M.S. programs may be successfully completed totally via distance.

Degrees

- Youth, Family, and Community Sciences (MR) (p. 185)
- Youth, Family, and Community Sciences (MS) (p. 186)
- Family Life Education and Coaching (Certificate) (p. 187)
- Leadership and Volunteer Management (Certificate) (p. 187)
- Youth Development and Leadership (Certificate) (p. 188)

Faculty

Full Professors

Kimberly Allen
Carolyn Bird
Benjamin Chapman
Carolyn Dunn
Sarah Kirby
Michael Schulman
Benjamin Silliman

Associate Professors

Jamie Alexander
Dara Bloom
Harriett C. Edwards
Annie Haridson-Moody
Lindsey Haynes-Maslow

Assistant Professors

Maru Gonzalez

Emeritus Faculty

Lucille Bearon
Karen DeBord

Youth, Family, and Community Sciences (MR)

Degree Requirements

<table>
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<tr>
<th>Code</th>
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<th>Title</th>
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<td>YFCS 500</td>
<td>Supervised Professional Experience in Family Life &amp; Youth Development</td>
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<td>YFCS 502</td>
<td>Theories in Family Science</td>
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<tr>
<td>YFCS 551</td>
<td>Research Methods in Youth, Family, and Community Sciences</td>
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<td>YFCS 552</td>
<td>Program Development &amp; Evaluation in Youth &amp; Family Settings</td>
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<td>YFCS 585</td>
<td>Professional Ethics and Family Policy</td>
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Applied Concepts Course

- YFCS 543 Applied Concepts in Parenting and Family Life Education
- YFCS 553 Applied Concepts in Child and Youth Development

Elective Courses

Select four courses from "Elective Courses" listed below
Total Hours 30

Elective Courses

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<tr>
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<td>YFCS 531</td>
<td>Effective Management of Family Resources</td>
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<td>YFCS 533</td>
<td>Complex Family Issues</td>
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<td>YFCS 537</td>
<td>Human Sexuality</td>
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<td>YFCS 540</td>
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<td>YFCS 545</td>
<td>Family Communication and Coaching</td>
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### Youth, Family, and Community Sciences (MS)

#### Degree Requirements

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<tr>
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<td>YFCS 502</td>
<td>Theories in Family Science</td>
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<td>YFCS 511</td>
<td>Statistical Methods For Researchers I</td>
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<td>YFCS 545</td>
<td>Family Communication and Coaching</td>
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<td>YFCS 547</td>
<td>Family Life Coaching</td>
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<td>YFCS 550</td>
<td>Family and Youth Professionals as Leaders</td>
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<td>YFCS 552</td>
<td>Program Development &amp; Evaluation in Youth &amp; Family Settings</td>
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<td>YFCS 553</td>
<td>Contemporary Issues in Volunteer Resource Management</td>
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<td>YFCS 557</td>
<td>Volunteerism in Youth and Family Settings</td>
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<td>YFCS 558</td>
<td>Special Topics Family Life and Youth Development</td>
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<td>Faculty</td>
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<tr>
<td></td>
<td>Kimberly Allen</td>
<td></td>
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<td></td>
<td>Carolyn Bird</td>
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<td></td>
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<td></td>
<td>Carolyn Dunn</td>
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<td></td>
<td>Sarah Kirby</td>
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<td></td>
<td>Michael Schulman</td>
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<td></td>
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<td>Lindsey Haynes-Maslow</td>
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<td>Karen DeBord</td>
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<td>YFCS 500</td>
<td>Supervised Professional Experience in Family Life &amp; Youth Development</td>
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</tr>
<tr>
<td>YFCS 502</td>
<td>Theories in Family Science</td>
<td></td>
</tr>
</tbody>
</table>

### Faculty

#### Full Professors

- Kimberly Allen
- Carolyn Bird
- Benjamin Chapman
- Carolyn Dunn
- Sarah Kirby
- Michael Schulman
- Benjamin Silliman

#### Associate Professors

- Jamie Alexander

#### Emeritus Faculty

- Lucille Bearon
- Karen DeBord

#### Elective Courses

- Select four courses below

### Methodological Inquiry Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>YFCS 511</td>
<td>Research Methods in Youth, Family, and Community Sciences</td>
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<td>YFCS 695</td>
<td>Thesis Research</td>
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<tr>
<td>ST 511</td>
<td>Statistical Methods For Researchers I</td>
<td></td>
</tr>
</tbody>
</table>

### Total Hours

- 36
Family Life Education and Coaching (Certificate)

The Graduate Certificate in Family Life Education and Coaching prepares students to work with parents, professionals, and families as both family life educators and family life coaches. Family Life Educators (FLE) are strengths-based professionals who provide preventative research-based education to families in organized efforts designed to impart information, skills, experiences, or resources to strengthen, improve, or enrich their family experience. Family Life Coaches (FLC) partner with clients in a thought-provoking and creative process that inspires families to maximize their potential, reach goals, and achieve healthy relationships. Required courses are designed to strengthen the student’s understanding and application of the critical aspects of family life coaching and education, including a strengthened understanding of the fields of coaching psychology and family life education. The 12-credit graduate program can be completed entirely online.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Required Courses</strong></td>
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<tr>
<td>YFCS 543</td>
<td>Applied Concepts in Parenting and Family Life Education</td>
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<td>YFCS 545</td>
<td>Family Communication and Coaching</td>
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<td></td>
<td><strong>Elective Course</strong></td>
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<tr>
<td></td>
<td>See “Elective Courses” listed below</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total Hours</strong></td>
<td>12</td>
</tr>
</tbody>
</table>

Elective Courses

Select one of the following electives that most aligns with your professional interests:

- YFCS 502 Theories in Family Science
- YFCS 523 Family Relationships Over the Life Course
- YFCS 531 Effective Management of Family Resources
- YFCS 533 Complex Family Issues
- YFCS 537 Human Sexuality
Youth Development and Leadership (Certificate)

The Graduate Certificate in Youth Development and Leadership prepares future and strengthens current professionals working with community-based youth development programs. The required courses are designed to strengthen the student’s understanding and application of critical aspects of community youth programs, including theories of youth development, social, emotional, cognitive, and physical development, resource development and management, volunteer development, advisory committees and boards, organizational structure, human resource management, and current/emerging issues impacting youth and families.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>YFCS 550</td>
<td>Family and Youth Professionals as Leaders</td>
<td>3</td>
</tr>
<tr>
<td>YFCS 553</td>
<td>Applied Concepts in Child and Youth Development</td>
<td>3</td>
</tr>
</tbody>
</table>

Organizational Administration Course

See “Organizational Administration Electives” listed below

Youth / Family Development Elective Course

See “Youth and Family Development Electives” listed below

Total Hours 12

Organizational Administration Courses

Select one of the following courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>YFCS 531</td>
<td>Effective Management of Family Resources</td>
<td>3</td>
</tr>
<tr>
<td>YFCS 552</td>
<td>Program Development &amp; Evaluation in Youth &amp; Family Settings</td>
<td>3</td>
</tr>
<tr>
<td>YFCS 557</td>
<td>Volunteerism in Youth and Family Settings</td>
<td>3</td>
</tr>
<tr>
<td>YFCS 558</td>
<td>Contemporary Issues in Volunteer Resource Management</td>
<td>3</td>
</tr>
<tr>
<td>YFCS 585</td>
<td>Professional Ethics and Family Policy</td>
<td>3</td>
</tr>
</tbody>
</table>

Youth and Family Development Courses

Select one of the following courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>YFCS 502</td>
<td>Theories in Family Science</td>
<td>3</td>
</tr>
<tr>
<td>YFCS 523</td>
<td>Family Relationships Over the Life Course</td>
<td>3</td>
</tr>
<tr>
<td>YFCS 531</td>
<td>Effective Management of Family Resources</td>
<td>3</td>
</tr>
<tr>
<td>YFCS 533</td>
<td>Complex Family Issues</td>
<td>3</td>
</tr>
<tr>
<td>YFCS 535</td>
<td>Family Health &amp; Well-being</td>
<td>3</td>
</tr>
<tr>
<td>YFCS 537</td>
<td>Human Sexuality</td>
<td>3</td>
</tr>
<tr>
<td>YFCS 540</td>
<td>Environmental Influences on the Family</td>
<td>3</td>
</tr>
</tbody>
</table>
For more information or to enroll in the Certificate Program, contact: Dr. Melissa Srougi (mcsrougi@ncsu.edu) with your student ID number, MR program, and anticipated graduation.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIT 501</td>
<td>Ethical Issues in Biotechnology</td>
<td>1</td>
</tr>
<tr>
<td>BIT 510</td>
<td>Core Technologies in Molecular and Cellular Biology (+ Capstone Cloning Project)</td>
<td>2</td>
</tr>
</tbody>
</table>

Elective Courses
See "Elective Courses" listed below

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIT 564</td>
<td>Protein Purification</td>
<td>2</td>
</tr>
<tr>
<td>BIT 566</td>
<td>Animal Cell Culture Techniques</td>
<td>2</td>
</tr>
<tr>
<td>BIT 577</td>
<td>Metagenomics</td>
<td>2</td>
</tr>
<tr>
<td>BIT 579</td>
<td>High-Throughput Discovery</td>
<td>2</td>
</tr>
<tr>
<td>BIT 595</td>
<td>Special Topics</td>
<td>1-6</td>
</tr>
<tr>
<td>BIT 571</td>
<td>RNA Interference and Model Organisms</td>
<td>2</td>
</tr>
<tr>
<td>BIT 572</td>
<td>Proteomics</td>
<td>2</td>
</tr>
<tr>
<td>BIT 573</td>
<td>Protein Interactions</td>
<td>2</td>
</tr>
<tr>
<td>BIT 580</td>
<td>Yeast Metabolic Engineering</td>
<td>2</td>
</tr>
<tr>
<td>BIT 815</td>
<td>Advanced Special Topics</td>
<td>1-6</td>
</tr>
</tbody>
</table>

1 Students may take another approved research ethics/bioethics course determined in conjunction with the academic committee

2 Upon passing BIT 510 Core Technologies in Molecular and Cellular Biology with an 80% or higher, students must complete a Capstone Cloning Project.

3 Students may choose another 500-level or higher elective course outside "Elective Courses" listed below determined in conjunction with the academic committee

Elective Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIT 571</td>
<td>RNA Interference and Model Organisms</td>
</tr>
<tr>
<td>BIT 572</td>
<td>Proteomics</td>
</tr>
<tr>
<td>BIT 573</td>
<td>Protein Interactions</td>
</tr>
<tr>
<td>BIT 580</td>
<td>Yeast Metabolic Engineering</td>
</tr>
<tr>
<td>BIT 815</td>
<td>Advanced Special Topics</td>
</tr>
</tbody>
</table>

Objectives

- Provide a focus and formal program for students from many disciplines to pursue training in the technical and engineering aspects of designing and analyzing environmental systems with an emphasis on the watershed-scale.
- Provide students the opportunity to develop a solid foundation in engineering systems targeted at environmental issues, particularly related to non-point sources and their impact on water quality at the watershed-scale.
- Provide practicing engineers and other professionals a source of graduate level engineering education in the environmental field.

Admission Requirements

Applicants must have successfully completed an accredited undergraduate engineering program with a GPA of 3.0 (based on a 4.0 scale), or with an overall undergraduate GPA of at least 2.8 coupled with a 3.0 or higher in the undergraduate major, or be currently enrolled in a graduate engineering program. Applicants with a four-year undergraduate science degree who have successfully completed (with a C or better) calculus, differential equations, physics and chemistry will also be considered. A program that includes fluid mechanics or hydraulics is highly recommended. Environmental professionals who do not meet the above criteria may also qualify if appropriate experience can be demonstrated.

Program Requirements

A minimum of 12 hours of coursework selected from the list below. One course can be selected from outside of BAE (up to 2 credit hours), but at least 9 credit hours must be BAE courses.

Plan Requirements

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>BIT 501</td>
<td>Ethical Issues in Biotechnology</td>
<td>1</td>
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<tr>
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</tbody>
</table>

Elective Courses

<table>
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<tr>
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<th>Title</th>
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<tbody>
<tr>
<td>BIT 564</td>
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<tr>
<td>BIT 579</td>
<td>High-Throughput Discovery</td>
</tr>
<tr>
<td>BIT 595</td>
<td>Special Topics</td>
</tr>
<tr>
<td>BIT 571</td>
<td>RNA Interference and Model Organisms</td>
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<tr>
<td>BIT 572</td>
<td>Proteomics</td>
</tr>
<tr>
<td>BIT 573</td>
<td>Protein Interactions</td>
</tr>
<tr>
<td>BIT 580</td>
<td>Yeast Metabolic Engineering</td>
</tr>
<tr>
<td>BIT 815</td>
<td>Advanced Special Topics</td>
</tr>
</tbody>
</table>

Watershed Assessment and Restoration (Certificate)

The Department of Biological and Agricultural Engineering offers a Graduate Certificate Program in Design and Analysis of Environmental Systems: Watershed Assessment and Restoration.
College of Design

Programs

- Architecture (p. 190)
- Art and Design (p. 199)
- Design (p. 201)
- Graphic Design (p. 204)
- Industrial Design (p. 206)
- Landscape Architecture (p. 208)

Degree Programs

Master's (MR)

- Art and Design (MR) (p. 200)
- Graphic Design (MR) (p. 205)
- Industrial Design (MR) (p. 207)
- Landscape Architecture (MR) (p. 208)

Doctor of Philosophy (PhD)

- Design (PhD) (p. 202)

Doctor of Design (DDes)

- Design (DDes) (p. 203)

Minors

- Landscape Architecture (Minor) (p. 211)

Certificates

- City Design (Certificate) (p. 196)
- Energy and Technology in Architecture (Certificate) (p. 197)
- Public Interest Design (Certificate) (p. 198)

Architectural Accrediting Board (NAAB)

In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accrediting Board (NAAB), which is the sole agency authorized to accredit U.S. professional degree programs in architecture, recognizes three types of degrees: the Bachelor of Architecture, the Master of Architecture, and the Doctor of Architecture. A program may be granted a 8-year, 4-year, or 2-year term of accreditation, depending on the extent of its conformance with established educational standards.

Doctor of Architecture and Master of Architecture degree programs may consist of a pre-professional undergraduate degree and a professional graduate degree that, when earned sequentially, constitute an accredited professional education. However, the pre-professional degree is not, by itself, recognized as an accredited degree.

The NC State University School of Architecture offers the following NAAB accredited degree programs:

B.Arch (pre-professional degree + 30 graduate credits)
M.Arch Track 1 (pre-professional degree + 48 graduate credits)
M.Arch Track 3 (non-pre-professional degree + 96 credits)

Next Accreditation Visit for All Programs: 2026

Degrees

- Architecture (MR) (p. 191)
- Architecture (Minor) (p. 196)
- City Design (Certificate) (p. 196)
• Energy and Technology in Architecture (Certificate) (p. 197)
• Public Interest Design (Certificate) (p. 198)

Faculty
Full Professors
Robin Fran Abrams
Thomas M. Barrie
Soolyeon Cho
David Brian Hill
Wayne Place
J. Patrick Rand

Associate Professors
Bryan Bell Jr.
Burak Erdim
George Elvin
Dana Kathleen Gulling
Jianxin Hu
Patricia E. Morgado
Sara Glee Queen
Kristen J. Schaffer

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Traci Rose Rider

Practice/Research/Teaching Professors
Marshall E. Purnell

Emeritus Faculty
Peter Batchelor
Georgia Bizios
Fatih A. Rifki
Henry Sanoff

Adjunct Faculty
Margret Kentgens-Craig

Architecture (MR)

Degree Requirements
Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Architecture" without track specifications.

Track 1
Track 1 is for students with a four-year undergraduate preprofessional degree in architecture (BEDA degree or equivalent).

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall Semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required Course</td>
<td>ARC 500 Architectural Design: Professional Studio</td>
<td>6</td>
</tr>
<tr>
<td>Major Courses 1</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>&quot;Major Courses&quot; will be determined in conjunction with the academic committee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring Semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required Course</td>
<td>ARC 503 Advanced Architectural Design (Series)</td>
<td>6</td>
</tr>
<tr>
<td>Major Course 1</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>&quot;Major Course&quot; will be determined in conjunction with the academic committee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elective Course 1</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>&quot;Elective Course&quot; will be determined in conjunction with the academic committee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall Semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required Course</td>
<td>ARC 503 Advanced Architectural Design (Series)</td>
<td>6</td>
</tr>
<tr>
<td>Major Course or Final Project</td>
<td>ARC 697Final Project Research in Architecture</td>
<td>2</td>
</tr>
<tr>
<td>&quot;Major Course&quot; will be determined in conjunction with the academic committee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elective Course</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>&quot;Elective Course&quot; will be determined in conjunction with the academic committee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring Semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required Course</td>
<td>ARC 503 or ARC 598 Advanced Architectural Design (Series) or Final Project Studio In Architecture</td>
<td>6</td>
</tr>
<tr>
<td>Major Course</td>
<td>&quot;Major Course&quot; will be determined in conjunction with the academic committee</td>
<td></td>
</tr>
<tr>
<td>Elective Course</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>&quot;Elective Course&quot; will be determined in conjunction with the academic committee</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 39
Architecture Electives: 24 credits must include ARC 561 The Practice of Architecture and may include 6 credits taken from 400 level or above courses offered within the College of Design with LAR, ID, GD, or A+D prefixes. ARC courses must be at the 500 level or above.

If the faculty approves the student to undertake a Final Project, the student must take ARC 697 Final Project Research in Architecture as 3 credits of Architecture Elective and will substitute ARC 598 Final Project Studio In Architecture for the ARC 503 Advanced Architectural Design (Series) in the last semester.

Track 2

Track 2 is for students with a five-year NAAB accredited Bachelor of Architecture degree.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall Semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required Course</td>
<td>ARC 503 Advanced Architectural Design (Series)</td>
<td>6</td>
</tr>
<tr>
<td>Major Course</td>
<td>&quot;Major Course&quot; will be determined in conjunction with the academic committee</td>
<td>3</td>
</tr>
<tr>
<td>Elective Course</td>
<td>&quot;Elective Course&quot; will be determined in conjunction with the academic committee</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Hours</strong></td>
<td>12</td>
</tr>
<tr>
<td>Spring Semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required Course</td>
<td>ARC 697 Final Project Research in Architecture</td>
<td>3</td>
</tr>
<tr>
<td>Major Course</td>
<td>&quot;Major Course&quot; will be determined in conjunction with the academic committee</td>
<td>3</td>
</tr>
<tr>
<td>Elective Course</td>
<td>&quot;Elective Course&quot; will be determined in conjunction with the academic committee</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Hours</strong></td>
<td>9</td>
</tr>
<tr>
<td><strong>Second Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall Semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required Course</td>
<td>ARC 598 Final Project Studio In Architecture</td>
<td>6</td>
</tr>
<tr>
<td>Elective Course</td>
<td>&quot;Elective Course&quot; will be determined in conjunction with the academic committee</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Hours</strong></td>
<td>9</td>
</tr>
<tr>
<td></td>
<td><strong>Total Hours</strong></td>
<td>30</td>
</tr>
</tbody>
</table>

1 Architecture Electives: 18 credits may include 6 credits taken from 400 level or above courses offered within the College of Design with LAR, ID, GD, or A+D prefixes. ARC courses must be at the 500 level or above.

2 Track 2 students must take ARC 697 Final Project Research as 3 credits of Architecture Elective and ARC 598 Final Project Studio in the last semester.

Track 3

Track 3 is for students without a preprofessional degree in architecture.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required Courses</td>
<td>ARC 450 Architectural Drawing</td>
<td>6</td>
</tr>
<tr>
<td>ARC 451 Digital Drawing and Modeling</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Hours</strong></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td><strong>Total Hours</strong></td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Second Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall Semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required Courses</td>
<td>ARC 403 Architectural Design Fundamentals: Environment</td>
<td>12</td>
</tr>
<tr>
<td>ARC 211 Natural Systems and Architecture</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>ARC 241 History of World Architecture</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Hours</strong></td>
<td>12</td>
</tr>
<tr>
<td>Spring Semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required Courses</td>
<td>ARC 404 Architectural Design Fundamentals: Form</td>
<td>12</td>
</tr>
<tr>
<td>ARC 232 Structures and Materials</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>ARC 242 History of Western Architecture</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Hours</strong></td>
<td>12</td>
</tr>
<tr>
<td><strong>Third Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall Semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required Course</td>
<td>ARC 503 Advanced Architectural Design (Series)</td>
<td>6</td>
</tr>
<tr>
<td>Elective Courses</td>
<td>&quot;Elective Courses&quot; will be determined in conjunction with the academic committee</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td><strong>Hours</strong></td>
<td>12</td>
</tr>
</tbody>
</table>
### Spring Semester

**Required Course**
- ARC 503 Advanced Architectural Design (Series) 6

**Elective Courses**
- "Elective Courses" will be determined in conjunction with the academic committee 6

---

**Total Hours**
- 12

---

**Fourth Year**

**Fall Semester**

**Required Course**
- ARC 503 Advanced Architectural Design (Series) 6

**Elective Courses**
- "Elective Courses" will be determined in conjunction with the academic committee 6

---

**Total Hours**
- 12

---

1. Architecture Electives: 24 credits must include ARC 561 The Practice of Architecture and may include 6 credits taken from 400 level or above courses offered within the College of Design with LAR, ID, GD, or A+D prefixes. ARC courses must be at the 500 level or above.

2. If the faculty approves the student to undertake a Final Project, the student must take ARC 697 Final Project Research in Architecture as 3 credits of Architecture Elective and will substitute ARC 598 Final Project Studio In Architecture for the ARC 503 Advanced Architectural Design (Series) in the last semester.

### Faculty

**Full Professors**
- Robin Fran Abrams
- Thomas M. Barrie
- Soolyeon Cho
- David Brian Hill
- Wayne Place
- J. Patrick Rand

**Associate Professors**
- Bryan Bell Jr.
- Burak Erdim
- George Elvin
- Dana Kathleen Gulling
- Jianxin Hu
- Patricia E. Morgado
- Sara Glee Queen
- Kristen J. Schaffer

### Assistant Professors

- Traci Rose Rider

### Practice/Research/Teaching Professors

- Marshall E. Purnell

### Emeritus Faculty

- Peter Batchelor
- Georgia Bizios
- Fatih A. Rifki
- Henry Sanoff

### Adjunct Faculty

- Margret Kentgens-Craig

### Architecture (MR): History and Theory of Architecture Concentration

#### Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Architecture" without focus area track specifications.

#### Track 1

Track 1 is for students with a four-year undergraduate preprofessional degree in architecture (BEDA degree or equivalent).

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fall Semester</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required Course</td>
<td>ARC 500 Architectural Design: Professional Studio</td>
<td>6</td>
</tr>
<tr>
<td>Major Courses</td>
<td>&quot;Major Courses&quot; will be determined in conjunction with the academic committee</td>
<td>6</td>
</tr>
<tr>
<td>Hours</td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

| **Spring Semester** |                                      |       |
| Required Course    | ARC 503 Advanced Architectural Design (Series) | 6     |
| Major Course       | "Major Course" will be determined in conjunction with the academic committee | 3     |
| Elective Course    | "Elective Course" will be determined in conjunction with the academic committee | 3     |
| Hours              |                                               | 12    |
Second Year
Fall Semester
Required Course 6
ARC 503 Advanced Architectural Design (Series)
Major Course or Final Project
"Major Course" will be determined in conjunction with the academic committee
ARC 697 Final Project Research in Architecture
Elective Course
"Elective Course" will be determined in conjunction with the academic committee

Hours 6

Spring Semester
Required Course 6
ARC 503 Advanced Architectural Design (Series)
or ARC 598 Final Project Studio In Architecture
Major Course
"Major Course" will be determined in conjunction with the academic committee
Elective Course 3
"Elective Course" will be determined in conjunction with the academic committee

Hours 9

Total Hours 39

1 Architecture Electives: 24 credits must include ARC 561 The Practice of Architecture and may include 6 credits taken from 400 level or above courses offered within the College of Design with LAR, ID, GD, or A+D prefixes. ARC courses must be at the 500 level or above.

2 If the faculty approves the student to undertake a Final Project, the student must take ARC 697 Final Project Research as 3 credits of Architecture Elective and ARC 598 Final Project Studio In Architecture for the ARC 503 Advanced Architectural Design (Series) in the last semester.

Track 2
Track 2 is for students with a five-year NAAB accredited Bachelor of Architecture degree.

Course  Title  Hours
First Year
Fall Semester
Required Course 6
ARC 503 Advanced Architectural Design (Series)
Major Course 3
"Major Course" will be determined in conjunction with the academic committee
Elective Course 3
"Elective Course" will be determined in conjunction with the academic committee

Hours 12

Spring Semester
Required Course 3
ARC 697 Final Project Research in Architecture
Major Course 3

"Major Course" will be determined in conjunction with the academic committee

Track 3
Track 3 is for students without a preprofessional degree in architecture.

Course  Title  Hours
First Year
Summer
Required Courses 6
ARC 450 Architectural Drawing
ARC 451 Digital Drawing and Modeling

Hours 6

Total Hours 6

Fall Semester
Required Courses 12
ARC 403 Architectural Design Fundamentals: Environment
ARC 211 Natural Systems and Architecture
ARC 241 History of World Architecture

Hours 12

Spring Semester
Required Courses 12
ARC 404 Architectural Design Fundamentals: Form
ARC 232 Structures and Materials
ARC 242 History of Western Architecture

Hours 12

Second Year
Fall Semester
Required Courses 15

"Major Course" will be determined in conjunction with the academic committee
Elective Course 3
"Elective Course" will be determined in conjunction with the academic committee

Hours 9

Total Hours 30

1 Architecture Electives: 18 credits may include 6 credits taken from 400 level or above courses offered within the College of Design with LAR, ID, GD, or A+D prefixes. ARC courses must be at the 500 level or above.

2 Track 2 students must take ARC 697 Final Project Research as 3 credits of Architecture Elective and ARC 598 Final Project Studio in Architecture for the ARC 503 Advanced Architectural Design (Series) in the last semester.
Concentration Requirements

Concentration students are required to complete a minimum of 12 hours of approved courses in the History and Theory of Architecture within the existing curricula of the Master of Architecture (Tracks 1, 2, and 3) degrees.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Primary Courses</strong></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Select one or both of the following Primary Courses:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ARC 540 Architectural Theory</td>
<td></td>
</tr>
<tr>
<td></td>
<td>or ARC 545 Methods of Interpretation in Architectural History</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Secondary Courses</strong></td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>ARC 530 Tectonics and Craft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ARC 535 Experiments in Architecture Prototypes</td>
<td></td>
</tr>
</tbody>
</table>

Faculty

**Full Professors**

Robin Fran Abrams
Thomas M. Barrie
Soolyeon Cho
David Brian Hill
Wayne Place
J. Patrick Rand

**Associate Professors**

Bryan Bell Jr.
Burak Erdim
George Elvin
Dana Kathleen Gulling
Jianxin Hu
Patricia E. Morgado
Sara Glee Queen
Assistant Professors
Traci Rose Rider

Practice/Research/Teaching Professors
Marshall E. Purnell

Emeritus Faculty
Peter Batchelor
Georgia Bizios
Fatih A. Rifki
Henry Sanoff

Adjunct Faculty
Margret Kentgens-Craig

City Design (Certificate)

The Graduate Certificate in City Design is a joint program between the School of Architecture and the Department of Landscape Architecture. The certificate program promotes design inquiry and application at the scale of the city for students and practitioners of architecture and landscape architecture. The program's objectives are to consider the human condition, particularly in making significative urban places; design integrated systems of movement with increased accessibility; promote a greater mix of uses and amenities within a well-scaled urban fabric; foster new opportunities for energy production at the local scale; define new means of 'greening' the city; and capture greater senses of identity, meaning, and quality within the city fabric.

Admissions Requirements
Applicants must complete an application form to be considered for the certificate program. To qualify for admission to the certificate program, students must be enrolled in a professional program in architecture or landscape architecture. At the time of application, students must have a 3.00 grade point average (GPA) in their professional degree program.

Degree Requirements
Students must complete 15 hours of coursework from the course menu, as specified in the certificate application, and have a minimum of 3.00 GPA on all certificate coursework. All grades on courses taken towards the certificate program in courses numbered 400 and above are included in the GPA. Courses at the 300 level and below are not eligible for certificate credit and subsequently do not affect the graduate GPA.

The minimum grade to receive certificate credit can be no lower than B-. Students who take letter-graded 400-, 500-, and 700-level courses do not have the option of taking the courses for ‘credit only’ if they intend for the course to be part of the graduate certificate. Transfer credit from other institutions is not allowed for the graduate certificate. All course work must be registered through NC State University.

All certificate requirements must be completed within four (4) calendar years, beginning with the date that the student commences courses.
applicable to the certificate, unless a more restrictive time limit has been established by the program or academic college/school.

**Plan Requirements**

Certificate students are expected to complete a total of 15 hours of coursework. There are three methods of fulfilling this requirement:

- one studio option;
- two studio option;
- no studio option.

Studies must be approved by the certificate coordinator in advance, as to whether they fulfill all, or a majority of the intentions of the certificate program.

Certificates earned will be distributed as: “Graduate Certificate in City Design” without studio option specifications.

**Admissions**

Applicants must complete an application form to be considered for the certificate program. To qualify for admission to the graduate certificate in Energy and Technology in Architecture, students must be enrolled in (or have completed) a professional program in architecture. At the time of application, students must have a 3.00 grade point average (GPA) in their professional degree program.

**Requirements**

Students must complete 15 hours of coursework from the course menu, as specified in the certificate application, and have a minimum of 3.00 GPA on all certificate coursework. All grades on courses taken towards the certificate program in courses numbered 400 and above are included in the GPA. Courses at the 300 level and below are not eligible for certificate credit and subsequently do not affect the graduate GPA. The minimum grade to receive certificate credit can be no lower than B-.

Students who take letter-graded 400-, 500-, and 700-level courses do not have the option of taking the courses for ‘credit only’ if they intend for the course to be part of the graduate certificate. Transfer credit from other institutions is not allowed for the graduate certificate. All course work must be registered through NC State University.

All certificate requirements must be completed within four (4) calendar years, beginning with the date that the student commences courses applicable to the certificate, unless a more restrictive time limit has been established by the program or academic college/school. A student may obtain more than one certificate. Each certificate must have a least nine (9) credit hours that are unique to it.

**Other Information**

Students in this certificate program will become part of an academic and professional community that offers a broad range of extracurricular activities, including the NC Solar Center GreenBuild Lecture Series, visiting lecturers, and colloquia. Note that academic success might have a strong bearing on admission to a degree program, but completion of the certificate program in no way guarantees entry into a graduate degree program. For more information regarding course requirements and the application process, please contact the certificate program coordinator.

**Plan Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>ARC 570</td>
<td>Anatomy of the City</td>
<td>9</td>
</tr>
<tr>
<td>ARC 503</td>
<td>Advanced Architectural Design (Series)</td>
<td></td>
</tr>
<tr>
<td>or LAR 507</td>
<td>Advanced Topics Studio in Landscape Architecture and Environmental Planning</td>
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</table>

**Elective Courses**

Select at least two courses from the following:

**School of Architecture Courses**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>ARC 544</td>
<td>American City Planning History</td>
<td></td>
</tr>
<tr>
<td>ARC 571</td>
<td>Urban House</td>
<td></td>
</tr>
<tr>
<td>ARC 572</td>
<td>Regional Infrastructures</td>
<td></td>
</tr>
<tr>
<td>ARC 574</td>
<td>Place and Place Making</td>
<td></td>
</tr>
<tr>
<td>ARC 575</td>
<td>Participatory Design in Architecture – course pending Admin Board Approval 2020</td>
<td></td>
</tr>
<tr>
<td>ARC 576</td>
<td>Community Design</td>
<td></td>
</tr>
<tr>
<td>ARC 577</td>
<td>Sustainable Communities</td>
<td></td>
</tr>
<tr>
<td>ARC 589</td>
<td>Architectural Travel Study II</td>
<td>1</td>
</tr>
<tr>
<td>ARC 590</td>
<td>Special Topics in Architecture</td>
<td></td>
</tr>
<tr>
<td>ARC 630</td>
<td>Independent Study</td>
<td>1</td>
</tr>
</tbody>
</table>

**Department of Landscape Architecture Courses**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAR 535</td>
<td>Environmental Social Equity and Design</td>
<td></td>
</tr>
<tr>
<td>LAR 542</td>
<td>Human Use of the Urban Landscape</td>
<td></td>
</tr>
<tr>
<td>LAR 545</td>
<td>City Planning and Design - Building Great Communities</td>
<td></td>
</tr>
<tr>
<td>LAR 582</td>
<td>Special Topics In Landscape Architecture (Intro to Environment and Behavior for Designers)</td>
<td></td>
</tr>
<tr>
<td>LAR 582</td>
<td>Special Topics In Landscape Architecture 1</td>
<td></td>
</tr>
<tr>
<td>LAR 630</td>
<td>Independent Study</td>
<td>1</td>
</tr>
</tbody>
</table>

Total Hours 15

1 Requires approval of certificate coordinator

**Energy and Technology in Architecture (Certificate)**

The Graduate Certificate in Energy and Technology in Architecture provides students the opportunity to focus their elective studies through courses and design studio(s) that concentrate on building energy systems along with other building systems. The program’s objectives are to provide educational opportunities for architecture graduate students who wish to acquire knowledge and skills in the design and operation of building system at site and building levels, with an emphasis on energy and materials; to advocate for the importance of energy efficiency over the entire life cycle of a building; and to make our students more competitive in the fields of architectural practice, building engineering, and construction. This certificate program also provides unique interdisciplinary academic and research opportunities among the College of Design, programs within the College of Engineering, NC Solar Center, and building design industries/organizations (i.e. architecture, engineering, general contracting, real estate companies, and public policy agencies).
Public Interest Design (Certificate)

Elective Courses

See "Elective Courses" listed below

Total Hours 15

1 Students have the option to take a third elective course from "Elective Courses" listed below.

Elective Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>ARC 503</td>
<td>Advanced Architectural Design (Series) (Collaborative Design Studio: Architecture + Engineering)</td>
<td>6</td>
</tr>
<tr>
<td>ARC 503</td>
<td>Advanced Architectural Design (Series) (Airport Design)</td>
<td>6</td>
</tr>
<tr>
<td>ARC 503</td>
<td>Advanced Architectural Design (Series) (High-rise Building Design)</td>
<td>6</td>
</tr>
<tr>
<td>ARC 503</td>
<td>Advanced Architectural Design (Series) (Production for Architecture)</td>
<td>6</td>
</tr>
<tr>
<td>ARC 520</td>
<td>Sustainable Architecture</td>
<td>3</td>
</tr>
<tr>
<td>ARC 521</td>
<td>Daylighting and Passive Energy Systems for Architecture</td>
<td>3</td>
</tr>
<tr>
<td>ARC 522</td>
<td>Building Energy Efficiency &amp; Renewable Energy for Architecture</td>
<td>3</td>
</tr>
<tr>
<td>ARC 523</td>
<td>Building Energy Modeling and Simulation</td>
<td>3</td>
</tr>
<tr>
<td>ARC 524</td>
<td>Building Energy Optimization</td>
<td>3</td>
</tr>
<tr>
<td>ARC 530</td>
<td>Tectonics and Craft</td>
<td>3</td>
</tr>
<tr>
<td>ARC 536</td>
<td>Materials for Design</td>
<td>3</td>
</tr>
<tr>
<td>ARC 537</td>
<td>Digital Materials Translations</td>
<td>3</td>
</tr>
<tr>
<td>ARC 538</td>
<td>Manufacturing Architecture</td>
<td>3</td>
</tr>
<tr>
<td>CE 504</td>
<td>Airport Planning and Design</td>
<td>3</td>
</tr>
<tr>
<td>HI 540</td>
<td>American Environmental History</td>
<td>3</td>
</tr>
<tr>
<td>HI 585</td>
<td>History of American Technology</td>
<td>3</td>
</tr>
<tr>
<td>ID 500</td>
<td>Advanced Industrial Design (Series)</td>
<td>6</td>
</tr>
<tr>
<td>ID 511</td>
<td>Industrial Design Materials and Processes I</td>
<td>3</td>
</tr>
<tr>
<td>ID 512</td>
<td>Industrial Design Materials and Processes II</td>
<td>3</td>
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<tr>
<td>ID 582</td>
<td>Special Topics in Industrial Design</td>
<td>1-6</td>
</tr>
<tr>
<td>MAE 589</td>
<td>Special Topics in Mechanical Engineering</td>
<td>1-6</td>
</tr>
<tr>
<td>MSE 556</td>
<td>Composite Materials</td>
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<tr>
<td>MSE 576</td>
<td>Technology Entrepreneurship and Commercialization I</td>
<td>3</td>
</tr>
<tr>
<td>MSE 577</td>
<td>Technology Entrepreneurship and Commercialization II</td>
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Energy-Focused Courses

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<tbody>
<tr>
<td>ARC 503</td>
<td>Advanced Architectural Design (Series) (Collaborative Design Studio: Architecture + Engineering)</td>
<td>6</td>
</tr>
<tr>
<td>ARC 503</td>
<td>Advanced Architectural Design (Series) (Airport Design)</td>
<td>6</td>
</tr>
<tr>
<td>ARC 520</td>
<td>Sustainable Architecture</td>
<td>3</td>
</tr>
<tr>
<td>ARC 521</td>
<td>Daylighting and Passive Energy Systems for Architecture</td>
<td>3</td>
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<tr>
<td>ARC 522</td>
<td>Building Energy Efficiency &amp; Renewable Energy for Architecture</td>
<td>3</td>
</tr>
<tr>
<td>ARC 523</td>
<td>Building Energy Modeling and Simulation</td>
<td>3</td>
</tr>
<tr>
<td>ARC 524</td>
<td>Building Energy Optimization</td>
<td>3</td>
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Material/Tectonic-Focused Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>ARC 503</td>
<td>Advanced Architectural Design (Series) (High-rise Building Design)</td>
<td>6</td>
</tr>
<tr>
<td>ARC 503</td>
<td>Advanced Architectural Design (Series) (Production for Architecture)</td>
<td>6</td>
</tr>
<tr>
<td>ARC 530</td>
<td>Tectonics and Craft</td>
<td>3</td>
</tr>
<tr>
<td>ARC 536</td>
<td>Materials for Design</td>
<td>3</td>
</tr>
<tr>
<td>ARC 537</td>
<td>Digital Materials Translations</td>
<td>3</td>
</tr>
<tr>
<td>ARC 538</td>
<td>Manufacturing Architecture</td>
<td>3</td>
</tr>
<tr>
<td>ARC 534</td>
<td>Design of Architectural Details</td>
<td>3</td>
</tr>
<tr>
<td>ARC 535</td>
<td>Experiments in Architecture Prototypes</td>
<td>3</td>
</tr>
</tbody>
</table>

ETA Certificate Course Structure

Certificate students are required to take at least one course in each of the above two categories to achieve the learning outcomes defined for the program.

Faculty

Full Professors

Soolyeon Cho
David Hill
Wayne Place
Pat Rand

Associate Professors

Dana Gulling
Jianxin Hu

Assistant Professors

Traci Rider

Public Interest Design (Certificate)

Plan Requirements

The Graduate Certificate in Public Interest Design is divided into three options based on design and studio courses.

Certificates earned will be distributed as: "Graduate Certificate in Public Interest Design" without course option specifications.
Option One

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td>Required Course</td>
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</tr>
<tr>
<td></td>
<td>ARC 563 Public Interest Design Seminar: Case Studies and</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Current Issues</td>
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</tr>
<tr>
<td></td>
<td>Design Studio Courses</td>
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<tr>
<td></td>
<td>See &quot;Design Studio Courses&quot; listed below</td>
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Option Two

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<tr>
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<td>Required Course</td>
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<tr>
<td></td>
<td>ARC 563 Public Interest Design Seminar: Case Studies and</td>
<td>3</td>
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<tr>
<td></td>
<td>Current Issues</td>
<td></td>
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<td></td>
<td>Design Studio Course</td>
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<td></td>
<td>See &quot;Design Studio Courses&quot; listed below</td>
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<tr>
<td></td>
<td>Seminar Courses</td>
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<tr>
<td></td>
<td>See &quot;Seminar Courses&quot; listed below</td>
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Option 3

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<tbody>
<tr>
<td></td>
<td>Required Course</td>
<td></td>
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<tr>
<td></td>
<td>ARC 563 Public Interest Design Seminar: Case Studies and</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Current Issues</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Seminar Courses</td>
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</tr>
<tr>
<td></td>
<td>See &quot;Seminar Courses&quot; listed below</td>
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<td></td>
<td>Total Hours</td>
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</table>

Design Studio Electives

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LAR 500 Landscape Design Studio</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>ARC 503 Advanced Architectural Design (Series) (Affordable</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Housing Studio)</td>
<td></td>
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<tr>
<td></td>
<td>ARC 503/563 Advanced Architectural Design (Series) (PID</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Incubator Studio)</td>
<td></td>
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<tr>
<td></td>
<td>ARC 503 Advanced Architectural Design (Series) (Coastal</td>
<td>6</td>
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<tr>
<td></td>
<td>Dynamics Studio)</td>
<td></td>
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<tr>
<td></td>
<td>ARC 503 Advanced Architectural Design (Series) (Design</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Build Summer Studio)</td>
<td></td>
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<tr>
<td></td>
<td>LAR 582 Special Topics In Landscape Architecture (Coastal</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Dynamics Studio)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Hours</td>
<td>15</td>
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</table>

Seminar Electives

<table>
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<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LAR 582 Special Topics In Landscape Architecture (Introduction to Research Methods)</td>
<td>3</td>
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<tr>
<td></td>
<td>LAR 582 Special Topics In Landscape Architecture (Human Centered Design)</td>
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<tr>
<td></td>
<td>ID 582 Special Topics In Industrial Design (Human Centered Design)</td>
<td>3</td>
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<tr>
<td></td>
<td>ARC 590 Special Topics in Architecture (DIY Cartography) or ADN 592 Graduate Art + Design Special Topics</td>
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<td>Total Hours</td>
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Public Administration Seminar Electives

<table>
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<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td></td>
<td>PA 510 Public Administration Institutions and Values</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PA 512 The Budgetary Process</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PA 521 Government and Planning</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PA 535 Problem Solving for Public and Nonprofit Managers</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PA 536 Management of Nonprofit Organizations</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PA 546 Seminar in Program Evaluation</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PA 553 Disaster, Crisis and Emergency Management and Policy</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PA 598 Special Topics in Public Administration (Grant Writing and Management)</td>
<td>3</td>
</tr>
</tbody>
</table>

Art and Design

The Art and Design program offers an educational structure that creates a new art and design professional: one for whom artistic and practical talents are developed as different expressions of individual potential. Our objectives are to graduate highly educated art and design professionals with integrated competencies in art, design, aesthetics, theory, hand and digital technologies, design process, and the combination of skills in the chosen concentration with other disciplines of human knowledge.

Admission Requirements

Students will be required to submit a portfolio of past work in electronic format; three letters of recommendation; a statement of personal goals; and transcripts of undergraduate work (minimum undergraduate GPA of 3.0). An interview will be required, but in cases of international applicants or those quite distant from NC State University, may be conducted by means of a long distance phone conversation or may be waived at the faculty’s discretion.

Masters Degree Requirements

The program of study requires a minimum of 48 credit hours of graduate work depending on background preparation of the applicant. Separate tracks of 60 and 72 credit hours accommodate students changing design disciplines or with insufficient background in the chosen concentration.

Other Information

We will only admit students to the program in the fall semester each year. Deadline for application is January 5.

Degrees

- Art and Design (MR) (p. 200)

Faculty

Full Professors

Chandra D Cox
Herman Marchant
Associate Professors

Tania Leigh Allen
Patrick J Fitzgerald
Derek Ham
Kathleen Callahan Rieder
Marc Ernest Russo

Assistant Professors

Todd Michael Berreth
Justin Johnson

Emeritus Faculty

Susan D. Brandeis
Charles Edward Joyner
Vita Karina Plume
Dana Gordon Raymond
Susan Margaret Toplikar

Art and Design (MR)

Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Art and Design" without track specifications.

Track 1

<table>
<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
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<tr>
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<tr>
<td>ADN 510</td>
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<td>ADN 511</td>
<td>Graduate Seminar IV: Final Project Documentation</td>
<td></td>
</tr>
<tr>
<td>ADN 570</td>
<td>Graduate Studio III: Final Project Definition</td>
<td></td>
</tr>
<tr>
<td>ADN 571</td>
<td>Fibers and Surface Design Seminar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elective Courses</td>
<td>12</td>
</tr>
<tr>
<td>ADN 502</td>
<td>Advanced Visual Laboratory</td>
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<tr>
<td>ADN 592</td>
<td>Graduate Art + Design Special Topics</td>
<td></td>
</tr>
<tr>
<td>ADN 630</td>
<td>Independent Study in Art &amp; Design</td>
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Track 2

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<td>Graduate Seminar: Art + Design as Future Making</td>
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<td>ADN 510</td>
<td>Graduate Seminar III: Final Project Research</td>
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<td>ADN 511</td>
<td>Graduate Seminar IV: Final Project Documentation</td>
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</tr>
<tr>
<td>ADN 560</td>
<td>Graduate Studio I: Immersive and Experimental Narratives</td>
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<td>ADN 561</td>
<td>Graduate Studio II: Exploring the HyperReal: Materiality, Reality and Speculation</td>
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<td>Graduate Studio III: Final Project Definition</td>
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<td>Fibers and Surface Design Seminar</td>
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Track 3

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<td>ADN 561</td>
<td>Graduate Studio II: Exploring the HyperReal: Materiality, Reality and Speculation</td>
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<td>Total Hours</td>
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</table>

1 2 credit hours 400-level studio, 12 credit hours electives
Faculty

Full Professors
Chandra D. Cox
Hernan Marchant
J. Mark Scearce

Associate Professors
Tania Leigh Allen
Patrick J. Fitzgerald
Derek Ham
Kathleen Callahan Rieder
Marc Ernest Russo

Assistant Professors
Todd Michael Berreth
Justin Johnson

Emeritus Faculty
Susan D. Brandeis
Charles Edward Joyner
Vita Karina Plume
Dana Gordon Raymond
Susan Margaret Toplikar

Design

At the College of Design, NC State University, the mission of the Doctoral Programs in Design (comprising both the Ph.D. and D.Des. programs) is to improve the human condition through design research and scholarship. This mission is built in equal parts on the recognition of a fertile common ground among the design disciplines and on the need for specificity and depth within them.

The Doctor of Philosophy (Ph.D.) in Design program values a broad range of research interests that aim to improve the human condition through design. The aim of the Ph.D. in Design is to prepare students holding previous degrees in design disciplines to conduct research in the areas of: design for health and well-being; design for learning; design for sustainability; design and technology; design and the urban context; design methods; and design history and criticism.

The Doctor of Design (D.Des.) program provides distance-education opportunities for established design professionals to conduct original investigations using design practices, cases, and methods. D.Des. students pursue practice-based design research in support of professions creating the artifacts, communications, environments, organizing structures, and systems of the future.

Both programs provide a forum for connecting design research to the needs of society, by promoting the application of new knowledge in design and addressing design impacts on larger systems.

Admission Requirements

For admission to both the Ph.D. and D.Des. programs, submit official transcripts from earned undergraduate and graduate degrees (two minimum); three letters of reference; TOEFL scores (for international students); residency statement (US residents only); College of Design personal data form; statement of research intent; and portfolio. GRE scores are required for all Ph.D. applicants, however, if reasoning and writing ability is clearly demonstrated through previous graduate degrees, or professional or academic work products and impact, D.Des. applicants may ask for a waiver of GRE scores.

Doctoral Degree Requirements

Both programs of study require a minimum of 54 credit hours of graduate work beyond the Master’s degree.

Degrees

- Design (PhD) (p. 202)
- Design (DDes) (p. 203)

Faculty

Full Professors
Robin Fran Abrams
Thomas M. Barrie
Kofi Malik Boone
Chandra D. Cox
Denise M. Crisp
Margaret Elen Deming
Andrew Alan Fox
David Brian Hill
Mark Elison Hoversten
Sharon Melissa Bennett Joines
Tsailu Liu
Robin C. Moore
Wayne Place
J. Mark Scearce
Gavin Paul Smith

Associate Professors
Tania Leigh Allen
Helen Saunders Armstrong
Timothy W. Buie
Degree Requirements

<table>
<thead>
<tr>
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<tr>
<td>DDN 701</td>
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<td>Research Paradigms in Design</td>
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<td>DDN 809</td>
<td>Dissertation Colloquium</td>
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<td>Student must take an additional methods courses determined in conjunction with the academic committee</td>
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<td>Students must take a field foundation course determined in conjunction with the academic committee</td>
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<td>Doctoral Preliminary Examination</td>
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<td>DDN 893</td>
<td>Doctoral Supervised Research</td>
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<tr>
<td>DDN 895</td>
<td>Doctoral Dissertation Research</td>
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<td></td>
<td>&quot;Elective Courses&quot; that will be applied to reach 72 total hours will be determined in conjunction with the academic committee</td>
<td>33</td>
</tr>
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</table>

Total Hours 72

1 Must take course 3 times
2 Not counted for graduation

Faculty

Full Professors
Robin Fran Abrams
Thomas M. Barrie
Kofi Malik Boone
Chandra D. Cox
Denise M. Crisp
Margaret Elen Deming
Andrew Alan Fox
David Brian Hill
Mark Elison Hoversten
Sharon Melissa Bennett Joines
Tsallu Liu
Robin C. Moore
Wayne Place
J. Mark Scearce
Gavin Paul Smith

Assistant Professors
Todd Michael Berreth
Burak Erdim
Celen Pasalar
Matthew O. Peterson
Traci Rose Rider
Kelly Ann Umstead

Emeritus Faculty
Eugene H Bressler
Meredith Joy Davis
Haig Khachatoorian
Arthur R Rice
Paul Tesar

Practice/Research/Teaching Professors
Nilda Graciela Cosco
Emily Ryan McCoy
Marshall E. Purnell

Associate Professors
Tania Leigh Allen
Helen Saunders Armstrong
Timothy W. Buie
Degree Requirements

<table>
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<th>Code</th>
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<td></td>
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<td></td>
<td>DDN 740 Introduction to Practice-Based Design Research</td>
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<tr>
<td></td>
<td>DDN 795 Special Topics (DDN 742 Methods in Design Research (cross-listed with DDN 701) – pending Admin Board approval 2020)</td>
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<td>DDN 810 Special Topics (DDN 883 Directed Study [Workshop] Part I – pending Admin Board approval 2020)</td>
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<td>DDN 810 Special Topics (DDN 833 Directed Study [Workshop] Part II – pending Admin Board approval 2020)</td>
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<td>Select four courses of the following:</td>
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<td>DDN 741 Case Study Analysis in Design</td>
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<tr>
<td></td>
<td>DDN 795 Special Topics (DDN 743 Practice Legacy – pending Admin Board Approval 2020)</td>
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<td>DDN 795 Special Topics (DDN 744 Innovation &amp; Entrepreneurship in Design – pending Admin Board Approval 2020)</td>
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<td>Select two courses of the following:</td>
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<td></td>
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<td><strong>Level 4 Courses</strong></td>
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<td>DDN 899 Doctoral Dissertation Preparation</td>
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¹ Students must take 12 total credit hours of DDN 893 Doctoral Supervised Research and 18 total credit hours of DDN 895 Doctoral Dissertation Research

Optional Elective

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<tbody>
<tr>
<td>DDN 810</td>
<td>Special Topics (Topics vary)</td>
<td>1-6</td>
</tr>
</tbody>
</table>

Faculty

Full Professors

Robin Fran Abrams
Thomas M. Barrie
Kofi Malik Boone
Chandra D. Cox
Denise M. Crisp
Margaret Elen Deming
Andrew Alan Fox
Emeritus Faculty
Eugene H Bressler
Meredith Joy Davis
Haig Khachatourian
Arthur R Rice
Paul Tesar

Practice/Research/Teaching Professors
Nilda Graciela Cosco
Emily Ryan McCoy
Marshall E. Purnell

Graphic Design

Overview
The Masters of Graphic Design (MGD) program helps move the passionate student toward a deeper knowledge of graphic and experience design and purposeful, individually driven design practices. Inquiry into contemporary and emergent design issues prepares graduates of the program for leadership positions that both evolve the profession and advance the discipline. Successful completion of the MGD results in a terminal degree, equal to the MFA, and qualifies graduates to teach at the university level or to pursue a PhD in Design.

Faculty charge graduate students to closely examine the cultural and technological situatedness of graphic design and its products, and to seek understanding of the people who use and interact with the things that graphic designers make. Coursework acquaints students with relevant theories and design research methods that frame and ground the design of propositional visual communication systems.

Varied topics prompt students to explore contemporary design concerns: the cultural contexts of design, the influence and experiences of end users, the social and technological environments within which designed artifacts operate. Subtopics within these broad concerns allow faculty and students the opportunity to frame, research, and respond to current and future design challenges.

The MGD program is consistently recognized as one of the top NASAD accredited graduate graphic design programs in the country and one of the few with STEM Classification (CIP). The faculty is nationally and internationally recognized (see Faculty at a Glance). Alumni are designers in leading professional offices around the world, faculty members in colleges and universities throughout the US and Canada, and doctoral students in PhD programs worldwide.

Affordable NC State tuition usually makes the cost of attending NC State well below that of equivalent graduate institutions. For out-of-state students, North Carolina residency laws recognize graduate students as residents after their first year.

MGD II: Two-year Master of Graphic Design Program
The MGD II program targets applicants who have earned a BFA or equivalent in graphic design and are practiced in visual communication,
user interaction design (UI), user experience design (UX) and/or related design fields.

Integrated graduate studios, seminars, and workshops expose students to histories, design-related theories, and research methods relevant to current and emerging practices. Students investigate questions individually and collaboratively around the design of communication and interaction in several ways: through making (visualizations, visual diagrams, and functioning prototypes, for instance); assigned and independent reading and research; discussion and critique; and writing. Students also enroll in at least one elective offered in the college, university, or our affiliate universities, Duke University and UNC, Chapel Hill.

Students create a body of work as they explore a research interest area within studio and seminar subtopics. The experience of creating this work, coupled with researching and writing, positions students to identify a design investigation in their final year, which culminates in the required Final Project. For this work, students comprehensively research an area of interest, design propositional artifacts (findings), document the research and findings in a written thesis, and present the project in a public forum.

**MGD III: Three-year Master of Graphic Design Program**

The MGD III program targets applicants who have some professional experience but who have not earned a first degree in graphic design or have earned a BA with a graphic design concentration. (Note that applicants aiming for a qualifying professional degree in graphic design should apply to the Bachelor of Graphic Design program.)

MGD III students enroll in two semesters of specialized and advanced undergraduate coursework prior to matriculating to the MGD II program. The curriculum includes two studio--based courses and at least two lecture/seminar courses. The 6 credit studios cover systems thinking in design for user experience, visual communication, and other professional graphic design topics while they prepare the student for graduate level inquiry. Additional three credit courses focus on subjects such as mobile interaction, typography, graphic design theory and history, coding and modeling for interface design.

**Admissions Requirements**

Applications for Priority Admission are due to the Graduate School by January 5. Applications are reviewed until all seats are filled. In addition to Graduate School requirements, the Department asks for department personal data forms, a written personal statement, and a website or accessible online PDF portfolio that demonstrates experience and skills in visual communication.

**Degree Requirements**

The MGD (II) degree requires successful completion of 48 total credits, however students typically take advantage of additional coursework during their time at NC State.

The core curriculum consists of a 9-credit studio and a 3-credit seminar -- either Design Methods, Design Frameworks, or Final Project Research -- in each of the first three semesters of study. Students are encouraged to augment their study during this time with 400 or 500 level design coursework that enhances skills and/or investigates topics of interest. For instance, the program offers seminars on Graphic Design Pedagogy, Design Discourse and Typography, and Special Topics in Social Innovation. Students are required to enroll in a 3-credit 400 or 500 level elective within another college at NC State or at nearby Duke University or UNC/Chapel Hill under NC State tuition. The fourth semester is devoted to the final project for 6 credits, under the supervision of three Graphic Design faculty members comprising each student’s graduate committee.

**Degrees**

- Graphic Design (MR) (p. 205)

**Faculty**

**Full Professors**

Denise M. Crisp
Scott Townsend

**Associate Professors**

Helen Armstrong
Kermit L. Bailey
Russell Flinchum
Carolina Gill
Deborah K. Littlejohn

**Emeritus Faculty**

Meredith Joy Davis
Austin S. Lowrey
Martha Scotford

**Graphic Design (MR)**

**Degree Requirements**

Degrees earned will be distributed as: "Master of Graphic Design" without program length specifications.

**Two Year Program**

The MGD II program targets applicants who have earned a BFA or equivalent in graphic design and are practiced in visual communication, user interaction design (UI), user experience design (UX) and/or related design fields.

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<thead>
<tr>
<th>Code</th>
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<tr>
<td>GD 501</td>
<td>Graduate Graphic Design Studio</td>
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<tr>
<td>GD 502</td>
<td>Graduate Graphic Design Studio II</td>
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<td>GD 572</td>
<td>Design as Cultural Artifact</td>
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<tr>
<td>GD 503</td>
<td>Graduate Graphic Design Studio III</td>
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<td>GD 571</td>
<td>Design As Cognitive Artifact</td>
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<tr>
<td>GD 573</td>
<td>New Information Environments</td>
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<tr>
<td>GD 581</td>
<td>Graphic Design Final Project Research</td>
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Three Year Program

The MGD III program targets applicants who have some professional experience but who have not earned a first degree in graphic design or have earned a BA with a graphic design concentration.

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<td>GD 500 Foundations of Graphic Design – course pending Admin Board approval 2020</td>
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<td>GD 592 Special Topics In Graphic Design (Tech Tinkering Seminar)</td>
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<td>GD 303 Graphic Design Theory and Practice</td>
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<td>GD 400 Advanced Graphic Design Studio</td>
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<td>GD 592 Special Topics In Graphic Design (Design Discourse and Typography)</td>
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<td>Elective Course</td>
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Elective Courses:

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<td>GD 203 History of Graphic Design</td>
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<td>GD 317 Typographic Language, Writing, and Reading</td>
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<tr>
<td>GD 417 Information and Publishing Design Systems</td>
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<td></td>
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<tr>
<td>GD 592 Special Topics In Graphic Design (Design Pedagogy)</td>
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</tr>
<tr>
<td>GD 510 Imaging for Graphic Design IV</td>
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<tr>
<td>GD 517 Type IV</td>
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</tr>
</tbody>
</table>

Faculty

Full Professors

Denise M. Crisp
Scott Townsend

Associate Professors

Helen Armstrong
Kermit L. Bailey
Russell Flinchum
Carolina Gill
Deborah K. Littlejohn

Emeritus Faculty

Meredith Joy Davis
Austin S. Lowrey
Martha Scotford

Industrial Design

Industrial Design is the professional service of creating and developing concepts and specifications that optimize the value, function and appearance of products and product systems to the mutual benefit of both user and manufacturer. This service is often provided in the context of a cooperative working relationship with other members of a development group.

Typical groups include management, marketing, engineering and manufacturing specialists. Industrial designers place special emphasis on human characteristics, needs and interests. These require particular understanding of visual, tactile, safety and convenience criteria. Industrial designers combine these considerations with practical concern for technical processes and requirements for manufacture; marketing opportunities and economic constraints; and distribution, sales and servicing arrangements. Industrial designers are guided by the awareness of their obligations to protect and promote public safety and well-being; to respect the environment; and to observe ethical business practices. Augmenting transdisciplinary practices, emerging areas of industrial design include design research and experience design.

Graduates with a Master of Industrial Design have career opportunities in four general areas; corporate design offices in manufacturing companies, design consulting firms, governmental agencies and educational institutions.

Admissions Requirements

Students must make application to the Department of Graphic Design and Industrial Design by January 5. In addition to Graduate School requirements, the Department requires department personal data forms, a digital portfolio of design work, resume, and a statement of intent. The GRE is required for students whose first degree is not in Industrial Design.

Master’s Requirements

The Master of Industrial Design degree requires a minimum of

- 48 credit hours for applications with a Bachelor’s degree in Industrial Design (Track II), or
- 78 credit hours for applications with Bachelor’s degrees in an area other than Industrial Design (Track III).

The program generally does not accept transfer credits in lieu of required coursework at NC State. Studio credits presented for elective transfer must be accompanied by a portfolio of work from the courses under consideration.

Student Financial Support

The Department has limited provisions for tuition remission and assistantships. Assistantships are awarded on the basis of student and departmental needs. Assistantship requests should be made to the Department of Graphic Design and Industrial Design and should be
submitted with the application for admission (for incoming students) or by advertised deadline (for continuing students).

Degrees
- Industrial Design (MR) (p. 207)

Faculty

Full Professors
Sharon Melissa Bennett Joines
Tsailu Liu
Bret Smith

Associate Professors
Timothy W. Buie
Russell Flinchum
Carolina Gill
Percy Rivera Hooper
Bongil Jin
Bryan W. Lafitte

Assistant Professors
Kelly Umstead

Emeritus Faculty
Vincent Foote
Haig Khachatoorian

Industrial Design (MR)

Degree Requirements
Degrees earned will be distributed as: "Master of Industrial Design" without track specifications.

Track 2

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>ID 500</td>
<td>Advanced Industrial Design (Series) (Human Centered Design Studio)</td>
<td>36</td>
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<tr>
<td>ID 500</td>
<td>Advanced Industrial Design (Series) (Design Research Studio)</td>
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<tr>
<td>ID 500</td>
<td>Advanced Industrial Design (Series) (Product Innovation Lab)</td>
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<td>ID 588</td>
<td>Final Project Studio In Industrial Design</td>
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<tr>
<td>ID 512</td>
<td>Industrial Design Materials and Processes II</td>
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<tr>
<td>ID 582</td>
<td>Special Topics In Industrial Design (Research Methods in Design)</td>
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</tr>
<tr>
<td>ID 581</td>
<td>Industrial Design Project Preparation</td>
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</table>

Elective Courses
Students will select two design electives that will be determined in conjunction with the academic committee

Total Hours 48

Track 3

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>ID 582</td>
<td>Special Topics In Industrial Design</td>
<td>12</td>
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</tbody>
</table>

Elective Courses
Students will select two design electives that will be determined in conjunction with the academic committee

Total Hours 48

1 Students are required to take 30 hours of pre-degree coursework. These courses will not be included on the Graduate Plan of Work.

Faculty

Full Professors
Sharon Melissa Bennett Joines
Tsailu Liu
Bret Smith
Landscape Architecture

Course offerings or research facilities are available in the following areas: site planning and design, landscape history, urban public spaces, community design, regional design, resource management, outdoor learning environments, international urban and rural landscapes, and specialized landscapes.

Admission Requirements

The best-qualified applicants are accepted up to the maximum number of spaces that are available for new students. Exceptions to the minimum 3.00 GPA may be made for students with special backgrounds, abilities and interests.

Master's Degree Requirements

• Accredited First Professional Degree in Landscape Architecture: Candidates follow an 82-hour sequence of courses over a six-semester period. Three semesters of the program of study are determined by the required curriculum. The last three semesters of study are outlined by the student's Chair of the Department, Director of Graduate Programs, and/or advisor. Research and case studies lead to the final project and design application. The investigative direction is set in collaboration with the chair of the faculty committee. A formal presentation of findings to the faculty, student body and local professionals is required. The summary research and project report must be submitted to the College of Design faculty to meet the graduation requirements.

• Advanced Studies in Landscape Architecture: Candidates with an accredited undergraduate Landscape Architecture degree follow a 48-hour sequence of courses. Twenty-seven hours of electives are chosen through advising with the Director of Graduate Programs, advisors and faculty committee. Comprehensive research work is required for a final project with a final report is required. A formal presentation of findings to the faculty, student body and local professionals is also required.

Other Relevant Information

Students have the option of including a graduate minor in their course of studies. Minors can be in any other graduate program offered at NC State, UNC-CH and Duke University. Some examples of graduate minors are: natural resources, parks, recreation and tourism management, architecture, education, planning, civil engineering, and art and design. The College of Design includes the Center for Universal Design, the Office of Research, Extension & Engagement, and the Natural Learning Initiative.

Degrees

• Landscape Architecture (MR) (p. 208)

Faculty

Full Professors
Kofi Malik Boone
Margaret Evans Calkins
Margaret Elen Deming
Andrew Alan Fox
Mark Elison Hoversten
Robin C. Moore
Gavin Paul Smith

Associate Professors
Carla F. Delcambre
Fernando H. Magallanes
Celen Pasalar
Julieta Trevino Sherk

Practice/Research/Teaching Professors
Nilda Graciela Cosco
Charles Albert Flink
Emily Ryan McCoy
Rodney Leon Swink

Emeritus Faculty
Eugene H Bressler
Arthur Rice

Landscape Architecture (MR)

Degree Requirements

Degrees earned will be distributed as: "Master of Landscape Architecture" without track specifications.
**Track 1**

This curriculum is designed for graduate students with prior LAAB accredited degrees in landscape architecture.

### Curriculum A

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
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<td><strong>Studio Courses</strong></td>
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<tr>
<td></td>
<td>Select a minimum of three of the following:</td>
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<tr>
<td>LAR 502</td>
<td>Site Design and Environmental Planning Studio</td>
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<tr>
<td>LAR 503</td>
<td>Landscape Architecture Design Development &amp; Construction Documentation Studio</td>
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</tr>
<tr>
<td>LAR 507</td>
<td>Advanced Topics Studio in Landscape Architecture and Environmental Planning</td>
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<tr>
<td>LAR 697</td>
<td>Design Research Project Independent Study</td>
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<td><strong>Seminar Courses</strong></td>
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<td>Select a minimum of ten courses of the following:</td>
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<td>LAR 517</td>
<td>GIS Applications in Landscape Architecture and Environmental Planning</td>
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</tr>
<tr>
<td>LAR 520</td>
<td>Environment and Culture</td>
<td></td>
</tr>
<tr>
<td>LAR 523</td>
<td>Landscape Architecture Plant Identification</td>
<td></td>
</tr>
<tr>
<td>LAR 524</td>
<td>Planting Design Applications in Landscape Architecture</td>
<td></td>
</tr>
<tr>
<td>LAR 527</td>
<td>Landform, Grading, and Environmental Site Systems</td>
<td></td>
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<tr>
<td>LAR 528</td>
<td>Landscape Architecture Construction Materials and Methods</td>
<td></td>
</tr>
<tr>
<td>LAR 582</td>
<td>Special Topics In Landscape Architecture (History of Landscape Architecture)</td>
<td></td>
</tr>
<tr>
<td>LAR 582</td>
<td>Special Topics In Landscape Architecture (Landscape Architecture Immersion)</td>
<td></td>
</tr>
<tr>
<td>LAR 534</td>
<td>Landscape Architecture Theory and Criticism</td>
<td></td>
</tr>
<tr>
<td>LAR 545</td>
<td>City Planning and Design - Building Great Communities</td>
<td></td>
</tr>
<tr>
<td>LAR 540</td>
<td>Research Methods in Landscape Architecture and Environmental Planning</td>
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</tr>
<tr>
<td>LAR 550</td>
<td>Landscape Architecture Professional Practice</td>
<td></td>
</tr>
<tr>
<td>LAR 535</td>
<td>Environmental Social Equity and Design</td>
<td></td>
</tr>
<tr>
<td>LAR 543</td>
<td>Landscape Performance and Metrics</td>
<td></td>
</tr>
<tr>
<td>LAR 544</td>
<td>Contemporary Issues in Landscape Preservation</td>
<td></td>
</tr>
<tr>
<td>LAR 546</td>
<td>The Landscape Imperative</td>
<td></td>
</tr>
<tr>
<td>LAR 552</td>
<td>Survey of Natural Hazards and Disasters – course pending Admin Board approval 2020</td>
<td></td>
</tr>
<tr>
<td>LAR 553</td>
<td>Natural Hazards, Disasters and Climate Change Adaptation Lecture Series – course pending Admin Board approval 2020</td>
<td></td>
</tr>
<tr>
<td>LAR 554</td>
<td>Survey of Natural Hazards and Disasters – course pending Admin Board approval 2020</td>
<td></td>
</tr>
<tr>
<td>LAR 582</td>
<td>Special Topics In Landscape Architecture (Sustainable Food Systems)</td>
<td></td>
</tr>
<tr>
<td>LAR 582</td>
<td>Special Topics In Landscape Architecture (Design Week)</td>
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</tr>
<tr>
<td>LAR 582</td>
<td>Special Topics In Landscape Architecture (Advanced Digital Media)</td>
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<tr>
<td>LAR 582</td>
<td>Special Topics In Landscape Architecture (Sustainable Sites)</td>
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Total Hours: 48

### Curriculum B

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<th>Code</th>
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<td>LAR 508</td>
<td>Landscape Architecture Design Research Project</td>
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<td>LAR 540</td>
<td>Research Methods in Landscape Architecture and Environmental Planning</td>
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<tr>
<td></td>
<td><strong>Additional Courses</strong></td>
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<td>&quot;Additional Courses&quot; are determined in conjunction with the academic committee to meet the 30 total hours</td>
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</tbody>
</table>

Total Hours: 30

**Track 2**

This LAAB Accredited curriculum is designed for graduate students with prior degrees in landscape architecture, architecture, or related design programs that are not LAAB accredited; also graduate students obtaining concurrent degrees in Architecture, Urban Design or Urban Planning.

<table>
<thead>
<tr>
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<td>LAR 501</td>
<td>Landscape Architecture Introduction Design Studio</td>
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<td>or LAR 507</td>
<td>Advanced Topics Studio in Landscape Architecture and Environmental Planning</td>
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<tr>
<td>LAR 502</td>
<td>Site Design and Environmental Planning Studio</td>
<td></td>
</tr>
<tr>
<td>LAR 503</td>
<td>Landscape Architecture Design Development &amp; Construction Documentation Studio</td>
<td></td>
</tr>
<tr>
<td>LAR 507</td>
<td>Advanced Topics Studio in Landscape Architecture and Environmental Planning</td>
<td></td>
</tr>
<tr>
<td>LAR 507</td>
<td>Advanced Topics Studio in Landscape Architecture and Environmental Planning</td>
<td></td>
</tr>
<tr>
<td>or LAR 697</td>
<td>Design Research Project Independent Study</td>
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**Representation and Modeling Sequence**

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<td>GIS Applications in Landscape Architecture and Environmental Planning</td>
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<td>LAR 520</td>
<td>Environment and Culture</td>
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<tr>
<td>LAR 523</td>
<td>Landscape Architecture Plant Identification</td>
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</tr>
<tr>
<td>LAR 524</td>
<td>Planting Design Applications in Landscape Architecture</td>
<td></td>
</tr>
<tr>
<td>LAR 527</td>
<td>Landform, Grading, and Environmental Site Systems</td>
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<tr>
<td>LAR 528</td>
<td>Landscape Architecture Construction Materials and Methods</td>
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</tr>
<tr>
<td>LAR 582</td>
<td>Special Topics In Landscape Architecture (History of Landscape Architecture)</td>
<td></td>
</tr>
<tr>
<td>LAR 582</td>
<td>Special Topics In Landscape Architecture (Landscape Architecture Immersion)</td>
<td></td>
</tr>
<tr>
<td>LAR 534</td>
<td>Landscape Architecture Theory and Criticism</td>
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</tr>
<tr>
<td>LAR 550</td>
<td>Landscape Architecture Professional Practice</td>
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<td>LAR 535</td>
<td>Environmental Social Equity and Design</td>
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<td>LAR 543</td>
<td>Landscape Performance and Metrics</td>
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<td>LAR 544</td>
<td>Contemporary Issues in Landscape Preservation</td>
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<tr>
<td>LAR 546</td>
<td>The Landscape Imperative</td>
<td></td>
</tr>
<tr>
<td>LAR 552</td>
<td>Survey of Natural Hazards and Disasters – course pending Admin Board approval 2020</td>
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<tr>
<td>LAR 553</td>
<td>Natural Hazards, Disasters and Climate Change Adaptation Lecture Series – course pending Admin Board approval 2020</td>
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<tr>
<td>LAR 554</td>
<td>Survey of Natural Hazards and Disasters – course pending Admin Board approval 2020</td>
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<tr>
<td>LAR 582</td>
<td>Special Topics In Landscape Architecture (Sustainable Food Systems)</td>
<td></td>
</tr>
<tr>
<td>LAR 582</td>
<td>Special Topics In Landscape Architecture (Design Week)</td>
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</tr>
<tr>
<td>LAR 582</td>
<td>Special Topics In Landscape Architecture (Advanced Digital Media)</td>
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</tr>
<tr>
<td>LAR 582</td>
<td>Special Topics In Landscape Architecture (Sustainable Sites)</td>
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**Site Works Sequence**

<table>
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<tr>
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<tbody>
<tr>
<td>LAR 520</td>
<td>Environment and Culture</td>
<td>13</td>
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<tr>
<td>LAR 523</td>
<td>Landscape Architecture Plant Identification</td>
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<tr>
<td>LAR 524</td>
<td>Planting Design Applications in Landscape Architecture</td>
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</tr>
<tr>
<td>LAR 527</td>
<td>Landform, Grading, and Environmental Site Systems</td>
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<tr>
<td>LAR 528</td>
<td>Landscape Architecture Construction Materials and Methods</td>
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**History, Theory and Criticism Sequence**

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<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>LAR 582</td>
<td>Special Topics In Landscape Architecture (History of Landscape Architecture)</td>
<td>12</td>
</tr>
<tr>
<td>LAR 582</td>
<td>Special Topics In Landscape Architecture (Landscape Architecture Immersion)</td>
<td></td>
</tr>
<tr>
<td>LAR 534</td>
<td>Landscape Architecture Theory and Criticism</td>
<td></td>
</tr>
</tbody>
</table>
LAR 545  City Planning and Design - Building Great Communities  

**Research and Professional Practice Sequence**  
LAR 540  Research Methods in Landscape Architecture and Environmental Planning  
LAR 550  Landscape Architecture Professional Practice  

**Elective Courses**  
LAR 535  Environmental Social Equity and Design  
LAR 543  Landscape Performance and Metrics  
LAR 544  Contemporary Issues in Landscape Preservation  
LAR 546  The Landscape Imperative  
LAR 552  Survey of Natural Hazards and Disasters – course pending Admin Board approval 2020  
LAR 553  Natural Hazards, Disasters and Climate Change Adaptation Lecture Series – course pending Admin Board approval 2020  
LAR 554  Survey of Natural Hazards and Disasters – course pending Admin Board approval 2020  
LAR 582  Special Topics In Landscape Architecture (Sustainable Food Systems)  
LAR 582  Special Topics In Landscape Architecture (Design Week)  
LAR 582  Special Topics In Landscape Architecture (Advanced Digital Media)  
LAR 582  Special Topics In Landscape Architecture (Sustainable Sites)  
LAR 582  Special Topics In Landscape Architecture (Computational Design and Parametric Modeling)  
LAR 582  Special Topics In Landscape Architecture (Introduction to Envt. and Behavior for Designers)  

Total Hours 64-70  

1  May be waived  

**Track 3**  
The LAAB Accredited Track III curriculum is intended for graduate students with undergraduate degrees in fields other than landscape architecture, architecture or related design areas.  

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
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<td>LAR 501</td>
<td>Landscape Architecture Introduction Design Studio</td>
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<tr>
<td>LAR 502</td>
<td>Site Design and Environmental Planning Studio</td>
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</tr>
<tr>
<td>LAR 503</td>
<td>Landscape Architecture Design Development &amp; Construction Documentation Studio</td>
<td></td>
</tr>
<tr>
<td>LAR 506</td>
<td>Landscape Architecture Design + Build Studio</td>
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</tr>
<tr>
<td>LAR 507</td>
<td>Advanced Topics Studio in Landscape Architecture and Environmental Planning</td>
<td></td>
</tr>
<tr>
<td>LAR 507</td>
<td>Advanced Topics Studio in Landscape Architecture and Environmental Planning</td>
<td>1</td>
</tr>
<tr>
<td>LAR 507</td>
<td>Design Research Project Independent Study</td>
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</tr>
<tr>
<td>LAR 697</td>
<td>or LAR 697 Design Research Project Independent Study</td>
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</tr>
<tr>
<td>LAR 514</td>
<td>Landscape Architecture Digital Design Media 2</td>
<td></td>
</tr>
<tr>
<td>LAR 517</td>
<td>GIS Applications in Landscape Architecture and Environmental Planning</td>
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</tr>
</tbody>
</table>

**Total Hours** 82  

**Faculty**  
**Full Professors**  
Kofi Malik Boone  
Margaret Evans Calkins  
Margaret Elen Deming
Landscape Architecture (Minor)

Plan Requirements

- 9 (MS student) or 12 (PhD student) credit hours

Faculty

Full Professors

Kofi Malik Boone
Margaret Evans Calkins
Margaret Elen Deming
Andrew Alan Fox
Mark Elison Hoversten
Robin C. Moore
Gavin Paul Smith

Associate Professors

Carla F. Delcambre
Fernando H. Magallanes
Celen Pasalar

Emeritus Faculty

Eugene H Bressler
Arthur Rice

Practice/Research/Teaching Professors

Nilda Graciela Cosco
Charles Albert Flink
Emily Ryan McCoy
Rodney Leon Swink

Degree Programs

Master of Arts (MA)

- Teaching (MA) (p. 263)
- Teaching (MA): Elementary Education Concentration (p. 264)
- Teaching (MA): English as a Second Language Concentration (p. 265)
- Teaching (MA): K-12 Reading Concentration (p. 267)
- Teaching (MA): Middle Grades Education Concentration (p. 269)
- Teaching (MA): Science Education Concentration (p. 273)
- Teaching (MA): Social Studies Education Concentration (p. 274)
- Teaching (MA): Special Education Concentration (p. 275)
Master’s (MR)
- School Administration Distance Education (MR) (p. 253)

Master of Science (MS)
- Adult and Community College Education (MS) (p. 214)
- Curriculum and Instruction (MS) (p. 230)
- Curriculum and Instruction (MS): Educational Psychology Concentration (p. 232)
- Curriculum and Instruction, New Literacies and Global Learning (MS) (p. 234)
- Curriculum and Instruction, New Literacies and Global Learning (MS): English Education Concentration (p. 235)
- Curriculum and Instruction, New Literacies and Global Learning (MS): Reading Education Concentration (p. 237)
- Curriculum and Instruction, New Literacies and Global Learning (MS): Social Studies Education Concentration (p. 238)
- Curriculum and Instruction: Curriculum and Developmental Supervision (MS) (p. 233)
- Elementary Education (MS) (p. 247)
- Learning Design & Technology (MS) (p. 250)
- Mathematics Education (MS) (p. 252)
- Science Education (MS) (p. 256)
- Special Education (MS) (p. 260)
- Teaching (MA): English Education Concentration (p. 266)
- Teaching (MA): Math Education Concentration (p. 268)
- Technology Education (MS) (p. 279)

Doctor of Education (EdD)
- Adult and Community College Education (EdD) (p. 215)
- Community College Leadership (EdD) (p. 215)
- Educational Administration and Supervision (EdD) (p. 240)

Doctor of Philosophy (PhD)
- Educational Leadership, Policy, and Human Development (PhD) (p. 242)
- Educational Leadership, Policy, and Human Development (PhD) Counseling and Counselor Education Concentration (p. 244)
- Learning & Teaching in STEM (PhD) (p. 249)
- Teacher Education and Learning Sciences (PhD) (p. 262)

Minors
- Adult & Community College Education (Minor) (p. 216)
- Education Research & Policy Analysis (Minor) (p. 244)
- Educational Administration and Supervision (Minor) (p. 241)
- Mathematics Education (Minor) (p. 252)
- Science Education (Minor) (p. 256)
- Special Education (Minor) (p. 260)
- Teacher Education and Learning Sciences (Minor) (p. 262)
- Teaching (Minor) (p. 277)
- Technology Education (Minor) (p. 279)
- Training & Development (Minor) (p. 281)

Certificates
- Counselor Education (Certificate) (p. 239)
- Mathematics Teaching and Learning (Certificate) (p. 259)
- Teaching, Training, and Educational Technology (Certificate) (p. 245)

Adult and Community College Education

The Adult and Community College Education program area is a unique program in its emphasis on serving the spectrum of both formal and informal adult learning organizations, and its inclusion of administrative, instructional and technology-related leadership within a practitioner preparation program. Based on a land-grant, Research Extensive University, the department reflects the tripartite commitment to quality instruction, research scholarship and service outreach.

The Master’s degree in Adult and Community College Education is one-of-a-kind as its primary commitment is to part-time students who are full-time working professionals. Full-time students are eligible for consideration to receive full funding through scholarships, fellowships and research and teaching assistantships, which allow our students to work with top faculty on cutting-edge projects. To meet the needs of full- and part-time students, most courses are offered once a week during late afternoon or evening hours. Some courses are regularly available during summer sessions and weekends and through distance education technologies. The Master in Adult and Community College Education provides opportunities to specialize in one of three areas: Adult and Continuing Professional Education, Community College Teaching, or Health Professions Education.

Admission Requirements

Applications for admission are submitted through the Graduate School, accepted year-round and are applicable for the first available term. We accept students from a wide range of disciplinary backgrounds. To qualify for admission, applicants must have a bachelor’s degree from an accredited institution of higher education in any field. International applicants must also have a TOEFL score of 100 or higher. Admission decisions are based on several criteria, including undergraduate GPA, work history and interest in the field.

Student Financial Support

To be eligible for financial aid, students must be enrolled in Master’s or Doctoral degree programs offered by the University. Unfortunately there is no financial aid available for Graduate Certificate students. Occasionally graduate assistantships are available for full time students in our degree programs. Please check with your advisor about assistantship opportunities. We recommend that you contact the Office of Scholarships and Financial Aid to find out what other options are available.

_degrees
- Adult and Community College Education (MEd) (p. 213)
- Adult and Community College Education (MS) (p. 214)
- Adult and Community College Education (EdD) (p. 215)
- Community College Leadership (EdD) (p. 215)
- Adult & Community College Education (Minor) (p. 216)
Faculty

Full Professors
Duane Akroyd
Tony W. Cawthon
Mattie Jayne Fleener
Joy Gaston Gayles
Audrey J. Jaeger
Stephen Robert Porter
Alyssa Nicole Rockenbach
Paul David Umbach

Associate Professors
Susan J Barcinas
James E Bartlett II
Chad David Hoggan

Practice/Research/Teaching Professors
Diane D Chapman

Emeritus Faculty
George A Baker III
Paul F. Bitting
Joseph Conrad Glass Jr
Carol Edith Kasworm
George B Vaughan

Adult and Community College Education (MEd)

Degree Requirements
Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: “Master of Education in Adult and Community College Education” without focus area track specifications.

Adult and Continuing Professional Education Track

<table>
<thead>
<tr>
<th>Code</th>
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<tr>
<td>EAC 730</td>
<td>Foundations of Adult, Higher, and Human Res Education</td>
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<tr>
<td>or EAC 522</td>
<td>Foundations of Adult Education</td>
<td></td>
</tr>
<tr>
<td>EAC 559</td>
<td>The Adult Learner</td>
<td>3</td>
</tr>
<tr>
<td>EAC 539</td>
<td>Teaching in the Online Environment</td>
<td>3</td>
</tr>
<tr>
<td>EAC 538</td>
<td>Instructional Strategies In Adult and Higher Education</td>
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</tr>
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<td>EAC 560</td>
<td>Assessment &amp; Evaluation in Adult &amp; Higher Education</td>
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<tr>
<td>EAC 708</td>
<td>Continuing Education for the Professions</td>
<td>3</td>
</tr>
<tr>
<td>or EAC 700</td>
<td>Community College and Two-Year Postsecondary Education</td>
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<tr>
<td>Select 12 hours of Specialization credits</td>
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<td>EAC 551</td>
<td>Research in Adult &amp; Higher Education</td>
<td>3</td>
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<tr>
<td>EAC 692</td>
<td>Research Projects In Education</td>
<td>3</td>
</tr>
<tr>
<td>or EAC 651</td>
<td>Internship In Adult and Community College Education</td>
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<td>Total Hours</td>
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Community College Teaching Track

<table>
<thead>
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<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>EAC 730</td>
<td>Foundations of Adult, Higher, and Human Res Education</td>
<td>3</td>
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<tr>
<td>or EAC 522</td>
<td>Foundations of Adult Education</td>
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<tr>
<td>EAC 703</td>
<td>The Programming Process In Adult and Community College Education</td>
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<td>EAC 560</td>
<td>Assessment &amp; Evaluation in Adult &amp; Higher Education</td>
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</tr>
<tr>
<td>EAC 538</td>
<td>Instructional Strategies In Adult and Higher Education</td>
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<tr>
<td>Select 15-18 credit hours of specialization</td>
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<td>Research in Adult &amp; Higher Education</td>
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<tr>
<td>EAC 692</td>
<td>Research Projects In Education</td>
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<tr>
<td>Total Hours</td>
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Health Professions Education Track

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<tr>
<td>EAC 730</td>
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<tr>
<td>or EAC 522</td>
<td>Foundations of Adult Education</td>
<td></td>
</tr>
<tr>
<td>EAC 559</td>
<td>The Adult Learner</td>
<td>3</td>
</tr>
<tr>
<td>EAC 560</td>
<td>Assessment &amp; Evaluation in Adult &amp; Higher Education</td>
<td>3</td>
</tr>
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<td>EAC 538</td>
<td>Instructional Strategies In Adult and Higher Education</td>
<td>3</td>
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<tr>
<td>EAC 539</td>
<td>Teaching in the Online Environment</td>
<td>3</td>
</tr>
<tr>
<td>EAC 708</td>
<td>Continuing Education for the Professions</td>
<td>3</td>
</tr>
<tr>
<td>EAC 532</td>
<td>Health Care Delivery Systems and Environments</td>
<td>3</td>
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<tr>
<td>EAC 536</td>
<td>Issues and Trends In Education For the Health Professions</td>
<td>3</td>
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<td>Select six credit hours of Specialization Electives</td>
<td>6</td>
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<td>EAC 551</td>
<td>Research in Adult &amp; Higher Education</td>
<td>3</td>
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<tr>
<td>EAC 692</td>
<td>Research Projects In Education</td>
<td>3</td>
</tr>
<tr>
<td>Total Hours</td>
<td>36</td>
<td></td>
</tr>
</tbody>
</table>
Faculty
Full Professors
Duane Akroyd
Tony W. Cawthon
Mattie Jayne Fleener
Joy Gaston Gayles
Audrey J. Jaeger
Stephen Robert Porter
Alyssa Nicole Rockenbach
Paul David Umbach

Associate Professors
Susan J Barcinas
James E Bartlett II
Chad David Hoggan

Practice/Research/Teaching Professors
Diane D Chapman

Emeritus Faculty
George A Baker III
Paul F. Bitting
Joseph Conrad Glass Jr
Carol Edith Kasworm
George B Vaughan

Adult and Community College Education (MS)

Degree Requirements
Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Science in Adult and Community College Education" without focus area track specifications.

Adult and Continuing Professional Education Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
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<td>Foundations of Adult, Higher, and Human Res Education</td>
<td>3</td>
</tr>
<tr>
<td>or EAC 522</td>
<td>Foundations of Adult Education</td>
<td>3</td>
</tr>
<tr>
<td>EAC 559</td>
<td>The Adult Learner</td>
<td>3</td>
</tr>
<tr>
<td>EAC 538</td>
<td>Instructional Strategies In Adult and Higher Education</td>
<td>3</td>
</tr>
<tr>
<td>EAC 560</td>
<td>Assessment &amp; Evaluation in Adult &amp; Higher Education</td>
<td>3</td>
</tr>
<tr>
<td>EAC 708</td>
<td>Continuing Education for the Professions</td>
<td>3</td>
</tr>
<tr>
<td>or EAC 700</td>
<td>Community College and Two-Year Postsecondary Education</td>
<td>3</td>
</tr>
</tbody>
</table>

Select a minimum of six credit hours of Specialization | 6
Select a minimum of nine credit hours of Research | 9
EAC 695 | Master's Thesis Research                       | 6

Total Hours | 39

Community College Teaching Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAC 730</td>
<td>Foundations of Adult, Higher, and Human Res Education</td>
<td>3</td>
</tr>
<tr>
<td>or EAC 522</td>
<td>Foundations of Adult Education</td>
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<td>EAC 559</td>
<td>The Adult Learner</td>
<td>3</td>
</tr>
<tr>
<td>EAC 538</td>
<td>Instructional Strategies In Adult and Higher Education</td>
<td>3</td>
</tr>
<tr>
<td>EAC 560</td>
<td>Assessment &amp; Evaluation in Adult &amp; Higher Education</td>
<td>3</td>
</tr>
<tr>
<td>EAC 539</td>
<td>Teaching in the Online Environment</td>
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</tr>
<tr>
<td>EAC 700</td>
<td>Community College and Two-Year Postsecondary Education</td>
<td>3</td>
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</tbody>
</table>

Select 18-24 credit hours of Academic Discipline Focus | 18-24
Select six credit hours of Research Methods | 6
EAC 695 | Master's Thesis Research                       | 6

Total Hours | 48-54

Health Professions Education Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
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<tr>
<td>EAC 730</td>
<td>Foundations of Adult, Higher, and Human Res Education</td>
<td>3</td>
</tr>
<tr>
<td>or EAC 522</td>
<td>Foundations of Adult Education</td>
<td>3</td>
</tr>
<tr>
<td>EAC 559</td>
<td>The Adult Learner</td>
<td>3</td>
</tr>
<tr>
<td>EAC 560</td>
<td>Assessment &amp; Evaluation in Adult &amp; Higher Education</td>
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</tr>
<tr>
<td>EAC 538</td>
<td>Instructional Strategies In Adult and Higher Education</td>
<td>3</td>
</tr>
<tr>
<td>EAC 539</td>
<td>Teaching in the Online Environment</td>
<td>3</td>
</tr>
<tr>
<td>EAC 708</td>
<td>Continuing Education for the Professions</td>
<td>3</td>
</tr>
<tr>
<td>EAC 532</td>
<td>Health Care Delivery Systems and Environments</td>
<td>3</td>
</tr>
<tr>
<td>EAC 536</td>
<td>Issues and Trends In Education For the Health Professions</td>
<td>3</td>
</tr>
</tbody>
</table>

Select a minimum of three credit hours of Specialization Electives | 3
Select a minimum of six credit hours of Research Component | 6
EAC 695 | Master's Thesis Research                       | 6

Total Hours | 39
Faculty
Full Professors
Duane Akroyd
Tony W. Cawthon
Mattie Jayne Fleener
Joy Gaston Gayles
Audrey J. Jaeger
Stephen Robert Porter
Alyssa Nicole Rockenbach
Paul David Umbach

Associate Professors
Susan J Barcinas
James E Bartlett II
Chad David Hoggan

Practice/Research/Teaching Professors
Diane D Chapman

Emeritus Faculty
George A Baker III
Paul F. Bitting
Joseph Conrad Glass Jr
Carol Edith Kasworm
George B Vaughan

Adult and Community College Education (EdD)

Faculty
Full Professors
Duane Akroyd
Tony W. Cawthon
Mattie Jayne Fleener
Joy Gaston Gayles
Audrey J. Jaeger
Stephen Robert Porter
Alyssa Nicole Rockenbach
Paul David Umbach

Associate Professors
Susan J Barcinas
James E Bartlett II
Chad David Hoggan

Practice/Research/Teaching Professors
Diane D Chapman

Emeritus Faculty
George A Baker III
Paul F. Bitting
Joseph Conrad Glass Jr
Carol Edith Kasworm
George B Vaughan

Community College Leadership (EdD)

All doctoral degrees in the College of Education require a minimum of 72 graduate credit hours beyond the bachelor’s degree. Most doctoral programs in the College of Education require a minimum of 60 graduate credit hours beyond an approved master’s degree.

Our doctoral program takes three-and-a-half years to complete, including a dissertation that begins in the first semester.

Thematic Research Areas
Select from the following six areas in which to conduct research:
- Completion and Transfer
- Learning Outcomes
- Equity
- Labor Market Outcomes
- Technology
- Culture/Organizational Behavior

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>YEAR 1</td>
<td></td>
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<tr>
<td>Summer session (6 hours)</td>
<td>Reflective Practice</td>
<td>6</td>
</tr>
<tr>
<td>The Change Process</td>
<td>Fall semester (7 hours)</td>
<td>7</td>
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<tr>
<td>Improvement Science</td>
<td>Dissertation Seminar</td>
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</tr>
<tr>
<td>Organizational Issues in Adult and Community College Education</td>
<td>Spring semester (7 hours)</td>
<td>7</td>
</tr>
<tr>
<td>Proposal Writing</td>
<td>Administrative Issues in Adult and Community College Education</td>
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Dissertation Seminar

**YEAR 2**

**Summer session (7 hours)** 7

Research Methods I
Leadership in Adult and Higher Education
Dissertation Seminar

**Fall semester (7 hours)** 7

Research Methods II
Community College and Two-Year Post-secondary Education
Dissertation Seminar

**YEAR 3**

**Summer session (7 hours)** 7

Evaluation
Internship
Dissertation Seminar

**Fall semester (3 hours)** 3

Dissertation Seminar

**Spring semester (3 hours)** 3

Dissertation Seminar

Total Hours 47

---

**Faculty**

**Full Professors**

Duane Akroyd
Tony W. Cawthon
Mattie Jayne Fleener
Joy Gaston Gayles
Audrey J. Jaeger
Stephen Robert Porter
Alyssa Nicole Rockenbach
Paul David Umbach

**Associate Professors**

Susan J Barcinas
James E Bartlett II
Chad David Hoggan

**Practice/Research/Teaching Professors**

Diane D Chapman

**Emeritus Faculty**

George A Baker III
Paul F. Bitting
Joseph Conrad Glass Jr
Carol Edith Kasworm
George B Vaughan

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**Clinical Mental Health Counseling**

The Department of Counselor Education offers three programs of study (concentrations) leading to the Master of Education Degree: Clinical Mental Health Counseling, College Counseling and Student Development, and School Counseling.

All master’s degree programs (on-campus and online deliveries) are accredited by the Council for Accreditation of Counseling and Related Educational Programs until October 31, 2020. Because of the impact of
COVID-19 pandemic, the accreditation review has been delayed. We expect to receive a one-year extension of accreditation from CACREP to complete the review process.

Admission Requirements
Admissions Requirements for Master’s Programs (on-campus and online programs):

- Completed online application, resume, personal statement/goals, and non-refundable application fee
- GRE Scores/MAT Scores
- 3 recommendations from people who know your academic record and potential for graduate study (letters should be uploaded online)
- Official transcripts of all post-secondary education
- Official** statement of English Proficiency (TOEFL) for international students

Applicants are expected to have an undergraduate GPA of 3.0 or higher.

Master’s Degree Requirements
For master's degree concentrations, admission is limited in order to maintain faculty student interaction in didactic classes, for supervision in practica and for informal contact. Generally, class size averages between 20 and 25 in didactic, 4-5 in practica, and the advising ratio is approximately 1 to 10.

The Master’s of Education Degree (M.Ed.) is primarily a practitioner-oriented master’s and is offered in the on-campus program or DE online program (same degree). There are three concentrations: (a) school counseling (elementary and middle or secondary), (b) college counseling and student development, and (c) clinical mental health counseling.

These concentrations require a minimum of 60 credits. Students who complete the program will be eligible to sit for the National Counselor Examination (NCE).

The Master’s of Science Degree (M.S.) is primarily oriented to the practitioner-researcher and is also offered in the three concentrations. The program requires 66 hours of course work, including a thesis, and an oral examination. Generally, the same criteria for admission are applied as for the M.Ed. except that the candidate needs to show clearer evidence of research competency in addition to the requisite professional and academic competencies. M.S. option is not offered in DE online program.

Student Financial Support
At NC State, our goal is to assure that no student who can benefit from an NC State education be denied that opportunity due to finances. We are committed to allocating our financial aid resources to help the broadest range of students.

Graduate students may apply for Federal Subsidized and Unsubsidized Stafford Loans, and for Federal Work-Study employment. Qualified graduate students pursuing masters or doctoral degrees may also apply for fellowships, assistantships and other awards offered through individual colleges and the Graduate School.

Degrees
- Clinical Mental Health Counseling (MEd) (p. 217)

Faculty

Full Professors
Stanley Baker
Marc A. Grimmett
Sylvia Christine Maria Nassar
Jose’ A. Picart
Siu-Man Ting

Assistant Professors
Adria Shipp Dunbar
Brean’a Parker

Practice/Research/Teaching Professors
Cristina Braga
Nicole Marie Childs
Sharon Yeokyang Chung
Helen S. Lupton-Smith
Rolanda Levica Mitchell
Angela Carmella Smith

Adjunct Faculty
Amanda Allen
Clinton Bolton
Richard E. Tyler-Walker Jr.
Monica Osbourne

Emeritus Faculty
Edwin Gerler

Clinical Mental Health Counseling (MEd)

Degree Requirements

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<th>Title</th>
<th>Hours</th>
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<td>ECD 510</td>
<td>Orientation to Professional Counseling, Identity, and Ethics</td>
<td>60</td>
</tr>
<tr>
<td>ECD 524</td>
<td>Career Counseling and Development</td>
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<tr>
<td>ECD 525</td>
<td>Multicultural Counseling</td>
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<tr>
<td>ECD 530</td>
<td>Theories and Tech of Counseling</td>
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</tr>
<tr>
<td>ECD 536</td>
<td>Introduction to Clinical Mental Health Counseling</td>
<td></td>
</tr>
<tr>
<td>ECD 539</td>
<td>Group Counseling</td>
<td></td>
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</tbody>
</table>
College Counseling and Student Development

The Department of Counselor Education offers three programs of study (concentrations) leading to the Master of Education Degree: Clinical Mental Health Counseling, College Counseling and Student Development, and School Counseling.

All master's degree programs (on-campus and online deliveries) are accredited by the Council for Accreditation of Counseling and Related Educational Programs until October 31, 2020. Because of the impact of COVID-19 pandemic, the accreditation review has been delayed. We expect to receive a one-year extension of accreditation from CACREP to complete the review process.

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the broadest range of students. Go to the following Internet site for information about financial aid: http://www.fis.ncsu.edu/financial_aid/

Graduate students may apply for Federal Subsidized and Unsubsidized Stafford Loans, and for Federal Work-Study employment. Qualified graduate students pursuing masters or doctoral degrees may also apply for fellowships, assistantships and other awards offered through individual colleges and the Graduate School.

**Degrees**

- College Counseling and Student Development (MEd) (p. 219)

**Faculty**

**Full Professors**

Stanley Baker
Marc A. Grimmett
Sylvia Christine Maria Nassar
Jose’ A Picart
Siu-Man Ting

**Assistant Professors**

Adria Shipp Dunbar
Brean’a Parker

**Practice/Research/Teaching Professors**

Cristina Braga
Nicole Marie Childs
Sharon Yeokyung Chung
Helen Lupton-Smith
Rolanda Levica Mitchell
Angela Carmella Smith

**Emeritus Faculty**

Edwin Gerler

**Adjunct Faculty**

Amanda Allen
Clinton Bolton
Monica Osbourne
Richard Tyler-Walker

**College Counseling and Student Development (MEd)**

**Degree Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Core Courses</th>
<th>Title</th>
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<tr>
<td>ECD 510</td>
<td>Orientation to Professional Counseling, Identity, and Ethics</td>
<td></td>
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</tr>
<tr>
<td>ECD 524</td>
<td>Career Counseling and Development</td>
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<td>ECD 525</td>
<td>Multicultural Counseling</td>
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</tr>
<tr>
<td>ECD 530</td>
<td>Theories and Tech of Counseling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECD 535</td>
<td>Introduction to College Counseling and Student Development</td>
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<td></td>
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<td>ECD 539</td>
<td>Group Counseling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECD 540</td>
<td>Gender Issues In Counseling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECD 541</td>
<td>Substance Abuse and Counseling</td>
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</tr>
<tr>
<td>ECD 542</td>
<td>Research in Counseling</td>
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<td></td>
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<tr>
<td>ECD 545</td>
<td>Counseling Couples and Families</td>
<td></td>
<td></td>
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<td>ECD 546</td>
<td>Crisis Interventions in Counseling</td>
<td></td>
<td></td>
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<tr>
<td>ECD 561</td>
<td>Strategies for Clinical Assessment in Counseling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECD 562</td>
<td>Techniques in Counseling</td>
<td></td>
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<td>ECD 575</td>
<td>Multicultural Lifespan Development</td>
<td></td>
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<td>ECD 642</td>
<td>Practicum In Counseling</td>
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<tr>
<td>ECD 652</td>
<td>Internship In College Counseling and Student Development</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* ECD 652 Internship In College Counseling and Student Development covers over two semesters, Fall and Spring 6 credits each, 12 credit hours in total

**Faculty**

**Full Professors**

Stanley Baker
Marc A. Grimmett
Sylvia Christine Maria Nassar
Jose’ A Picart
Siu-Man Ting

**Assistant Professors**

Adria Shipp Dunbar
Brean’a Parker

**Practice/Research/Teaching Professors**

Cristina Braga
Nicole Marie Childs
Sharon Yeokyung Chung
Helen Lupton-Smith
Rolanda Levica Mitchell
Curriculum and Instruction

The department of Teacher Education and Learning Sciences offers master’s degrees in multiple areas of curriculum and instruction: Curriculum Development and Supervision, Educational Psychology, and New Literacies and Global Learning (with sub-concentrations in English education, general studies, middle grades, reading/literacy education, and secondary social studies).

For more please see https://ced.ncsu.edu/graduate/graduate-programs/masters/

The NC Department of Public Instruction has conferred accreditation to the graduate programs in Teacher Education and Learning Sciences. The College of Education is approved any the Council for the Accreditation of Educator Preparation (CAEP).

Admission Requirements

Curriculum and Instruction: A 500-800 word statement describing professional goals is required, along with transcripts and reference letters. Some areas of study require that applicants be qualified to hold a baccalaureate-level teaching license or have teaching experience. The Graduate School requires a 3.0 in the undergraduate program. Students from diverse backgrounds are welcome to apply. Admission is competitive. The best qualified applicants will be accepted up to the limited number of spaces available for new students. TOEFL or IELTS scores for international applicants whose first language is not English. GRE scores not more than five years old are required for the Educational Psychology program area.

Master’s Degree Requirements

Curriculum and Instruction: A minimum of 30 course credit hours. For the M.S. degree, a minimum of 36 hours is required. The M.S. degree requires a thesis and final oral examination approved by the graduate committee.

Student Financial Support

Teaching Assistantships are available on a limited basis.

Degrees

- Curriculum and Instruction (MEd) (p. 221)
- Curriculum and Instruction (MEd): Educational Psychology Concentration (p. 222)
- Curriculum and Instruction, Curriculum and Developmental Supervision (MEd) (p. 223)
- Curriculum and Instruction, New Literacies and Global Learning (MEd) (p. 225)
- Curriculum and Instruction, New Literacies and Global Learning (MEd): English Education Concentration (p. 226)
- Curriculum and Instruction, New Literacies and Global Learning (MEd): Middle Grades Education Concentration (p. 227)
- Curriculum and Instruction, New Literacies and Global Learning (MEd): Reading Education Concentration (p. 228)
- Curriculum and Instruction, New Literacies and Global Learning (MEd): Social Studies Education Concentration (p. 229)
- Curriculum and Instruction (MS) (p. 230)
- Curriculum and Instruction (MS): Educational Psychology Concentration (p. 232)
- Curriculum and Instruction, Curriculum and Developmental Supervision (MS) (p. 233)
- Curriculum and Instruction, New Literacies and Global Learning (MS) (p. 234)
- Curriculum and Instruction, New Literacies and Global Learning (MS): English Education Concentration (p. 235)
- Curriculum and Instruction, New Literacies and Global Learning (MS): Reading Education Concentration (p. 237)
- Curriculum and Instruction, New Literacies and Global Learning (MS): Social Studies Education Concentration (p. 238)
- Counselor Education (Certificate) (p. 239)

Faculty

Full Professors

Cathy L. Crossland
Jessica Theresa DeCuir-Gunby
John K. Lee
Patricia L. Marshall
John Nietfeld
Kevin M. Oliver
Edward J. Sabornie
Margareta M. Thomson

Associate Professors

Candy M. Beal
Sarah J. Carrier
Dennis Scott Davis
Deniz Eseryel
DeLeon L. Gray
Jessica Heather Hunt
Meghan McGlinn Manfra
Curriculum and Instruction (MEd)

Degree Requirements

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<th>Code</th>
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<td>EDP 582</td>
<td>Adolescent Development</td>
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<td>EDP 590</td>
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Curriculum and Instruction (MEd): Educational Psychology Concentration

Edward J. Sabornie
Margareta M. Thomson

Associate Professors
Candy M. Beal
Sarah J. Carrier
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Lois M. Thies-Sprinthall
Ellen S. Vasu

Curriculum and Instruction (MEd): Educational Psychology Concentration

Degree Requirements

**Core Courses**

Select 18-24 credits of the following courses:

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**Curriculum and Learning Courses**

Select one of the following courses:

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<tr>
<td>ECI 806</td>
<td>Seminar on Teacher as Learner: Developmental Theory, Research and Practice</td>
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**Research Courses**

Select a minimum of two of the following courses:

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<td>Research Applications in Curriculum and Instruction</td>
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<td>ECI 523</td>
<td>Teacher as Researcher</td>
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</tbody>
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Faculty

Full Professors
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Lois M. Thes-Sprinthall
Ellen S. Vasu

Curriculum and Instruction, Curriculum and Developmental Supervision (MEd)

Degree Requirements

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Diversity
Select one of the following courses:
- ECI 500 Theory and Practice In Teaching Diverse Populations
- ECI 585 Education of Children with Exceptionalities
- EDP 575 Multicultural Lifespan Development

Teacher Leadership and Professional Development
- ECI 705 Instructional Coaching and Supervision Of Teachers
- ECI 606/806 Seminar on Teacher as Learner: Developmental Theory, Research and Practice
- ECI 641/841 Practicum In Mentoring and Coaching
  or ECI 851 Internship In Mentoring

Administration
- ECI 630 Independent Study in Curriculum and Instruction (Intro to Educational Law Independent Study)

Elective Courses
“Elective Courses” will be determined in conjunction with the academic committee

Research Courses
Select one of the following courses:
- ECI 510 Research Applications In Curriculum and Instruction
- ECI 523 Teacher as Researcher

Total Hours 30

Faculty
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- Edwin R. Gerler Jr.
- Lawrence Keith Jones
- Susan Sinclair Osborne
- Carol A. Pope
Curriculum and Instruction, New Literacies and Global Learning (MEd)

Degree Requirements

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<td>Theory and Research in Global Learning</td>
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<td>ECI 508</td>
<td>Teachers as Leaders</td>
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Concentration Requirements

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Faculty

Full Professors
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Emeritus Faculty
John F. Arnold
Barbara J. Fox
Edwin R. Gerler Jr.
Lawrence Keith Jones
Susan Sinclair Osborne
Curriculum and Instruction, New Literacies and Global Learning (MEd): English Education Concentration

Degree Requirements

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Concentration Requirements

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<td>ECI 521</td>
<td>Teaching Literature For Young Adults</td>
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<td>ECI 513</td>
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English Course

"English Course" will be determined in conjunction with the academic committee

Education / English / Psychology Elective

"Education / English / Psychology Elective" will be determined in conjunction with the academic committee

Total Hours

30

Faculty

Full Professors

Cathy L. Crossland
Jessica Theresa DeCuir-Gunby
John K. Lee
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Edward J. Sabornie
Margareta M. Thomson

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Ellen S. Vasu

Curriculum and Instruction, New Literacies and Global Learning (MEd): Middle Grades Education Concentration

Degree Requirements

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</table>

Social Studies / English Courses 6

“Social Studies / English Courses” are determined in conjunction with the academic committee

Total Hours 30

Faculty

Full Professors
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Sarah J. Carrier
Dennis Scott Davis
Deniz Eseryel
DeLeon L. Gray
Jessie Heathie Hunt
Curriculum and Instruction, New Literacies and Global Learning (MEd): Reading Education Concentration

McGlinn Manfra
James Minogue
Temple A. Walkowiak
Angela Michelle Wiseman
Carl A. Young

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Curriculum and Instruction, New Literacies and Global Learning (MEd): Reading Education Concentration

Degree Requirements

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<tr>
<td>ECI 645</td>
<td>Supervised Practicum in Literacy</td>
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</table>

Total Hours 30

Faculty
Full Professors
Cathy L. Crossland
Jessica Theresa DeCuir-Gunby
John K. Lee
Patricia L. Marshall
John Nietfeld
Kevin M. Oliver
Edward J. Sabornie
Margareta M. Thomson

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Ruie J. Pritchard
Norman A. Sprinthall
Lois M. Thies-Sprinthall
Ellen S. Vasu

Curriculum and Instruction, New Literacies and Global Learning (MEd): Social Studies Education Concentration

Degree Requirements

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Concentration Requirements

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<td>Emerging Technologies for Teaching and Learning</td>
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<td>Teaching and Learning with Digital Video</td>
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<td>Developing and Delivering Online Instruction</td>
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<td>ECI 515</td>
<td>Cultural Investigations and Technical Representations in Education</td>
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<td>ECI 516</td>
<td>Design and Evaluation Of Instructional Materials</td>
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<td>Theoretical Foundations of Advanced Learning Environments</td>
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<td>Contemporary Approaches In the Teaching Of Social Studies</td>
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<td>Foundations Of Middle Years Education</td>
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<td>EDP 582</td>
<td>Adolescent Development</td>
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</table>

Social Studies Courses
“Social Studies Courses” are determined in conjunction with the academic committee.

Total Hours: 30

1 Students are required to take courses with Social Studies content that include: history, political science, economics, anthropology, geography, social studies pedagogy.

Faculty

Full Professors

Cathy L. Crossland
Jessica Theresa DeCuir-Gunby
John K. Lee
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John Nietfeld
Kevin M. Oliver
Edward J. Sabornie
Margareta M. Thomson

Associate Professors

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Ellen S. Vasu

Curriculum and Instruction (MS)

Degree Requirements

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<td>ECI 585</td>
<td>Education of Children with Exceptionalities</td>
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<td>ECI 806</td>
<td>Seminar on Teacher as Learner: Developmental Theory, Research and Practice</td>
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<td>ECI 511</td>
<td>Introduction to Learning Design and Technology</td>
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<td>ECI 716</td>
<td>Design and Evaluation Of Instructional Materials</td>
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<td>ECI 520</td>
<td>The Teaching Of Composition</td>
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<td>EDP 590</td>
<td>Special Problems in Educational Psychology</td>
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<td>PSY 508</td>
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**Total Hours**: 36

**Faculty**

**Full Professors**
- Cathy L. Crossland
- Jessica Theresa Decuir-Gunby
- John K. Lee
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- John Nietfeld
- Kevin M. Oliver
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- Margareta M. Thomson

**Associate Professors**
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- Jonee Wilson

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- Sarah Cannon
- Valerie Ness Faulkner
- Ann D. Harrington
- Kristin Hoffmann
- Micha Jeffries
- Jill Jones
- Joanne Greer Koch
- Linda McCabe-Smith
- Julia O’Neal McKeown

**Emeritus Faculty**
- John F. Arnold
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- Edwin R. Gerler Jr.
- Lawrence Keith Jones
- Susan Sinclair Osborne
- Carol A. Pope
Curriculum and Instruction (MS): Educational Psychology Concentration

Degree Requirements

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<td>ECI 716 Design and Evaluation Of Instructional Materials</td>
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<td>EDP 590 Special Problems in Educational Psychology</td>
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<td>ECI 585 Education of Children with Exceptionalities</td>
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<td>ECI 607 Advanced Seminar in Multicultural Education</td>
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</table>

Faculty

Full Professors

Cathy L. Crossland
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Practice/Research/Teaching Professors

Drinda Elaine Benge
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Valerie Ness Faulkner
Curriculum and Instruction: Curriculum and Developmental Supervision (MS)

Degree Requirements

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<td>EDP 575</td>
<td>Multicultural Lifespan Development</td>
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<td><strong>Teacher Leadership and Professional Development</strong></td>
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</table>

**Elective Courses** 6

"Elective Courses" will be determined in conjunction with the academic committee

**Research Courses** 6

Select two of the following courses:
- ED 700 Introduction to Research Design in Education
- ED 710 Applied Quantitative Methods in Education I
- ED 730 Introduction to Qualitative Research in Education
- ECI 523 Teacher as Researcher

**Thesis Course** 6
- ECI 695 Master's Thesis Research

Total Hours 39

**Faculty**

**Full Professors**
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- Carl A. Young

**Assistant professors**
- Chandra Alston
- Christy Michelle Byrd
## Degree Requirements

<table>
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<tbody>
<tr>
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<tr>
<td>ECI 546</td>
<td>New Literacies &amp; Media</td>
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<td>ECI 508</td>
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### Elective Courses

#### English Language Arts (ELA) Education

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<td>ECI 500</td>
<td>Theory and Practice In Teaching Diverse Populations</td>
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<tr>
<td>ECI 520</td>
<td>The Teaching Of Composition</td>
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<tr>
<td>ECI 521</td>
<td>Teaching Literature For Young Adults</td>
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<tr>
<td>ECI 541</td>
<td>Reading In the Content Areas</td>
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<tr>
<td>ECI 522</td>
<td>Trends and Issues in English Language Arts Education</td>
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<tr>
<td>ECI 511</td>
<td>Introduction to Learning Design and Technology</td>
<td></td>
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<tr>
<td>ECI 512</td>
<td>Emerging Technologies for Teaching and Learning</td>
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<td>ECI 513</td>
<td>Teaching and Learning with Digital Video</td>
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<td>ECI 514</td>
<td>Developing and Delivering Online Instruction</td>
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<tr>
<td>ECI 515</td>
<td>Cultural Investigations and Technical Representations in Education</td>
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#### ELA Content Courses

Select a minimum of two courses from an English discipline (literature, language, writing, film) approved in conjunction with the academic committee

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<td>ECI 525</td>
<td>Contemporary Approaches In the Teaching Of Social Studies</td>
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<td>Theory and Research On Teaching and Learning Social Studies</td>
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<td>ECI 630</td>
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<td>or ECI 727</td>
<td>Special Problems in Social Studies Education</td>
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<tr>
<td>ECI 511</td>
<td>Introduction to Learning Design and Technology</td>
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<tr>
<td>ECI 512</td>
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### Social Studies Education

<table>
<thead>
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<td><strong>Select three courses from the following:</strong></td>
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<tr>
<td>ECI 500</td>
<td>Theory and Practice In Teaching Diverse Populations</td>
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</tr>
<tr>
<td>ECI 525</td>
<td>Contemporary Approaches In the Teaching Of Social Studies</td>
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<td>ECI 526</td>
<td>Theory and Research On Teaching and Learning Social Studies</td>
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</tr>
<tr>
<td>ECI 630</td>
<td>Independent Study in Curriculum and Instruction</td>
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<tr>
<td>or ECI 727</td>
<td>Special Problems in Social Studies Education</td>
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<tr>
<td>ECI 511</td>
<td>Introduction to Learning Design and Technology</td>
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</tr>
<tr>
<td>ECI 512</td>
<td>Emerging Technologies for Teaching and Learning</td>
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</table>
ECI 513 Teaching and Learning with Digital Video  
ECI 514 Developing and Delivering Online Instruction  
ECI 515 Cultural Investigations and Technical Representations in Education

Social Studies Content Courses  
Select a minimum of two courses from a Social Studies discipline (history, political science, economics, anthropology, or geography) approved in conjunction with the academic committee

Total Hours 15

Faculty

Full Professors
Cathy L. Crossland  
Jessica Theresa DeCuir-Gunby  
John K. Lee  
Patricia L. Marshall  
John Nietfeld  
Kevin M. Oliver  
Edward J. Sabornie  
Margareta M. Thomson

Associate Professors
Candy M. Beal  
Sarah J. Carrier  
Dennis Scott Davis  
Deniz Eseryel  
DeLeon L. Gray  
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Meghan McGlenn Manfra  
James Minogue  
Temple A. Walkowiak  
Angela Michelle Wiseman  
Carl A. Young

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Michelle Marie Falter  
Jill Freiberg Grifenhagen  
Shiyan Jiang

Practice/Research/Teaching Professors
Drinda Elaine Benge  
Sarah Cannon  
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Ann D. Harrington  
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Micha Jeffries  
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Lawrence Keith Jones  
Susan Sinclair Osborne  
Carol A. Pope  
Ruie J. Pritchard  
Norman A. Sprinthall  
Lois M. Thies-Sprinthall  
Ellen S. Vasu

Curriculum and Instruction, New Literacies and Global Learning (MS): English Education Concentration
Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td><strong>Core Courses</strong></td>
<td></td>
</tr>
<tr>
<td>ECI 546</td>
<td>New Literacies &amp; Media</td>
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</tr>
<tr>
<td>ECI 524</td>
<td>Theory and Research in Global Learning</td>
<td></td>
</tr>
<tr>
<td>ECI 523</td>
<td>Teacher as Researcher</td>
<td></td>
</tr>
<tr>
<td>ECI 508</td>
<td>Teachers as Leaders</td>
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<tr>
<td></td>
<td><strong>Specialty Courses</strong></td>
<td>9</td>
</tr>
<tr>
<td>ECI 550</td>
<td>Foundations Of Middle Years Education</td>
<td></td>
</tr>
<tr>
<td>ECI 510</td>
<td>Research Applications In Curriculum and Instruction</td>
<td></td>
</tr>
<tr>
<td>ECI 695</td>
<td>Master's Thesis Research</td>
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<tr>
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**Elective Courses**

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<tr>
<td>ECI 500</td>
<td>Theory and Practice In Teaching Diverse Populations</td>
<td></td>
</tr>
<tr>
<td>ECI 520</td>
<td>The Teaching Of Composition</td>
<td></td>
</tr>
<tr>
<td>ECI 521</td>
<td>Teaching Literature For Young Adults</td>
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<tr>
<td>ECI 541</td>
<td>Reading In the Content Areas</td>
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<tr>
<td>ECI 522</td>
<td>Trends and Issues in English Language Arts Education</td>
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<tr>
<td>ECI 511</td>
<td>Introduction to Learning Design and Technology</td>
<td></td>
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<td>ECI 512</td>
<td>Emerging Technologies for Teaching and Learning</td>
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<tr>
<td>ECI 513</td>
<td>Teaching and Learning with Digital Video</td>
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<tr>
<td>ECI 514</td>
<td>Developing and Delivering Online Instruction</td>
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</tr>
<tr>
<td>ECI 515</td>
<td>Cultural Investigations and Technical Representations in Education</td>
<td></td>
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</table>

**ELA Content Courses**

|        | Select a minimum of two courses from an English discipline (literature, language, writing, film) approved in conjunction with the academic committee | 6     |
|        | **Total Hours**                       | 15    |

**Faculty**

**Full Professors**

Cathy L. Crossland
Jessica Theresa DeCuir-Gunby
John K. Lee
Patricia L. Marshall
John Nietfeld
Kevin M. Oliver
Edward J. Sabornie
Margareta M. Thomson

**Associate Professors**

Candy M. Beal
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Amato Nocera
Jamie Nicole Pearson
Jackie Eunjung Relyea
Jonee Wilson

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Lois M. Thies-Sprinthall
Ellen S. Vasu

Curriculum and Instruction, New Literacies and Global Learning (MS): Reading Education Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
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<tr>
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<td><strong>Core Courses</strong></td>
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<td>ECI 546</td>
<td>New Literacies &amp; Media</td>
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</tr>
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<td>ECI 524</td>
<td>Theory and Research in Global Learning</td>
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</tr>
<tr>
<td>ECI 523</td>
<td>Teacher as Researcher</td>
<td></td>
</tr>
<tr>
<td>ECI 508</td>
<td>Teachers as Leaders</td>
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<tr>
<td></td>
<td><strong>Specialty Courses</strong></td>
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<tr>
<td>ECI 550</td>
<td>Foundations Of Middle Years Education</td>
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</tr>
<tr>
<td>ECI 510</td>
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</tr>
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<td>Master's Thesis Research</td>
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Elective Courses

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<tr>
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<td><strong>Elective Courses</strong></td>
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<tr>
<td></td>
<td>&quot;Elective Courses&quot; will be determined in conjunction with the academic committee</td>
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</tr>
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Faculty

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Curriculum and Instruction, New Literacies and Global Learning (MS): Social Studies Education Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
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<tr>
<td></td>
<td>Total Hours</td>
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Elective Courses

Select three courses from the following: 9

- ECI 500  Theory and Practice In Teaching Diverse Populations
- ECI 525  Contemporary Approaches In the Teaching Of Social Studies
- ECI 526  Theory and Research On Teaching and Learning Social Studies
- ECI 630  or ECI 727  Independent Study in Curriculum and Instruction
- ECI 630  or ECI 727  Special Problems in Social Studies Education
- ECI 511  Introduction to Learning Design and Technology
- ECI 512  Emerging Technologies for Teaching and Learning
- ECI 513  Teaching and Learning with Digital Video
- ECI 514  Developing and Delivering Online Instruction
- ECI 515  Cultural Investigations and Technical Representations in Education

Social Studies Content Courses 6

Select a minimum of two courses from a Social Studies discipline (history, political science, economics, anthropology, or geography) approved in conjunction with the academic committee

Total Hours 15

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John K. Lee
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Kevin M. Oliver
Edward J. Sabornie
Margareta M. Thomson

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DeLeon L. Gray
Jessica Heather Hunt
Meghan McGlinn Manfra
James Minogue
Temple A. Walkowiak
Counselor Education (Certificate)

Our innovative online program prepares school teachers, administrators, staff, advisors, tutors in schools and universities, human service workers, and individuals interested in counseling work to advocate and support students, their families, clients and local communities. Our certificate program allows students to learn in a flexible environment, with flexible online classwork, without the hassle of traffic and on-campus parking. Students will meet online each week for a 90-minute interactive discussion with the professor, instructors and classmates, in order to stay connected and challenged. The certificate program alone does not prepare students to work as professional counselors. In order to work in professional counseling, additional classes, training and licensure will be required through a master’s degree program.

Admission Requirements

- Completed online Graduate School application and admission fee
- Resume outlining education and work experience

Admission to the GCCE online program takes place in the spring for a summer start. Rolling base admissions are possible if seats are available. Email us at ncsu_gcce@ncsu.edu with any questions.

Graduate Certificate in Counselor Education Requirements

Students admitted to this program are required to complete four online courses: ECD 510 Orientation to Professional Counseling, Identity, and Ethics, ECD 530 Theories of Counseling, ECD 524 Career Counseling, and ECD 525 Multicultural Counseling.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>ECD 510</td>
<td>Orientation to Professional Counseling, Identity, and Ethics</td>
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<tr>
<td>ECD 524</td>
<td>Career Counseling and Development</td>
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<tr>
<td>ECD 530</td>
<td>Theories and Tech of Counseling</td>
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<tr>
<td>ECD 525</td>
<td>Multicultural Counseling</td>
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Educational Administration and Supervision

NC State’s Ed.D. in Educational Administration & Supervision program is tied for #14 in U.S. News & World Report’s rankings of 393 graduate programs in the U.S. and ranked #1 in North Carolina! The program is designed to prepare systems-level leaders to improve the quality of K-12 schools by preparing the next generation of superintendents dedicated to educational excellence and equity. Graduates are empowered with...
leadership strategies that improve student performance in environments that are dynamic, interactive, and culturally diverse.

Program Description
The Ed.D. in Educational Administration & Supervision leads to district/superintendent licensure and requires core courses in educational leadership, research methods (9 hours), an internship (6 hours), and a dissertation (12 hours). Students must be officially admitted to the Ed.D. program to enroll in doctoral classes. Please be aware that a Ph.D. in Educational Evaluation and Policy Analysis is also offered, but only the Ed.D. leads to superintendent licensure.

Course of Study
The program requires a minimum of 54 credit hours beyond the master’s degree. Students complete 27 hours of core and elective courses, 9 credit hours of research methods, a two-semester internship (6 hours), and 12 hours of dissertation research.

Admission Requirements
Applicants must hold a North Carolina Principal’s license or be eligible to receive one; transcripts; three letters of reference (at least one must be from your current supervisor); resume (including teaching assignments, leadership experiences, and trainings); personal statement of interest and fit with career goals; and official score report from either the Miller Analogies Test (MAT) or the Graduate Record Exam (GRE). Test should have been taken within the last five years.

Degrees
• Educational Administration and Supervision (EdD) (p. 240)
• Educational Administration and Supervision (Minor) (p. 241)

Faculty
Full Professors
Bonnie C Fusarelli
Lance D. Fusarelli

Associate Professors
Lisa Bass
Anna Margaret Jacob

Assistant Professors
Jennifer Ayscue
Timothy Drake

Practice/Research/Teaching Professors
Gregory E. Hicks
Henry Johnson
Francine Piscitelli Riddick
Michael Ward

Emeritus Faculty
Paul F. Bitting

Educational Administration and Supervision (EdD)

Degree Requirements

<table>
<thead>
<tr>
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<td>ELP 720</td>
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<td>ELP 724</td>
<td>Contemporary Educational Thought</td>
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<td>ELP 728</td>
<td>School Law For the Administrator</td>
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<td>ELP 729</td>
<td>Educational Finance</td>
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<td>ELP 735</td>
<td>Policy Research in Education</td>
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<td>ELP 751</td>
<td>Politics of P-12 Education</td>
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<tr>
<td>ELP 753</td>
<td>Data Decision Making for School Administrators</td>
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<tr>
<td>ELP 756</td>
<td>Organizational Leadership &amp; Management for School Leaders</td>
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<td>ELP 780</td>
<td>Evaluation Theory and Practice In Education</td>
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<tr>
<td>ELP 789</td>
<td>Personnel Recruitment, Selection, Development and Appraisal in Education</td>
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<tr>
<td>ELP 795</td>
<td>Special Topics</td>
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<tr>
<td>ELP 820</td>
<td>Special Problems In Education</td>
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Research Methods and Data Analysis Courses (9 hours)
Select a minimum of three courses of the following:

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<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>ED 710</td>
<td>Applied Quantitative Methods in Education I</td>
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<tr>
<td>ED 711</td>
<td>Applied Quantitative Methods in Education II</td>
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<td>ED 730</td>
<td>Introduction to Qualitative Research in Education</td>
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</tr>
<tr>
<td>ED 731</td>
<td>Advanced Qualitative Research and Data Analysis in Education</td>
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</table>

Internship Courses (6 hours)

<table>
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<tr>
<th>Code</th>
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<th>Hours</th>
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<tbody>
<tr>
<td>ELP 851</td>
<td>Internship In Educational Leadership and Program Evaluation</td>
<td></td>
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</table>

Dissertation Preparation / Writing Courses (12 hours)

<table>
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<tr>
<td>ELP 891</td>
<td>Problems Of Research Design In Education</td>
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</tr>
<tr>
<td>ELP 895</td>
<td>Doctoral Dissertation Research</td>
<td></td>
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</tbody>
</table>

Total Hours (54 hours)

1. ELP 795 Special Topics may be repeated for credit.
2. ELP 820 Special Problems In Education may be repeated once for credit.
3. ELP 851 Internship In Educational Leadership and Program Evaluation must be repeated consecutively.

Faculty
Full Professors
Bonnie C Fusarelli
Lance D. Fusarelli
Educational Administration and Supervision (Minor)

Plan Requirements

• 9 (MS student) or 12 (PhD student) credit hours

Educational Leadership, Policy and Human Development

The Adult, Workforce, and Continuing Professional Education specialization with the Ph.D. in Educational Leadership, Policy, and Human Development is unique in its emphasis on serving the spectrum of both formal and informal adult learning organizations, and its inclusion of administrative, instructional and technology-related leadership within a practitioner preparation program. Based on a land-grant, Research Extensive University, the department reflects the tripartite commitment to quality instruction, research scholarship and service outreach.

The Ph.D. in Educational Leadership, Policy, and Human Development with a specialization in Adult, Workforce, and Continuing Professional Education, is one-of-a-kind as its primary commitment is to part-time students who are full-time working professionals. Full-time students are eligible for consideration to receive full funding through scholarships, fellowships and research and teaching assistantships, which allow our students to work with top faculty on cutting-edge projects. To meet the needs of full- and part-time students, most courses are offered once a week during late afternoon or evening hours. Some courses are regularly available during summer sessions and weekends and through distance education technologies.

Admission Requirements

Applications for admission are submitted through the Graduate School. We accept students from a wide range of educational backgrounds. To qualify for admission, applicants must have a master’s degree from an accredited institution of higher education in any field. International applicants must also have a TOEFL score of 100 or higher. Admission decisions are based on several criteria, including undergraduate GPA, work history and interest in the field.

Student Financial Support

To be eligible for financial aid, students must be enrolled in Master’s or Doctoral degree programs offered by the University. Unfortunately there is no financial aid available for Graduate Certificate students. Occasionally graduate assistantships are available for full time students in our degree programs. Please check with your advisor about assistantship opportunities. We recommend that you contact the Office of Scholarships and Financial Aid (https://studentservices.ncsu.edu/contact-us/) to find out what other options are available.

Degrees

• Educational Leadership, Policy, and Human Development (PhD) (p. 242)
• Educational Leadership, Policy, and Human Development (PhD) Counseling and Counselor Education Concentration (p. 244)
• Education Research & Policy Analysis (Minor) (p. 244)
• Teaching, Training, and Educational Technology (Certificate) (p. 245)

Faculty

Full Professors

Duane Akroyd
Stanley B. Baker
Mary Ann Danowitz
Maltie Jayne Fleener
Bonnie C. Fusarelli
Lance D. Fusarelli
Joy Gaston Gayles
Marc Anderson Grimmett
Audrey J. Jaeger
Glenn Marshall Kleiman
Sylvia Christine Maria Nassar
Jose’ A. Picart
Stephen Robert Porter
Alyssa Nicole Rockenbach
Siu-Man Ting
Paul David Umbach

Associate Professors

Susan J. Barcinas
Assistant Professors
Jennifer Baucom Ayscue
Timothy Arthur Drake
Adria Shipp Dunbar
Michael Little
Lam Pham
Rhonda Saeleth Craver Sutton

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Patricia Andrews Ashley
Michelle E. Bartlett
Brenda D. Champion
Diane Dolores Chapman
Nicole Marie Childs
Peter A. Hessling
Gregory Eugene Hicks
Robert Grant Templin Jr.
Helen S. Lupton-Smith
Barry A. Olson
Francine Piscitelli Riddick
Angela Carmella Smith
Cathy Sue Williams

Educational Leadership, Policy, and Human Development (PhD)

Degree Requirements
Degrees earned will be distributed as: “Doctor of Philosophy in Education Leadership, Policy and Human Development” without specialization specifications.

In addition, students must select a specialization of the following:

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td></td>
<td><strong>Scholar Leader Core Courses</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>AWCPE Area of Study Courses</strong></td>
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<tr>
<td>EAC 711</td>
<td>Reflective Practice and Research Inquiry</td>
<td>6</td>
</tr>
<tr>
<td>EAC 803</td>
<td>Research Seminar in Adult and Higher Education</td>
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<tr>
<td>EAC 730</td>
<td>Foundations of Adult, Higher, and Human Res</td>
<td>12</td>
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<tr>
<td></td>
<td>or EAC 710 Adult Education: History, Philosophy, Contemporary Nature</td>
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<tr>
<td>EAC 759</td>
<td>Adult Learning Theory</td>
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<tr>
<td>EAC 703</td>
<td>The Programming Process In Adult and Community College Education</td>
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<td>EAC 780</td>
<td>Evaluation Theory and Practice In Education</td>
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<td><strong>Elective Courses</strong></td>
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<td>&quot;Elective Courses&quot; will be determined in conjunction with the academic committee</td>
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<td><strong>Dissertation Courses</strong></td>
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<tr>
<td></td>
<td>EAC 895 Doctoral Dissertation Research</td>
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<tr>
<td></td>
<td>or EAC 899 Doctoral Dissertation Preparation</td>
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<tr>
<td></td>
<td><strong>Total Hours</strong></td>
<td>72</td>
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</tbody>
</table>

For doctoral students either part-time or full-time who are working on their dissertation: Writing the dissertation requires a major commitment of time and effort on both the part of the doctoral student and the faculty advisor. There should be consultation between the student and the dissertation chair about what is expected to be accomplished, and how much time is to be invested before the student registers. The College of Education strongly recommends that students who are registering for EAC 895 Doctoral Dissertation Research or EAC 899 Doctoral Dissertation Preparation register for at least 3 semester hours per semester, when appropriate.

Educational Evaluation and Policy Analysis (EEPA)

<table>
<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td><strong>Scholar Leader Core Courses</strong></td>
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<tr>
<td>ELP 892</td>
<td>Research Projects In Educational Leadership and Program Evaluation</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>EEPA Area of Study Courses</strong></td>
<td>18-30</td>
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<tr>
<td></td>
<td><strong>Dissertation Courses</strong></td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>ELP 891 Problems Of Research Design In Education</td>
<td></td>
</tr>
</tbody>
</table>

In addition, students must select a specialization of the following:
ELP 895  Doctoral Dissertation Research
ELP 899  Doctoral Dissertation Preparation

Total Hours  72

1 For doctoral students either part-time or full-time who are working on their dissertation: Writing the dissertation requires a major commitment of time and effort on both the part of the doctoral student and the faculty advisor. There should be consultation between the student and the dissertation chair about what is expected to be accomplished, and how much time is to be invested before the student registers. The College of Education strongly recommends that students who are registering for ELP 891 Problems Of Research Design In Education, ELP 895 Doctoral Dissertation Research, or ELP 899 Doctoral Dissertation Preparation register for at least 3 semester hours per semester, when appropriate.

Higher Education (HE)

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<tr>
<td></td>
<td>Scholar Leaders Core Courses</td>
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<tr>
<td>EAC 795</td>
<td>Topical Problems in Adult and Community College Education</td>
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<tr>
<td>EAC 803</td>
<td>Research Seminar in Adult and Higher Education</td>
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<td></td>
<td>HE Area of Study Courses</td>
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<tr>
<td></td>
<td>HE Area of Study Courses</td>
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<tr>
<td>EAC 749</td>
<td>Finance in Higher Education</td>
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<td>EAC 787</td>
<td>Organizational Theories and Concepts in Higher Education</td>
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<td>Elective Courses</td>
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<td>the academic committee</td>
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<td>Advanced Research Course</td>
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<td>Total Hours</td>
<td>72</td>
</tr>
</tbody>
</table>

1 For doctoral students either part-time or full-time who are working on their dissertation: Writing the dissertation requires a major commitment of time and effort on both the part of the doctoral student and the faculty advisor. There should be consultation between the student and the dissertation chair about what is expected to be accomplished, and how much time is to be invested before the student registers. The College of Education strongly recommends that students who are registering for EAC 895 Doctoral Dissertation Research register for at least 3 semester hours per semester, when appropriate.

Faculty

Full Professors

Duane Akroyd
Joy Gaston Gayles
Marc Anderson Grimmett
Audrey J. Jaeger
Glenn Marshall Kleiman
Sylvia Christine Maria Nassar
Jose’ A. Picart
Stephen Robert Porter
Alyssa Nicole Rockenbach
Siu-Man Ting
Paul David Umbach

Associate Professors

Susan J. Barcinas
James E. Bartlett II
Lisa R. Bass
Chad David Hoggan
Anna Margaret Jacob
Tamara V. Young

Assistant Professors

Jennifer Baucom Ayscue
Timothy Arthur Drake
Adria Shipp Dunbar
Michael Little
Lam Pham
Rhonda Saeleth Craver Sutton

Practice/Research/Teaching Professors

Patricia Andrews Ashley
Michelle E. Bartlett
Brenda D. Champion
Diane Dolores Champion
Nicole Marie Childs
Peter A. Hessling
Gregory Eugene Hicks
Robert Grant Templin Jr.
Educational Leadership, Policy, and Human Development (PhD) Counseling and Counselor Education Concentration

Degree Requirements

Concentration Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td></td>
<td>Scholar Core Required Courses or Experiences</td>
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<tr>
<td>ECD 732</td>
<td>Advanced Multicultural Counseling</td>
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<td>ECD 860</td>
<td>Professional Issues In Counseling</td>
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<td></td>
<td>Program Area of Study 1</td>
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<tr>
<td>ECD 731</td>
<td>Career Development Theory and Research</td>
<td></td>
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<tr>
<td>ECD 735</td>
<td>Counseling Supervision: Theory and Research</td>
<td></td>
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<tr>
<td>ECD 843</td>
<td>Advanced Counseling Practicum</td>
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<tr>
<td>ECD 847</td>
<td>Internship in Supervision</td>
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<tr>
<td>ECD 850</td>
<td>Doctoral Internship</td>
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<tr>
<td>ECD 886</td>
<td>Internship in Teaching in Counselor Education</td>
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<tr>
<td></td>
<td>Thesis Equivalence Course 2</td>
<td>2</td>
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<tr>
<td>ECD 892</td>
<td>Doctoral Research Projects</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dissertation Courses 3</td>
<td>9</td>
</tr>
<tr>
<td>ECD 895</td>
<td>Doctoral Dissertation Research</td>
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</tr>
<tr>
<td>or ECD 899</td>
<td>Doctoral Dissertation Preparation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Hours</td>
<td>72</td>
</tr>
</tbody>
</table>

1 Prerequisites: (number of credits: zero to variable) 600 hour internship and masters level course work equivalent to those of a CACREP accredited program. Because of the impact of COVID-19 pandemic, the accreditation review has been delayed. We expect to receive a one-year extension of accreditation from CACREP to complete the review process.

2 A thesis equivalent is a program requirement for those not having completed a thesis during their master’s program.

3 For doctoral students either part-time or full-time who are working on their dissertation. Writing the dissertation requires a major commitment of time and effort on both the part of the doctoral student and the faculty advisor. There should be consultation between the student and the dissertation chair about what is expected to be accomplished, and how much time is to be invested before the student registers. The College of Education strongly recommends that students who are registering for ECD 895 Doctoral Dissertation Research or ECD 899 Doctoral Dissertation Preparation register for at least 3 semester hours per semester, when appropriate.

Education Research & Policy Analysis (Minor)

Plan Requirements

• 9 (MS student) or 12 (PhD student) credit hours

Faculty

Full Professors

Duane Akroyd
Stanley B. Baker
Mary Ann Danowitz
Mattie Jayne Fleener
Bonnie C. Fusarelli
Lance D. Fusarelli
Joy Gaston Gayles
Marc Anderson Grimmett
Audrey J. Jaeger
Glenn Marshall Kleiman
Sylvia Christine Maria Nassar
Jose’ A. Picart
Stephen Robert Porter
Alyssa Nicole Rockenbach
Siu-Man Ting
Paul David Umbach

Associate Professors

Susan J. Barcinas
James E. Bartlett II
Lisa R. Bass
Chad David Hoggan
Anna Margaret Jacob
Tamara V. Young

Assistant Professors

Jennifer Baucom Ayscue
Timothy Arthur Drake
Adria Shipp Dunbar
Michael Little
Teaching, Training, and Educational Technology (Certificate)

Delivered 100% online, the Certificate consists of five 3-credit courses focused on teaching, training, and the use of technology in a variety of educational environments. Students can tailor the program to meet their needs and gain the knowledge and skills necessary to design and deliver course-related content through face-to-face, technology-enhanced, and e-learning environments. The program is designed for mid-career individuals who may be without academic preparation for their current positions, or for those choosing to increase their knowledge and skills in the field for future job opportunities.

Students may choose one of the following specialty areas: Training and Development, Instructional Design, E-Learning, Community College Teaching, and Community College Leadership.

In order to be awarded the Certificate, all required courses must be taken and one elective is allowed. Transfer credit from other institutions is not allowed.

Please see the department website for the specific required and elective courses for each specialization. For course descriptions, please refer to the NC State listing of courses. For further information, see the Certificate in Teaching, Training, and Educational Technology website (https://ced.ncsu.edu/programs/teaching-training-educational-technology-certificate/).

Plan Requirements

Students can choose courses from the following specializations:

- Talent Development
- Instructional Design
- E-Learning / Educational Technology
- Community College Teaching
- Community College Leadership

Certificates earned will be distributed as: “Graduate Certificate in Teaching, Training, and Educational Technology” without focus area specifications.

Talent Development

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAC 692</td>
<td>Research Projects In Education</td>
<td>3</td>
</tr>
<tr>
<td>EAC 559</td>
<td>The Adult Learner</td>
<td>3</td>
</tr>
<tr>
<td>EAC 582</td>
<td>Organization and Operation Of Training and Development Programs</td>
<td>3</td>
</tr>
<tr>
<td>EAC 586</td>
<td>Methods and Techniques Of Training and Development</td>
<td>3</td>
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</table>

Select one of the following electives: 3 hours

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAC 556</td>
<td>Organization Change in HRD: Theory &amp; Practice</td>
</tr>
<tr>
<td>EAC 580</td>
<td>Designing Instructional Systems in Training and Development</td>
</tr>
<tr>
<td>EAC 584</td>
<td>Evaluating Training Transfer and Effectiveness</td>
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</tbody>
</table>

Total Hours 15

Instructional Design

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>EAC 692</td>
<td>Research Projects In Education</td>
<td>3</td>
</tr>
<tr>
<td>EAC 580</td>
<td>Designing Instructional Systems in Training and Development</td>
<td>3</td>
</tr>
<tr>
<td>EAC 581</td>
<td>Advanced Instructional Design in Training and Development</td>
<td>3</td>
</tr>
<tr>
<td>EAC 583</td>
<td>Needs Assessment and Task Analysis in Training and Development</td>
<td>3</td>
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Select one of the following electives: 3 hours

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>EAC 559</td>
<td>The Adult Learner</td>
</tr>
<tr>
<td>EAC 584</td>
<td>Evaluating Training Transfer and Effectiveness</td>
</tr>
<tr>
<td>EAC 585</td>
<td>Integrating Technology into Training Program</td>
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</table>

Total Hours 15

E-Learning / Educational Technology

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>EAC 692</td>
<td>Research Projects In Education</td>
<td>3</td>
</tr>
<tr>
<td>EAC 539</td>
<td>Teaching in the Online Environment</td>
<td>3</td>
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<tr>
<td>EAC 580</td>
<td>Designing Instructional Systems in Training and Development</td>
<td>3</td>
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<tr>
<td>EAC 585</td>
<td>Integrating Technology into Training Program</td>
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Select one of the following electives: 3 hours

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<th>Code</th>
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<tbody>
<tr>
<td>EAC 581</td>
<td>Advanced Instructional Design in Training and Development</td>
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</table>
Elementary Education

The Elementary Education program in the TELS department offers a Master of Education (M.Ed.) degree in Elementary Education with a concentration in either mathematics or science education. The Master’s program prepares teacher leaders who possess strong specialized content knowledge in mathematics or science and a deep understanding of how elementary students learn. The program, designed for those who already hold a current teaching license, is especially tailored to provide candidates with leadership and application skills to transfer their knowledge to their work with elementary school teachers and students.

The program is considered Distance Education (DE) and offered off campus at school sites in the region to take advantage of reduced DE tuition rates.

For more information please see https://ced.ncsu.edu/programs/elementary-education-master/

The coursework for the mathematics and science concentrations are approved by the North Carolina State Board of Education. Therefore, graduates of the M.Ed. program are eligible to receive the elementary mathematics or elementary science specialist add-on to their North Carolina K-6 teaching license from the Department of Public Instruction. The College of Education is accredited by the Council for the Accreditation of Educator Preparation (CAEP).

Admission Requirements

Elementary Education Master’s program: Application requirements include a 500-800 word statement describing professional goals, transcripts and reference letters, and a teaching license. The Graduate School requires a 3.0 GPA in an undergraduate program. The best qualified applicants will be accepted up to the limited number of spaces available for new students.

For the M.S. degree, a minimum of 33 hours is required. The M.S. degree requires a thesis and final oral examination approved by the graduate committee. It is the responsibility of MS students to secure an advisor in advance to supervise their thesis research.

Degrees

- Elementary Education (MEd) (p. 246)
- Elementary Education (MS) (p. 247)

Faculty

Full Professors
Paola Sztajn

Associate Professors
Sarah J. Carrier
Jessica Heather Hunt
James Minogue
Temple A. Walkowiak

Assistant Professors
Jill Freiberg Grifenhagen
Jonee Wilson

Practice/Research/Teaching Professors
Valerie Ness Faulkner

Elementary Education (MEd)
Degree Requirements

Math Leader

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>ELM 555</td>
<td>Number Systems and Operations: K-5 Mathematical Tasks</td>
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<tr>
<td>ELM 556</td>
<td>Rational Numbers and Operations: K-5 Learning Trajectories</td>
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<tr>
<td>ELM 557</td>
<td>Data Analysis and Measurement: K-5 Classroom Interactions</td>
<td>3</td>
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<tr>
<td>ELM 558</td>
<td>Algebraic Reasoning: K-5 Discourse and Questioning</td>
<td>3</td>
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<tr>
<td>ELM 559</td>
<td>Geometry and Spatial Visualization: K-5 Assessment</td>
<td>3</td>
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<tr>
<td>ELM 560</td>
<td>Mathematical Modeling: K-5 Leadership</td>
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<tr>
<td>ELM 520</td>
<td>Methods of Teaching Elementary School Science</td>
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<tr>
<td>ELM 530</td>
<td>Social Studies In the Elementary School</td>
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<tr>
<td>ECI 541</td>
<td>Reading In the Content Areas</td>
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<tr>
<td>ELM 654</td>
<td>Internship In Elementary Education (Inquiry Project)</td>
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Total Hours: 28-33

Science Leader

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<tr>
<td>ELM 524</td>
<td>Issues in Elementary School Science Education</td>
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<tr>
<td>ELM 539</td>
<td>Special Problems in Elementary School Science</td>
<td>3</td>
</tr>
<tr>
<td>ELM 520</td>
<td>Methods of Teaching Elementary School Science</td>
<td>3</td>
</tr>
<tr>
<td>ELM 530</td>
<td>Social Studies In the Elementary School</td>
<td>3</td>
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<tr>
<td>ECI 541</td>
<td>Reading In the Content Areas</td>
<td>3</td>
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<tr>
<td>ELM 654</td>
<td>Internship In Elementary Education (Inquiry Project)</td>
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</table>

Life Science Content | 3
Earth Science Content | 3
Physical Science Content | 3

Total Hours: 25-30

Faculty

Full Professors

Paola Sztajn

Associate Professors

Sarah J. Carrier
Jessica Heather Hunt
James Minogue
Temple A. Walkowiak

Assistant Professors

Jill Freiberg Grifenhagen
Jonee Wilson

Practice/Research/Teaching Professors

Valerie Ness Faulkner

Elementary Education (MS)

Faculty

Full Professors

Paola Sztajn

Associate Professors

Sarah J. Carrier
Jessica Heather Hunt
James Minogue
Temple A. Walkowiak

Assistant Professors

Jill Freiberg Grifenhagen
Jonee Wilson

Practice/Research/Teaching Professors

Valerie Ness Faulkner

Higher Education Administration

Degrees

• Higher Education Administration (MEd) (p. 247)

Faculty

Full Professors

Joy Gaston Gayles
Alyssa Nicole Rockenbach
Paul David Umbach

Practice/Research/Teaching Professors

Krispin Wagoner Barr
Barry A. Olson
David J. English

Higher Education Administration (MEd)
Learning and Teaching in STEM

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td>Core Courses</td>
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<tr>
<td>EAC 540</td>
<td>Foundations of Higher Education and Student Affairs</td>
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<tr>
<td>EAC 542</td>
<td>Student Characteristics and the College Environment</td>
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<td>EAC 543</td>
<td>Student Development Theory</td>
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<tr>
<td>EAC 545</td>
<td>Higher Education Masters Professional Seminar</td>
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<tr>
<td>EAC 595</td>
<td>Special Topics (College Outcomes)</td>
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<tr>
<td>EAC 595</td>
<td>Special Topics (Diversity in Higher Education)</td>
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<td>Research Component</td>
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<td>EAC 595</td>
<td>Special Topics (Research and Assessment in Higher Education)</td>
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<td>Experiential (Internship / Practicum) Component</td>
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<tr>
<td>EAC 651</td>
<td>Internship In Adult and Community College Education</td>
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<td>Elective Courses</td>
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<td>Select 15 credit hours of Higher Education Threads approved in conjunction with the academic committee</td>
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Faculty

Full Professors

Joy Gaston Gayles
Alyssa Nicole Rockenbach
Paul David Umbach

Practice/Research/Teaching Professors

Krispin Wagoner Barr
Barry A. Olson
David J. English

Student Financial Support

A small number of teaching and research assistantships are available, and out-of-state tuition remission may be available for one year for students on assistantships. Please discuss these opportunities directly with program area faculty.

Degrees

• Learning & Teaching in STEM (PhD) (p. 249)

Faculty

Full Professors

Margaret R. Blanchard
Aaron Catron Clark
Jo-Ann D. Cohen
Jere Confrey
Karen Flanagan Hollebrands
Carla Johnson
Melissa Gail Jones
Hollylynne Stohl Lee
Select at least 24 credit hours of Program Area Courses ²  
Total Hours 60

¹ At least one Quantitative Methods Course, one Qualitative Methods Course, and one Advanced Methods Course
² Determined by Program Area and consultation with Advisor

Faculty
Full Professors
Margaret R. Blanchard
Aaron Catron Clark
Jo-Ann D. Cohen
Jere Confrey
Karen Flanagan Hollebrands
Carla Johnson
Melissa Gail Jones
Hollylynne Stohl Lee
Soonhye Park
Lee Vernon Stiff
Eric N. Wiebe

Assistant Professors
Robin Keturah Anderson
Kirstin Collette Rogis Busch
Tamecia Raishaun Jones
Erin Krupa
Jonee Wilson

Practice/Research/Teaching Professors
Cynthia Page Edgington

Learning Design & Technology

The department of Teacher Education and Learning Sciences offers master’s degrees in Learning Design and Technology. These master’s programs prepare education professionals to lead digital learning
programs, design digital learning environments, and inquire into digital learning solutions to continuously refine instruction and improve student learning.

For more please see https://ced.ncsu.edu/programs/learning-design-technology-master/

The NC Department of Public Instruction has conferred accreditation to the graduate programs in Teacher Education and Learning Sciences. The College of Education is approved by the Council for the Accreditation of Educator Preparation (CAEP). Graduates of this program holding a North Carolina teaching license are eligible to add the 079 computer teacher endorsement and/or 077 technology specialist endorsement to their license.

Admission Requirements

Learning Design & Technology: A 500-800 word statement describing professional goals is required, along with transcripts and reference letters. The Graduate School requires a 3.0 in the undergraduate program. TOEFL or IELTS scores for international applicants whose first language is not English.

Master’s Degree Requirements

Learning Design & Technology: A minimum of 30 course credit hours. For the M.S. degree, a minimum of 36 hours is required. The M.S. degree requires a thesis and final oral examination approved by the graduate committee.

Degrees

- Learning Design & Technology (MEd) (p. 250)
- Learning Design & Technology (MS) (p. 250)

Full Professors

Kevin M. Oliver

Associate Professors

Deniz Eseryel

Assistant Professors

Shiyan Jiang

Practice/Research/Teaching Professors

Shaun B. Kellogg
Julia O’Neal McKeown
Heather Purichia
Mark Justin Samberg

Learning Design & Technology (MEd)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Courses</td>
<td></td>
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</tr>
<tr>
<td>ECI 511</td>
<td>Introduction to Learning Design and Technology</td>
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</tr>
<tr>
<td>ECI 515</td>
<td>Cultural Investigations and Technical Representations in Education</td>
<td></td>
</tr>
<tr>
<td>ECI 516</td>
<td>Design and Evaluation Of Instructional Materials</td>
<td></td>
</tr>
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<td>ECI 517</td>
<td>Theoretical Foundations of Advanced Learning Environments</td>
<td></td>
</tr>
<tr>
<td>ECI 652</td>
<td>Field-Based Applications of Learning Design and Technology</td>
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<tr>
<td>Elective Courses</td>
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<tr>
<td>Select a minimum of 15 credit hours of the following courses:</td>
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<tr>
<td>ECI 502</td>
<td>Technology Program Evaluation</td>
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</tr>
<tr>
<td>ECI 512</td>
<td>Emerging Technologies for Teaching and Learning</td>
<td></td>
</tr>
<tr>
<td>ECI 513</td>
<td>Teaching and Learning with Digital Video</td>
<td></td>
</tr>
<tr>
<td>ECI 514</td>
<td>Developing and Delivering Online Instruction</td>
<td></td>
</tr>
<tr>
<td>ECI 518</td>
<td>Digital Learning Program and Staff Development</td>
<td></td>
</tr>
<tr>
<td>ECI 721</td>
<td>Technology and Informal Learning Environments</td>
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</tr>
<tr>
<td>ECI 722</td>
<td>Theory and Research in Distance Education</td>
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<tr>
<td>Total Hours</td>
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</table>

Full Professors

Kevin M. Oliver

Associate Professors

Deniz Eseryel

Assistant Professors

Shiyan Jiang

Practice/Research/Teaching Professors

Shaun B. Kellogg
Julia O’Neal McKeown
Heather Purichia
Mark Justin Samberg

Learning Design & Technology (MS)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>Core Courses</td>
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<td>ECI 511</td>
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<td>ECI 515</td>
<td>Cultural Investigations and Technical Representations in Education</td>
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<tr>
<td>ECI 516</td>
<td>Design and Evaluation Of Instructional Materials</td>
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<tr>
<td>ECI 517</td>
<td>Theoretical Foundations of Advanced Learning Environments</td>
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<tr>
<td>Elective Courses</td>
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</table>
Select a minimum 12 credit hours of the following courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>ECI 502</td>
<td>Technology Program Evaluation</td>
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<tr>
<td>ECI 512</td>
<td>Emerging Technologies for Teaching and Learning</td>
</tr>
<tr>
<td>ECI 513</td>
<td>Teaching and Learning with Digital Video</td>
</tr>
<tr>
<td>ECI 514</td>
<td>Developing and Delivering Online Instruction</td>
</tr>
<tr>
<td>ECI 518</td>
<td>Digital Learning Program and Staff Development</td>
</tr>
<tr>
<td>ECI 519</td>
<td>Special Problems in Learning Design and Technology</td>
</tr>
<tr>
<td>ECI 721</td>
<td>Technology and Informal Learning Environments</td>
</tr>
<tr>
<td>ECI 722</td>
<td>Theory and Research in Distance Education</td>
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</table>

Research Methods / Thesis Courses 12

Select a minimum 12 credit hours of the following courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>ECI 510</td>
<td>Research Applications in Curriculum and Instruction</td>
</tr>
<tr>
<td>ECI 586</td>
<td>Introduction to Learning Analytics</td>
</tr>
<tr>
<td>ECI 587</td>
<td>Machine Learning in Education</td>
</tr>
<tr>
<td>ECI 588</td>
<td>Text Mining in Education</td>
</tr>
<tr>
<td>ECI 589</td>
<td>Analyzing Learning Networks</td>
</tr>
<tr>
<td>ECI 695</td>
<td>Master's Thesis Research</td>
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<td>ST 511</td>
<td>Statistical Methods For Researchers I</td>
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</table>

Total Hours 36

Full Professors
Kevin M. Oliver

Associate Professors
Deniz Eseryel

Assistant Professors
Shiyan Jiang

Practice/Research/Teaching Professors
Shaun B. Kellogg
Julia O'Neal McKeown
Heather Purichia
Mark Justin Samberg

Mathematics Education

Our mission is to prepare master's degree-seeking students for positions of instructional leadership in Mathematics Education as master teachers of mathematics in middle grades (6-9), high school (9-12) or post-secondary institutions such as community colleges. A master's program is offered that leads to initial teaching licensure. Master's programs are also offered leading to North Carolina M-licensure as a teacher of technology at grades 6-12. Programs are also available for those seeking advanced graduate-level certification as a teacher. Finally, students may choose a program to prepare for teaching careers in post-secondary education.

• Master of Education in STEM Education – Mathematics Concentration
• Master of Arts in Teaching – Mathematics Education

Admission Requirements

Applicants for M.S., degrees in mathematics education must submit a completed application specific to the program. Please see the Science, Technology, Engineering and Mathematics (STEM) Education website for details. The deadlines for submission of an application, and academic and professional background necessary for admission differ by specific program.

Master's Degree Requirements

The Master of Science Degree requires a minimum of 36 semester hours of graduate work.

Student Financial Support

A small number of teaching and research assistantships are available, and out-of-state tuition remission may be available for one year for students on assistantships. Please discuss these opportunities directly with program area faculty.

Degrees

• Mathematics Education (MS) (p. 252)
• Mathematics Education (Minor) (p. 252)

Faculty

Full Professors
Jo-Ann D. Cohen
Jere Confrey
Karen Flanagan Hollebrands
Hollylynne Stohl Lee
Lee Vernon Stiff
Paola Sztajn
Eric N. Wiebe

Associate Professors
Jessica Heather Hunt
Temple A. Walkowiak

Assistant Professors
Robin Keturah Anderson
Erin Krupa
Jonee Wilson
Emeritus Faculty
Norman Dean Anderson
John Ronald Kolb
Larry W. Watson

Mathematics Education (MS)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
</table>
| Core Courses | Select four of the following:  
EMS 513 Teaching and Learning of Algebraic Thinking | 12    |
| EMS 514 Teaching and Learning of Geometric Thinking      |       |
| EMS 519 Teaching and Learning of Statistical Thinking   |       |
| EMS 510 Interactions In the Mathematics Classroom       |       |
| EMS 573 Design of Tools and Learning Environments in STEM Education |       |
| EMS 580 Teaching Mathematics with Technology            |       |
| STEM Education course                                  | 3     |
| Mathematical Science courses                           | 15    |
| Elective course                                        | 3     |
| Research course                                        | 3     |
| Total Hours                                           | 36    |

1. One must be a technology course
2. 6/15 credit hours may be taken at 400 level

Faculty

Full Professors
Jo-Ann D. Cohen
Jere Confrey
Karen Flanagan Hollebrands
Hollylynne Stohl Lee
Lee Vernon Stiff
Paola Sztajn
Eric N. Wiebe

Associate Professors
Jessica Heather Hunt
Temple A. Walkowiak

Assistant Professors
Robin Keturah Anderson
Erin Krupa
Jonee Wilson

Emeritus Faculty
Norman Dean Anderson
John Ronald Kolb
Larry W. Watson

Mathematics Education (Minor)

Plan Requirements

Master's Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
</table>
| Required Courses | Select three of the following courses:  
EMS 510 Interactions In the Mathematics Classroom | 9  |
EMS 513 Teaching and Learning of Algebraic Thinking
EMS 514 Teaching and Learning of Geometric Thinking
EMS 519 Teaching and Learning of Statistical Thinking
EMS 580 Teaching Mathematics with Technology
EMS 573 Design of Tools and Learning Environments in STEM Education |
| Total Hours | 9 |

PhD Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</table>
| Required Courses | Select three or four courses from the following:  
EMS 704 Curriculum Development and Evaluation In Science and Mathematics | 12 |
EMS 705 Education and Supervision Of Teachers Of Mathematics and Science
EMS 711 Research on the Teaching and Learning of Math at Secondary and Early College Levels
EMS 712 Teaching Mathematics In Elementary and Junior High School
EMS 770 Foundations Of Mathematics Education
EMS 790 Foundational Learning Theories in STEM Education (course pending Admin Board approval 2020)
EMS 791 Contemporary Research and Critical Issues in STEM Education |
| Total Hours | 12 |

Select one or no courses from the following:
EMS 510 Interactions In the Mathematics Classroom
EMS 513 Teaching and Learning of Algebraic Thinking
EMS 514 Teaching and Learning of Geometric Thinking
EMS 519 Teaching and Learning of Statistical Thinking
EMS 580 Teaching Mathematics with Technology
EMS 573 Design of Tools and Learning Environments in STEM Education
Faculty

Full Professors
Jo-Ann D. Cohen
Jere Confrey
Karen Flanagan Hollebrands
Hollylynne Stohl Lee
Lee Vernon Stiff
Paola Sztajn
Eric N. Wiebe

Associate Professors
Jessica Heather Hunt
Temple A. Walkowiak

Assistant Professors
Robin Keturah Anderson
Erin Krupa
Jonee Wilson

Emeritus Faculty
Norman Dean Anderson
John Ronald Kolb
Larry W. Watson

School Administration

NCSU’s Master of School Administration (MSA) program is the top-ranked school leadership program in North Carolina and one of only six programs nationally to have been designated as exemplary by the University Council for Educational Administration. The cohort-based program prepares graduates to assume building-level leadership positions in schools (public, private, and charter) as assistant principals and principals and leads to principal licensure.

Admission Requirements
Personal statement including career goals and aspirations; transcripts; teaching experience in K-12 schools (three years preferred); resume; three letters of recommendation (one recommendation is to be from current supervisor); minimum 3.0 undergraduate GPA (preferred); participate in Candidate Assessment Day.

All application materials must be submitted through the Graduate School’s online application process only. No hard copies will be accepted. Because this program is cohort-based, no deferrals of admission are permitted.

Degrees
• School Administration Distance Education (MR) (p. 253)

Full Professors
Bonnie C. Fusarelli
Lance D. Fusarelli

Associate Professors
Lisa R. Bass
Anna Margaret Jacob

Assistant Professors
Jennifer Baucom Ayscue
Timothy Arthur Drake

Emeritus Faculty
Paul F. Bitting
Raymond G. Taylor Jr.

Practice/Research/Teaching Professors
Patricia Andrews Ashley
Brenda D. Champion
William Harrison
Gregory Eugene Hicks
Henry Johnson
Francine Piscitelli Riddick
Michael Ward
Cathy Sue Williams

School Administration Distance Education (MR)

Degree Requirements

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<tr>
<th>Code</th>
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<tr>
<td>ELP 515</td>
<td>Education and Social Diversity</td>
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<tr>
<td>ELP 518</td>
<td>Introduction To Education Law</td>
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<tr>
<td>ELP 550</td>
<td>Principles of Educational Leadership and Empowerment</td>
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<tr>
<td>ELP 551</td>
<td>Context and Challenges of School Improvement</td>
<td></td>
</tr>
<tr>
<td>ELP 552</td>
<td>School-Based Planning, Management, and Evaluation in Professional Learning Communities</td>
<td></td>
</tr>
<tr>
<td>ELP 553</td>
<td>Organizational Management I: Human Resource Management in K-12 Education</td>
<td></td>
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</tbody>
</table>
School Counseling

The Department of Counselor Education offers three programs of study (concentrations) leading to the Master of Education Degree: Clinical Mental Health Counseling, College Counseling and Student Development, and School Counseling.

All master’s degree programs (on-campus and online deliveries) are accredited by the Council for Accreditation of Counseling and Related Educational Programs until October 31, 2020. Because of the impact of COVID-19 pandemic, the accreditation review has been delayed. We expect to receive a one-year extension of accreditation from CACREP to complete the review process.

Admission Requirements

Admissions Requirements for Master’s Programs (on-campus and online programs):

- Completed online application, resume, personal statement/goals, and non-refundable application fee
- GRE Scores/MAT Scores
- 3 recommendations from people who know your academic record and potential for graduate study (letters should be uploaded online)
- Official transcripts of all post-secondary education
- Official** statement of English Proficiency (TOEFL) for international students

Applicants are expected to have an undergraduate GPA of 3.0 or higher.

Master’s Degree Requirements

For master’s degree concentrations, admission is limited in order to maintain faculty student interaction in didactic classes, for supervision in practica and for informal contact. Generally, class size averages between 20 and 25 in didactic, 4-5 in practica, and the advising ratio is approximately 1 to 10.

The Master’s of Education Degree (M.Ed.) is primarily a practitioner-oriented master’s and is offered in the on-campus program or DE online program (same degree). There are three concentrations: (a) school counseling (elementary and middle or secondary), (b) college counseling and student development, and (c) clinical mental health counseling. These concentrations require a minimum of 60 credits. Students who complete the program will be eligible to sit for the National Counselor Examination (NCE). Students in the school counseling track are also eligible for licensure as school counselors in North Carolina (providing they pass the counseling PRAXIS examination).

The Master’s of Science Degree (M.S.) is primarily oriented to the practitioner-researcher and is also offered in the three concentrations. The program requires 66 hours of course work, including a thesis, and an oral examination. Generally, the same criteria for admission are applied as for the M.Ed. except that the candidate needs to show clearer evidence of research competency in addition to the requisite professional and academic competencies. M.S. option is not offered in DE online program.

Student Financial Support

At NC State, our goal is to assure that no student who can benefit from an NC State education be denied that opportunity due to finances. We are committed to allocating our financial aid resources to help the broadest range of students.

Graduate students may apply for Federal Subsidized and Unsubsidized Stafford Loans, and for Federal Work-Study employment. Qualified graduate students pursuing masters or doctoral degrees may also apply for fellowships, assistantships and other awards offered through individual colleges and the Graduate School.
Degrees

- School Counseling (MEd) (p. 255)

Faculty

Full Professors
Stanley B Baker
Marc A. Grimmett
Sylvia Christine Maria Nassar
Jose' A. Picart
Siu-Man Ting

Assistant Professors
Adria Shipp Dunbar
Brean'a Parker

Practice/Research/Teaching Professors
Nicole Childs
Sharon Chung
Helen Lupton-Smith
Rolanda Mitchell
Angela Smith
Cristina Braga

Emeritus Faculty
Edwin R. Gerler Jr.

Adjunct Faculty
Richard Tyler-Walker
Amanda Allen
Clinton Bolton
Monica Osbourne

School Counseling (MEd)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>ECD 510</td>
<td>Orientation to Professional Counseling, Identity, and Ethics</td>
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<td>ECD 524</td>
<td>Career Counseling and Development</td>
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<td>ECD 525</td>
<td>Multicultural Counseling</td>
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<td>ECD 530</td>
<td>Theories and Tech of Counseling</td>
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<td>ECD 539</td>
<td>Group Counseling</td>
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<td>ECD 540</td>
<td>Gender Issues In Counseling</td>
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<td>ECD 541</td>
<td>Substance Abuse and Counseling</td>
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<td>ECD 542</td>
<td>Research in Counseling</td>
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<td>ECD 545</td>
<td>Counseling Couples and Families</td>
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<td>ECD 546</td>
<td>Crisis Interventions in Counseling</td>
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<td>ECD 561</td>
<td>Strategies for Clinical Assessment in Counseling</td>
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<td>ECD 562</td>
<td>Techniques in Counseling</td>
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<td>ECD 575</td>
<td>Multicultural Lifespan Development</td>
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<td>ECD 642</td>
<td>Practicum In Counseling</td>
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</tr>
<tr>
<td>ECD 651</td>
<td>Internship in School Counseling</td>
<td>60</td>
</tr>
</tbody>
</table>

* ECD 651 Internship in School Counseling covers over two semesters, Fall and Spring 6 credits each, 12 credit hours in total
Science Education

The Science Education Program offers a Master’s of STEM Education (MEd) Distance Education with a Concentration in Science Education. We prepare educators and researchers for positions as teachers, leaders, and university faculty of the highest quality. We are particularly proud of our emphasis on the use of technology to enhance teaching. Students take courses in their educational specialty in Science Education, and in academic discipline areas including: biological sciences, chemistry, earth science, environmental science, interdisciplinary science or physics.

Our STEM Ed Master’s program (MEd) leads to North Carolina M-licensure as a teacher of science at grades 6-12 or advanced credentials for informal educators. Programs are also available for those seeking advanced graduate-level certification as a teacher. Finally, students may design a program to prepare for teaching careers in post-secondary education.

Some of our elect to move directly from our master’s into our doctoral program in Learning and Teaching in STEM – Science Education. These students are knowledge-seekers and are eager to pursue educational problems and develop critical thinking skills in a collaborative environment. The programs prepare individuals for positions in their fields of study related to:

1. scholarly inquiry and discourse in science education,
2. preparation of K-12 teachers and informal science educators,
3. instruction and development issues in K-16, and
4. leadership positions.

Admission Requirements

Applicants for the STEM M.Ed. degree with a concentration in science education must submit a completed application specific to the program. No GRE is required. Please see the Science Education website for details. The deadlines for submission of an application, and academic and professional background necessary for admission differ by specific program.

Student Financial Support

A small number of scholarships may be available through the College of Education or NC State University. For those who apply for financial aid, there may be some grants available through the university. Please discuss these opportunities directly with program area faculty.

Degrees

- Science Education (MS) (p. 256)
- Science Education (Minor) (p. 256)

Faculty

Full Professors
Margaret R. Blanchard
Carla Johnson
Melissa Gail Jones

Associate Professors
Sarah J. Carrier
Cesar Delgado

Assistant Professors
K. C. Rogis Busch

Practice/Research/Teaching Professors
W. Matthew Reynolds

Emeritus Faculty
Glenda S. Carter
John H. Wheatley

Science Education (MS)

Faculty

Full Professors
Margaret R. Blanchard
Carla Johnson
Melissa Gail Jones

Associate Professors
Sarah J. Carrier
Cesar Delgado

Assistant Professors
K. C. Rogis Busch

Practice/Research/Teaching Professors
W. Matthew Reynolds

Emeritus Faculty
Glenda S. Carter
John H. Wheatley

Science Education (Minor)
Plan Requirements

- 9 (MS student) or 12 (PhD student) credit hours

Faculty

Full Professors
Margaret R. Blanchard
Carla Johnson
Melissa Gail Jones
Soonhye Park
Eric N Wiebe

Associate Professors
Sarah J. Carrier
Cesar Delgado

Assistant Professors
K. C. Rogis Busch

Practice/Research/Teaching Professors
W. Matthew Reynolds

Emeritus Faculty
Glenda S. Carter
John H. Wheatley

Science, Technology, Engineering, and Mathematics Education

The STEM Education Program offers a Master’s of Education (MEd) Distance Education with concentration in Science Education, Engineering and Technology Education, and Mathematics and Statistics Education. We prepare educators and researchers for positions as teachers, leaders, and university faculty of the highest quality. We are particularly proud of our emphasis on the use of technology to enhance teaching. Students take courses in their educational specialty in Science Education, and in academic discipline areas including: biological sciences, chemistry, earth science, environmental science, interdisciplinary science or physics.

Our Master’s program (MEd) leads to North Carolina M-licensure as a teacher of science at grades 6-12 or advanced credentials for informal educators. Programs are also available for those seeking advanced graduate-level certification as a teacher. Finally, students may design a program to prepare for teaching careers in post-secondary education.

Some of our students elect to move directly from our master’s into our doctoral program in Learning and Teaching in STEM – Science Education, Engineering and Technology Education or Mathematics and Statistics Education. These students are knowledge-seekers and are eager to pursue educational problems and develop critical thinking skills in a collaborative environment. The programs prepare individuals for positions in their fields of study related to:

1. scholarly inquiry and discourse in science education,
2. preparation of K-12 teachers and informal science educators,
3. instruction and development issues in K-16, and
4. leadership positions.

Admission Requirements

Applicants for the M.Ed. degree must submit a completed application specific to the program concentration. No GRE is required. Please see the concentration area website for details.

Science Education
Engineering and Technology Education
Mathematics and Statistics Education

The deadlines for submission of an application, and academic and professional background necessary for admission differ by specific concentration.

Student Financial Support

A small number of scholarships may be available through the College of Education or NC State University. For those who apply for financial aid, there may be some grants available through the university. Please discuss these opportunities directly with program area faculty.

Degrees

- Science, Technology, Engineering, and Mathematics Education (MEd) (p. 258)
- Science, Technology, Engineering, and Mathematics Education (MEd): Engineering and Technology Education Concentration (p. 258)
- Science, Technology, Engineering, and Mathematics Education (MEd): Mathematics & Statistics Education Concentration (p. 258)
- Science, Technology, Engineering, and Mathematics Education (MEd): Science Education Concentration (p. 259)
- Mathematics Teaching and Learning (Certificate) (p. 259)

Full Professors
Margaret R. Blanchard
Aaron Catron Clark
Jere Confrey
Karen Flanagan Hollebrands
Carla Johnson
Melissa Gail Jones
Hollylynne Stohl Lee
Soonhye Park
Eric N. Wiebe
Degree Requirements

### Core Course

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
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<tbody>
<tr>
<td>EMS 573</td>
<td>Design of Tools and Learning Environments in STEM Education</td>
<td>3</td>
</tr>
</tbody>
</table>

### Specialty Courses

Select a minimum of five courses in Science, Mathematics, Engineering, or Education approved in conjunction with the academic committee.

### Concentration Courses

See “Concentration Requirements” listed below.

### Total Hours

30

---

Science, Technology, Engineering, and Mathematics Education (MEd): Mathematics & Statistics Education Concentration

### Degree Requirements

#### Core Course

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>EMS 573</td>
<td>Design of Tools and Learning Environments in STEM Education</td>
<td>3</td>
</tr>
</tbody>
</table>

### Specialty Courses

Select a minimum of five courses in Science, Mathematics, Engineering, or Education approved in conjunction with the academic committee.

### Concentration Courses

See “Concentration Requirements” listed below.

### Total Hours

30

---

Science, Technology, Engineering, and Mathematics Education (MEd): Engineering and Technology Education Concentration

### Degree Requirements

#### Core Course

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>EMS 573</td>
<td>Design of Tools and Learning Environments in STEM Education</td>
<td>3</td>
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</tbody>
</table>

### Specialty Courses

Select a minimum of five courses in Science, Mathematics, Engineering, or Education approved in conjunction with the academic committee.

### Concentration Courses

See “Concentration Requirements” listed below.

### Total Hours

30

---

Concentration Requirements

Select four courses from the following:

- EMS 592 Special Problems In Mathematics Teaching (Design of Tools and Learning Environments in STEM Education)
- TED 530 Foundations for Teaching Technology
- TED 558 Teaching Creative Problem Solving
- TED 552 Curricula for Emerging Technologies
- TED 555 Developing and Implementing Technology Education

1. Generally Engineering and Education courses offered online
EMS 510 Interactions In the Mathematics Classroom
EMS 513 Teaching and Learning of Algebraic Thinking
EMS 514 Teaching and Learning of Geometric Thinking
EMS 519 Teaching and Learning of Statistical Thinking
EMS 580 Teaching Mathematics with Technology

Science, Technology, Engineering, and Mathematics Education (MEd): Science Education Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>EMS 573</td>
<td>Design of Tools and Learning Environments in STEM Education</td>
<td>3</td>
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</table>

Specialty Courses

Select a minimum of five courses in Science, Mathematics, Engineering, or Education approved in conjunction with the academic committee

Concentration Courses

See "Concentration Requirements" listed below

Total Hours 30

Concentration Requirements

<table>
<thead>
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<th>Hours</th>
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<tbody>
<tr>
<td>EMS 521</td>
<td>Advanced Methods in Science Education I</td>
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<td>EMS 522</td>
<td>Advanced Methods in Science Education II</td>
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</tr>
<tr>
<td>EMS 531</td>
<td>Introduction to Research in Science Education</td>
<td></td>
</tr>
<tr>
<td>EMS 575</td>
<td>Foundations Of Science Education</td>
<td></td>
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</table>

Mathematics Teaching and Learning (Certificate)

The Graduate Certificate in Mathematics Teaching and Learning is an online program that focuses on developing knowledge and instructional approaches in teaching mathematics. The program will primarily serve practicing teachers in middle school through college settings, or those preparing for careers in such settings, who want to expand their expertise related to teaching and learning mathematics. Students will learn how to apply research-based understandings of students’ thinking, pedagogical approaches, and broader educational issues (e.g., discourse and equity) to inform practices of teaching content such as geometry, algebra, and statistics.

Plan Requirements

Select four of the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>EMS 510</td>
<td>Interactions In the Mathematics Classroom</td>
<td>12</td>
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<tr>
<td>EMS 513</td>
<td>Teaching and Learning of Algebraic Thinking</td>
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</tr>
<tr>
<td>EMS 514</td>
<td>Teaching and Learning of Geometric Thinking</td>
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</tr>
<tr>
<td>EMS 519</td>
<td>Teaching and Learning of Statistical Thinking</td>
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</table>

EMS 580 Teaching Mathematics with Technology

Total Hours 12

Special Education

The department of Teacher Education and Learning Sciences offers master’s degrees in Special Education. The Special Education program at NC State prepares students for excellence in teaching, assessment, curriculum development, classroom and behavior management, teaching students with high incidence disabilities, evaluation and professional leadership, as well as other areas of service to students with disabilities and to schools and agencies. Our nationally recognized faculty provides excellent teaching, leadership opportunities, and high standards of performance.

For more please see https://ced.ncsu.edu/programs/special-education-master/

The NC Department of Public Instruction has conferred accreditation to the graduate programs in Teacher Education and Learning Sciences. The College of Education is approved any the Council for the Accreditation of Educator Preparation (CAEP).

Admission Requirements

Special Education: A 500-800 word statement describing professional goals is required, along with transcripts and reference letters. Some areas of study require that applicants be qualified to hold a baccalaureate-level teaching license or have teaching experience. A match to resources and faculty areas of interest and expertise is necessary, since the program is competitive. The Graduate School requires a 3.0 in the undergraduate program.

Degrees

• Special Education (MEd) (p. 260)
• Special Education (MS) (p. 260)
• Special Education (Minor) (p. 260)

Faculty

Full Professors

Cathy L. Crossland
Edward J. Sabomie

Associate Professors

Jessica Heather Hunt

Assistant Professors

Jamie Nicole Pearson

Practice/Research/Teaching Professors

Valerie Ness Faulkner
Kristin Hofmann
## Emeritus Faculty
Douglas A. Cullinan
Susan Sinclair Osborne

## Special Education (MEd)

### Degree Requirements

<table>
<thead>
<tr>
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<th>Hours</th>
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<tr>
<td>ECI 572</td>
<td>Resource Teaching In Special Education</td>
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<tr>
<td>ECI 573</td>
<td>Applied Behavior Analysis &amp; Positive Behavior Intervention and Support in Schools</td>
<td>3</td>
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<tr>
<td>ECI 581</td>
<td>Educational Diagnosis and Prescription For Children With Exceptionalities</td>
<td>3</td>
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<tr>
<td>ECI 585</td>
<td>Education of Children with Exceptionalities</td>
<td>3</td>
</tr>
<tr>
<td>ECI 681</td>
<td>Seminar in Special Education Literacy</td>
<td>3</td>
</tr>
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<td>ECI 658</td>
<td>Internship In Special Education</td>
<td>1-6</td>
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<tr>
<td>ECI 571</td>
<td>Instructional Strategies for Students with Disabilities</td>
<td>3</td>
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<tr>
<td>ECI 576</td>
<td>Teaching Functional and Life Skills to Students with Disabilities</td>
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<td>ECI 584</td>
<td>Intervention for Behavior Problems of Students with Disabilities</td>
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<td>ECI 682</td>
<td>Spe Ed Seminar in Teaching Numerical Concepts</td>
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<td><strong>Total Hours</strong></td>
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</table>

### Faculty

#### Full Professors
Cathy L. Crossland
Edward J. Sabornie

#### Associate Professors
Jessica Heather Hunt

#### Assistant Professors
Jamie Nicole Pearson

#### Practice/Research/Teaching Professors
Valerie Ness Faulkner
Kristin Hofmann

### Emeritus Faculty
Douglas A. Cullinan
Susan Sinclair Osborne

## Special Education (Minor)

### Plan Requirements
- 9 (MS student) or 12 (PhD student) credit hours

### Faculty

#### Full Professors
Cathy L. Crossland
Edward J. Sabornie

#### Associate Professors
Jessica Heather Hunt

#### Assistant Professors
Jamie Nicole Pearson

#### Practice/Research/Teaching Professors
Valerie Ness Faulkner
Kristin Hofmann

### Emeritus Faculty
Douglas A. Cullinan
Susan Sinclair Osborne
Teacher Education and Learning Sciences

The Ph.D. program in the Department of Teacher Education and Learning Sciences is primarily designed to prepare students for roles as researchers and educators in higher education and industry, or for instructional leadership at school district and state levels. Six program areas of study (focus) are offered by the department: Educational Equity; Educational Psychology; Elementary Learning Sciences; Learning, Design, & Technology; Literacy & English Language Arts; and Social Studies Education.

The NC Department of Public Instruction has conferred accreditation to the graduate programs in Teacher Education and Learning Sciences. The College of Education is approved by the Council for the Accreditation of Educator Preparation (CAEP).

Admission Requirements

Teacher Education and Learning Sciences: A 500-800 word statement describing professional goals and research interests is required, along with transcripts and reference letters. Some areas of study require that applicants be qualified to hold a baccalaureate-level teaching license or have teaching experience. A match to resources and faculty areas of interest and expertise is necessary since the program is competitive. The Graduate School requires a 3.0 in the undergraduate program. GRE scores not more than five years old are required for the doctoral program.

Doctoral Degree Requirements

Teacher Education and Learning Sciences: A minimum of 72 course credit hours beyond a bachelor's degree is required. For students with a master's degree, at least 60 new hours must be taken after the student matriculates into the doctoral program. The 60-hour program includes 12 hours of scholar leader courses (college and departmental levels), 15 hours of research, 24 hours of program area specialty courses, and 9 hours of dissertation credit.

Student Financial Support

Teaching and Research Assistantships are available on a limited basis.

Degrees

• Teacher Education and Learning Sciences (PhD) (p. 262)
• Teacher Education and Learning Sciences (Minor) (p. 262)

Full Professors

Cathy L. Crossland
Jessica Theresa DeCuir-Gunby
John K. Lee
Patricia L. Marshall
John Nietfeld
Kevin M. Oliver
Edward J. Sabornie
Margareta M. Thomson

Associate Professors

Candy M. Beal
Sarah J. Carrier
Dennis Scott Davis
Deniz Eseryel
DeLeon L. Gray
Jessica Heather Hunt
Meghan McGlinn Manfra
James Minogue
Angela Michelle Wiseman
Carl A. Young

Assistant Professors

Chandra Alston
Christy Michelle Byrd
Michelle Marie Falter
Jill Freiberg Grifenhagen
Shiyan Jiang
Crystal Lee
Paula McAvoy
Amato Nocera
Jamie Nicole Pearson
Jackie Eunjung Relyea
Jonee Wilson

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Drinda Elaine Benge
Sarah Cannon
Valerie Ness Faulkner
Ann D. Harrington
Kristin Hoffmann
Micha Jeffries
Jill Jones
Joanne Greer Koch
Linda McCabe-Smith
Julia O'Neal McKeown
Plan Requirements

- 9 (MS student) or 12 (PhD student) credit hours

TEXT

Teaching

The Master of Arts in Teaching (MAT) program is an accelerated program with a 100% online option that will prepare you to apply your experience to make a difference from your first day in the classroom, whether you're teaching in-person, remotely or both. The content areas being served by the MAT program are Secondary Math, Science, Social Studies, and English; Middle Grades Math, Science, Social Studies, and Language Arts; English as a Second Language; Special Education; Technology Education and Elementary Education.

For more please see https://ced.ncsu.edu/academics/professional-education/master-of-arts-in-teaching/

The NC Department of Public Instruction has conferred accreditation to the graduate programs in Teacher Education and Learning Sciences. The College of Education is approved any the Council for the Accreditation of Educator Preparation (CAEP).

Admission Requirements

Applicants must have (1) a four-year degree from a college or university that holds regional accreditation, such as SACS; (2) 3.00 GPA or higher in prior work, as required by the Graduate School; (4) an undergraduate degree in the content area/discipline or 24 semester hours/credits in content relevant to the area in which you wish to teach (if you have fewer than 24 hours in a relevant content field, or if your course work does not prepare you adequately to teach the North Carolina curriculum, you may be assigned additional coursework to overcome the deficiency).

Applications require original transcripts, 3 letters of recommendation (one of which should speak to teaching potential), a personal essay stating applicant’s background and goals, GRE scores are only required if undergraduate GPA is below 3.0 (and TOEFL if you have international citizenship), and a completed online application.

Master's Degree Requirements

A total of 30-33 credit hours must be earned for completion of the degree, depending on the particular licensure area. These hours include student teaching for non-lateral entry students.

Student Financial Support

Financial aid is available. Interested students should complete a Financial Aid Federal Student Aid (FAFSA) (http://www.fafsa.ed.gov/) form.

Degrees

- Teaching (MA) (p. 263)
- Teaching (MA): Elementary Education Concentration (p. 264)
- Teaching (MA): English as a Second Language Concentration (p. 265)
- Teaching (MA): English Education Concentration (p. 266)
- Teaching (MA): K-12 Reading Concentration (p. 267)
- Teaching (MA): Math Education Concentration (p. 268)
- Teaching (MA): Middle Grades Education Concentration (p. 269)
• Teaching (MA): Middle Grades Math Concentration (p. 270)
• Teaching (MA): Middle Grades Science Concentration (p. 271)
• Teaching (MA): Science Education Concentration (p. 273)
• Teaching (MA): Social Studies Education Concentration (p. 274)
• Teaching (MA): Special Education Concentration (p. 275)
• Teaching (MA): Technology Education Concentration (p. 276)
• Teaching (Minor) (p. 277)

Faculty

Full Professors
Margaret R. Blanchard
Aaron C. Clark
Jere Confrey
Cathy L. Crossland
Karen Hollebrands
M. Gail Jones
Hollylynne Stohl Lee
John Kelly Lee
Soonhye Park
Edward J. Sabornie
Lee Stiff

Associate Professors
Candy M. Beal
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Cesar Delgado
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Tamecia Jones
Erin Krupa

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Valerie Faulkner
Anne Harrington
Kristen Hoffmann
Micha Jennine Jeffries
Jill Jones
Joanna Greer Koch
W. Matt Reynolds
Linda Smith

Emeritus Faculty
Ruie J. Pritchard

Teaching (MA)

Degree Requirements

<table>
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<tr>
<th>Code</th>
<th>Core Courses</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>ED 508</td>
<td>Exploring Diversity in Classroom and Community</td>
<td></td>
<td>15</td>
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<tr>
<td>ECI 579</td>
<td>Organization and Behavioral Management of Inclusive Classrooms</td>
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<tr>
<td>ED 507</td>
<td>Principles of Developing and Interpreting Assessment</td>
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<td></td>
</tr>
<tr>
<td>ED 570</td>
<td>Classroom Action Research</td>
<td></td>
<td></td>
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<td>ED 571</td>
<td>Inquiry and Professional Development</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>Teaching Internship: MAT</td>
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<td></td>
</tr>
<tr>
<td>ED 572</td>
<td>Teacher Leadership</td>
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</tbody>
</table>

Faculty

Full Professors
Margaret R. Blanchard
Aaron C. Clark
Jere Confrey
Cathy L. Crossland
Teaching (MA): Elementary Education Concentration

Karen Hollebrands
M. Gail Jones
Hollylynne Stohl Lee
John Kelly Lee
Soonhye Park
Edward J. Sabornie
Lee Stiff

Associate Professors
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Jill Jones
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W. Matt Reynolds
Linda Smith

Emeritus Faculty
Ruie J. Pritchard

Teaching (MA): Elementary Education Concentration

Degree Requirements

<table>
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<tr>
<td>ELM 515</td>
<td>Instructional Practice in Schools I</td>
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<td>ELM 516</td>
<td>Instructional Practice in Schools II</td>
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<td>ELM 571</td>
<td>Language Arts, New Literacies and Media for Initial License</td>
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<td>ELM 572</td>
<td>Methods for Teaching Reading in the Elementary Classroom for Initial License</td>
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<td>ELM 573</td>
<td>Methods for Teaching Elementary School Science for Initial License</td>
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<tr>
<td>ELM 575</td>
<td>Social Studies in the Elementary School for Initial License</td>
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</table>

Total Hours 33

Faculty

Full Professors
Margaret R. Blanchard
Aaron C. Clark
Jere Confrey
Cathy L. Crossland
### Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
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<td>ECI 536</td>
<td>Perspectives on English as a New Language</td>
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<td>ECI 541</td>
<td>Reading In the Content Areas</td>
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<td>FL 524</td>
<td>Linguistics for ESL Professionals</td>
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<tr>
<td>ELM 537</td>
<td>Teaching Children's Literature</td>
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<tr>
<td>or ELM 572</td>
<td>Methods for Teaching Reading in the Elementary Classroom for Initial License</td>
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<tr>
<td>or ECI 524</td>
<td>Theory and Research in Global Learning</td>
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<td>Total Hours</td>
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<td>30</td>
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</table>
M. Gail Jones
Hollylynne Stohl Lee
John Kelly Lee
Soonhye Park
Edward J. Sabornie
Lee Stiff

### Associate Professors

- Candy M. Beal
- K.C. Busch
- Sarah Carrier
- Cesar Delgado
- Cameron D. Denson
- Jessica Hunt
- Karen Keene
- Meghan Manfra
- Angela Wiseman
- Carl A. Young

### Assistant Professors

- Robin Anderson
- Michelle Marie Falter
- Tamecia Jones
- Erin Krupa
- Crystal Lee
- Paula McAvoy
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### Practice/Research/Teaching Professors

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- Sarah Cannon
- Cyndi Edgington
- Valerie Faulkner
- Anne Harrington
- Kristen Hoffmann
- Micha Jennine Jeffries

### Emeritus Faculty

- Ruie J. Pritchard

### Faculty

### Full Professors

- Margaret R. Blanchard
- Aaron C. Clark
- Jere Confrey
- Cathy L. Crossland
- Karen Hollebrands
- M. Gail Jones

---

### Degree Requirements

<table>
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<th>Code</th>
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<td>ECI 520</td>
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<td>Teaching Literature For Young Adults</td>
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<td>ECI 541</td>
<td>Reading In the Content Areas</td>
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<tr>
<td>ECI 528</td>
<td>Strategies for Teaching English in Secondary Schools</td>
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<tr>
<td>ECI 522</td>
<td>Trends and Issues in English Language Arts Education</td>
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<td>or ECI 524</td>
<td>Theory and Research in Global Learning</td>
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<tr>
<td>or ECI 546</td>
<td>New Literacies &amp; Media</td>
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</tbody>
</table>

**Total Hours**: 30
Hollylynne Stohl Lee
John Kelly Lee
Soonhye Park
Edward J. Sabornie
Lee Stiff

**Associate Professors**
Candy M. Beal
K.C. Busch
Sarah Carrier
Cesar Delgado
Cameron D. Denson
Jessica Hunt
Karen Keene
Meghan Manfra
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Kristen Hoffmann
Micha Jennine Jeffries
Jill Jones

Joanna Greer Koch
W. Matt Reynolds
Linda Smith

**Emeritus Faculty**
Ruie J. Pritchard

**Teaching (MA): K-12 Reading Concentration**

**Degree Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Core Courses</strong></td>
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<td>Reading In the Content Areas</td>
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**Total Hours** 30

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Emeritus Faculty
Ruie J. Pritchard

Teaching (MA): Math Education Concentration

Degree Requirements

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<td>EMS 519</td>
<td>Teaching and Learning of Statistical Thinking</td>
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<td>Methods and Materials for Teaching Mathematics</td>
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<tr>
<td>EMS 572</td>
<td>Teaching Mathematics Topics in Senior High School (must be taken together)</td>
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Mathematical Science Courses

Select a minimum of six hours of Mathematical Science courses at the 400- or 500-level approved in conjunction with the academic committee – see "Mathematical Science Courses" listed below

Total Hours

33

Mathematical Science Courses

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Teaching (MA): Middle Grades Education Concentration

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Total Hours 30

English / Language Arts Concentration Requirements

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Teaching (MA): Middle Grades Math Concentration

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<td>EMS 570 &amp; EMS 572</td>
<td>Methods and Materials for Teaching Mathematics and Teaching Mathematics Topics in Senior High School</td>
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Ruie J. Pritchard

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**Science Methods Courses**

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<td>BSC 546</td>
<td>Humans and Disease: Communicable Diseases</td>
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<td>EA 506</td>
<td>Water Quality Assessment</td>
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<td>EDP 575</td>
<td>Multicultural Lifespan Development</td>
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<td>EDP 582</td>
<td>Adolescent Development</td>
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<td>GIS 510</td>
<td>Fundamentals of Geospatial Information Science and Technology</td>
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<td>GIS 520</td>
<td>Spatial Problem Solving</td>
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<td>Barriers to Climate Change Literacy</td>
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Teaching (MA): Science Education Concentration

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</table>

Select a minimum of six hours of Science and Science Education content courses approved in conjunction with the academic committee

Total Hours 33

Faculty

Full Professors
Margaret R. Blanchard
Aaron C. Clark
Jere Confrey

Cathy L. Crossland
Karen Hollebrands
M. Gail Jones
Hollylynne Stohl Lee
John Kelly Lee
Soonhye Park
Edward J. Sabornie
Lee Stiff

Associate Professors
Candy M. Beal
K.C. Busch
Sarah Carrier
Cesar Delgado
Cameron D. Denson
Jessica Hunt
Karen Keene
Meghan Manfra
Angela Wiseman
Carl A. Young

Assistant Professors
Robin Anderson
Michelle Marie Falter
Tamecia Jones
Erin Krupa
Crystal Lee
Paula McAvoy
Jamie Pearson
Jonee Wilson

Practice/Research/Teaching Professors
Drinda Elaine Benge
Sarah Cannon
Cyndi Edgington
Valerie Faulkner
Anne Harrington
Teaching (MA): Social Studies Education Concentration

Degree Requirements

<table>
<thead>
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<tr>
<td>ED 508</td>
<td>Exploring Diversity in Classroom and Community</td>
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<tr>
<td>ECI 579</td>
<td>Organization and Behavioral Management of Inclusive Classrooms</td>
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<tr>
<td>ED 507</td>
<td>Principles of Developing and Interpreting Assessment</td>
<td></td>
</tr>
<tr>
<td>ED 570</td>
<td>Classroom Action Research</td>
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<tr>
<td>ED 571</td>
<td>Inquiry and Professional Development</td>
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<tr>
<td>ED 569</td>
<td>Teaching Internship: MAT</td>
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<tr>
<td>ED 572</td>
<td>Teacher Leadership</td>
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Concentration Requirements

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<tr>
<td>ECI 550</td>
<td>Foundations Of Middle Years Education</td>
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<td>ECI 535</td>
<td>Methods and Materials for Teaching Social Studies in the Middle Grades</td>
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<tr>
<td>ECI 525</td>
<td>Contemporary Approaches In the Teaching Of Social Studies</td>
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<tr>
<td>ECI 526</td>
<td>Theory and Research On Teaching and Learning Social Studies</td>
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</table>

Select a graduate-level social science course approved in conjunction with the academic committee

Select one of the following courses:

- ECI 630 Independent Study in Curriculum and Instruction
- ECI 620 Special Problems In Curriculum and Instruction
- ECI 727 Special Problems in Social Studies Education
- ECI 524 Theory and Research in Global Learning

Total Hours 33

Faculty

Full Professors
Margaret R. Blanchard

Emeritus Faculty
Ruie J. Pritchard

Associate Professors
Candy M. Beal
K.C. Busch
Sarah Carrier
Cesar Delgado
Cameron D. Denson
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Cyndi Edgington
Valerie Faulkner
Anne Harrington
Kristen Hoffmann
Micha Jennine Jeffries
Jill Jones
Joanna Greer Koch
W. Matt Reynolds
Linda Smith

Emeritus Faculty
Ruie J. Pritchard

Teaching (MA): Special Education Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<td>Core Courses</td>
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<tr>
<td>ED 508</td>
<td>Exploring Diversity in Classroom and Community</td>
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<td>ECI 579</td>
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<td>ED 507</td>
<td>Principles of Developing and Interpreting Assessment</td>
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<tr>
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<td>Inquiry and Professional Development</td>
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<td>ED 569</td>
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<td>ED 572</td>
<td>Teacher Leadership</td>
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Concentration Requirements

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<td>Instructional Strategies for Students with Disabilities</td>
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<td>ECI 576</td>
<td>Teaching Functional and Life Skills to Students with Disabilities</td>
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<td>ECI 581</td>
<td>Educational Diagnosis and Prescription For Children With Exceptionalities</td>
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<td>ECI 584</td>
<td>Intervention for Behavior Problems of Students with Disabilities</td>
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<td>ECI 681</td>
<td>Seminar in Special Education Literacy</td>
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</tbody>
</table>

Total Hours 33

Faculty

Full Professors
Margaret R. Blanchard
Aaron C. Clark

Jere Confrey
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Sarah Cannon
Cyndi Edgington
Valerie Faulkner
Emeritus Faculty
Ruie J. Pritchard

Teaching (MA): Technology Education Concentration

Degree Requirements

<table>
<thead>
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<th>Hours</th>
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Concentration Requirements

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<td>Required Courses</td>
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<tr>
<td>EMS 505</td>
<td>Methods of Teaching Science I</td>
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<td>EMS 506</td>
<td>Methods of Teaching Science II</td>
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<td>TED 530</td>
<td>Foundations for Teaching Technology</td>
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<td>TED 558</td>
<td>Teaching Creative Problem Solving</td>
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<td>TED 552</td>
<td>Curricula for Emerging Technologies</td>
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<tr>
<td>TED 555</td>
<td>Developing and Implementing Technology Education</td>
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</tr>
</tbody>
</table>

Total Hours 33

Faculty

Full Professors
Margaret R. Blanchard
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Valerie Faulkner
Anne Harrington
Kristen Hoffmann
Micha Jennine Jeffries
Emeritus Faculty
Ruie J. Pritchard

Teaching (Minor)

Plan Requirements
- 9 (MS student) or 12 (PhD student) credit hours

Faculty

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Jill Jones
Joanna Greer Koch
W. Matt Reynolds
Linda Smith

Emeritus Faculty
Ruie J. Pritchard

Technology Education

The Technology Education Program offers a Master’s of Education – Distance Education concentration in Technology Education. We prepare educators and researchers for positions as teachers, leaders, and university faculty of the highest quality. We are particularly proud of our emphasis on the use of technology to enhance teaching. Students take courses in their educational specialty, in general professional education, and in academic discipline areas including: computer science, engineering, graphic arts, and statistics.

Our master’s program can lead to initial teaching licensure. The program can be designed to lead to North Carolina M-licensure as a teacher of technology at grades 6-9 and/or 9-12. Programs are also available for those seeking advanced graduate-level certification as a teacher. Finally, students may choose a program to prepare for teaching careers in post-secondary education.

Some of our elect to move directly from our master’s into our doctoral program in Learning and Teaching in STEM – Technology Education.
These students are knowledge-seekers and are eager to pursue educational problems and develop critical thinking skills in a collaborative environment. The programs prepare individuals for positions in their fields of study related to:

- scholarly inquiry and discourse in their discipline,
- preparation of K-12 teachers,
- instruction and development issues in K-16, and
- leadership positions.

Admission Requirements

Applicants for the Master of Education – Distance Ed degree in Technology Education must submit a completed application to the Graduate School. Please see the Technology Education website (https://ced.ncsu.edu/programs/technology-education-master/) for details. The deadlines for submission of an application, and academic and professional background necessary for admission differ by specific program.

Master’s Degree Requirements

Master’s Degree programs require a minimum of 30 semester hours of graduate work. Students who choose the M.S. degree may be able to substitute up to six semester hours of thesis research for part of the course load. The M.Ed. degree is online only.

Student Financial Support

A small number of teaching and research assistantships are available, and out-of-state tuition remission may be available for one year for students on assistantships. Please discuss these opportunities directly with program area faculty.

Degrees

- Technology Education (EdD) (p. 278)
- Technology Education (MS) (p. 279)
- Technology Education (MS): Graphic Communication Education Concentration (p. 279)
- Technology Education (Minor) (p. 279)

Faculty

Full Professors

Aaron Catron Clark

Eric N. Wiebe

Associate Professors

Cameron DeLeon Denson

Assistant Professors

Tamecia Raishaun Jones

Practice/Research/Teaching Professors

Tameshia Ballard Baldwin

Brian Matthews

Alice Y. Scales

Emeritus Faculty

Johnny L. Crow

V. William DeLuca

Richard Eric Peterson

Robert E. Wenig

Technology Education (EdD)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>TED 551/751</td>
<td>Technology Education: A Discipline</td>
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<td>TED 552/752</td>
<td>Curricula for Emerging Technologies</td>
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<tr>
<td>TED 555/755</td>
<td>Developing and Implementing Technology Education</td>
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<tr>
<td>TED 558/758</td>
<td>Teaching Creative Problem Solving</td>
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<td>TED 757</td>
<td>Leadership Development in TED</td>
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<td>TED 756</td>
<td>Planning of Change in TED</td>
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Elective Courses 12

Select 12 hours of the following courses:

- TED 530 Foundations for Teaching Technology
- TED 532 Current Trends in Technical Graphics Education
- TED 534 Instructional Design in Technical and Technology Education
- TED 536 Scientific and Technical Visualization: Theory and Practice
- TED 641 Internship in Technology Education
- TED 646 Field-based Research in Technology Education
- TED 709 Seminar in Technology Education
- TED 801 Practicum in Technology Education
- TED 810 Special Topics in Technology Education
- TED 821 Special Problems in Technology Education

Research Courses 24-27

Select two of the following courses:

- ED 700 Introduction to Research Design in Education
- ED 710 Applied Quantitative Methods in Education I
- ST 507 Statistics For the Behavioral Sciences I
- ST 508 Statistics For the Behavioral Sciences II
- TED 895 Doctoral Dissertation Research
- ED 711 Applied Quantitative Methods in Education II
- ED 730 Introduction to Qualitative Research in Education
- ED 731 Advanced Qualitative Research and Data Analysis in Education
- ED 750 Mixed Methods Research in Education
- ST 505 Applied Nonparametric Statistics

Minor 9-12
Select 9-12 hours from a cognitive area of study approved in conjunction with the academic committee

<table>
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1. TED 641 Internship in Technology Education and TED 646 Field-based Research in Technology Education are required for "M" Certification.
2. 90 total semester hours are required beyond an undergraduate degree.

Faculty

Full Professors
Aaron Catron Clark
Eric N. Wiebe

Associate Professors
Cameron DeLeon Denson

Assistant Professors
Tamecia Raishaun Jones

Practice/Research/Teaching Professors
Tameshia Ballard Baldwin
Brian Matthews
Alice Y. Scales

Emeritus Faculty
Johnny L. Crow
V. William DeLuca
Richard Eric Peterson
Robert E. Wenig

Technology Education (MS): Graphic Communication Education Concentration

Faculty

Full Professors
Aaron Catron Clark
Eric N. Wiebe

Associate Professors
Cameron DeLeon Denson

Assistant Professors
Tamecia Raishaun Jones

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Johnny L. Crow
V. William DeLuca
Richard Eric Peterson
Robert E. Wenig

Technology Education (Minor)

Plan Requirements
• 9 (MS student) or 12 (PhD student) credit hours
Training & Development

Faculty

Full Professors
Aaron Catron Clark
Eric N. Wiebe

Associate Professors
Cameron DeLeon Denson

Assistant Professors
Tamecia Raishaun Jones

Practice/Research/Teaching Professors
Tameshia Ballard Baldwin
Brian Matthews
Alice Y. Scales

Emeritus Faculty
Johnny L. Crow
V. William DeLuca
Richard Eric Peterson
Robert E. Wenig

Training & Development

The Master of Education (M.Ed.) degree in Training and Development, a fully online program, is based on a reflective practice approach offering practitioners opportunities to integrate their professional experiences with human resource development knowledge and practice skills. Completing this master’s program will give you the professional knowledge and skill required for entry or advancement in instructional design, and instructional, administrative, or evaluation positions that involve performance-based training. Our courses are in alignment with the Association of Talent Development’s Core Competency Model.

Our program emphasizes:

• Interaction
• Collaboration
• Team Learning
• Reflective Practice
• Adult Learning

Admission Requirements

Applicants for the M.Ed. degree in Training and Development must complete an application through the Graduate School, submit a personal statement, post-secondary transcripts, and three letters of recommendation. GRE scores are not required. Please see the Training and Development Program website for complete details.

Degrees

• Training & Development (MEd) (p. 280)
• Training & Development (Minor) (p. 281)

Faculty

Full Professors
Duane Akroyd
Tony W. Cawthon
Joy Gaston Gayles
Audrey J. Jaeger
Stephen Robert Porter
Alyssa Nicole Rockenbach

Associate Professors
Susan J. Barcinas
James E. Bartlett II
Chad David Hoggan

Practice/Research/Teaching Professors
Michelle E. Bartlett
Diane D Chapman
Kenneth Lyle Ender
Barry A. Olson
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Carrol Lynn Adams Warren

Emeritus Faculty
Carol Edith Kasworm
George B. Vaughan

Training & Development (MEd)

Degree Requirements

<table>
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<tr>
<th>Code</th>
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<tr>
<td>EAC 556</td>
<td>Organization Change in HRD: Theory &amp; Practice</td>
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<td>EAC 559</td>
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<td>EAC 580</td>
<td>Designing Instructional Systems in Training and Development</td>
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</table>
Training & Development (Minor)

Plan Requirements
- 9 (MS student) or 12 (PhD student) credit hours

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College of Engineering

Programs
- Aerospace Engineering (p. 283)
- Biomanufacturing (p. 287)
- Biomedical Engineering (p. 291)
- Chemical Engineering (p. 296)
- Civil Engineering (p. 303)
- Computer Engineering (p. 314)
• Computer Networking (p. 323)
• Computer Science (p. 327)
• Electric Power System Engineering (p. 338)
• Electrical Engineering (p. 340)
• Engineering (p. 355)
• Environmental Engineering (p. 358)
• Industrial Engineering (p. 363)
• Integrated Manufacturing Systems Engineering (p. 369)
• Materials Science & Engineering (p. 372)
• Mechanical Engineering (p. 381)
• Nanoengineering (p. 385)
• Nuclear Engineering (p. 387)

Degree Programs

Master's (MR)

• Biomanufacturing (MR) (p. 288)
• Chemical Engineering (MR) (p. 298)
• Civil Engineering (MR) (p. 304)
• Computer Science (MR) (p. 329)
• Engineering (MR) (p. 356)
• Engineering (MR): Aerospace Engineering Concentration (p. 356)
• Engineering (MR): Chemical Engineering Concentration (p. 356)
• Engineering (MR): Computer Engineering Concentration (p. 356)
• Engineering (MR): Computer Science Concentration (p. 357)
• Engineering (MR): General Engineering Concentration (p. 357)
• Engineering (MR): Engineering Management Concentration (p. 357)
• Engineering (MR): Industrial Engineering Concentration (p. 357)
• Engineering (MR): Materials Science and Engineering Concentration (p. 357)
• Engineering (MR): Mechanical Engineering Concentration (p. 358)
• Engineering (MR): Nuclear Engineering Concentration (p. 358)
• Environmental Engineering (MR) (p. 359)
• Industrial Engineering (MR) (p. 364)
• Integrated Manufacturing Systems Engineering (MR) (p. 370)
• Materials Science and Engineering (MR) (p. 373)
• Nanoengineering (MR): Biomedical Sciences in Nanoengineering Concentration (p. 386)
• Nanoengineering (MR): Materials Science in Nanoengineering Concentration (p. 387)
• Nanoengineering (MR): Nanoelectronics and Nanophotonics Concentration (p. 387)
• Nuclear Engineering (MR) (p. 389)

Master of Science (MS)

• Aerospace Engineering (MS) (p. 284)
• Biomanufacturing (MS) (p. 289)
• Biomedical Engineering (MS) (p. 292)
• Biomedical Engineering (MS): Translation Innovation and Entrepreneurship Concentration (p. 293)
• Chemical Engineering (MS) (p. 299)
• Civil Engineering (MS) (p. 308)
• Computer Engineering (MS) (p. 316)
• Computer Networking (MS) (p. 325)
• Computer Science (MS) (p. 332)
• Electric Power Systems Engineering (MS) (p. 339)
• Electric Power Systems Engineering (MS): Wide Bandgap Power Electronics Concentration (p. 339)
• Electrical Engineering (MS) (p. 342)
• Environmental Engineering (MS) (p. 362)
• Industrial Engineering (MS) (p. 365)
• Materials Science and Engineering (MS) (p. 375)
• Mechanical Engineering (MS) (p. 382)
• Nuclear Engineering (MS) (p. 390)

Doctor of Philosophy (PhD)

• Aerospace Engineering (PhD) (p. 285)
• Biomedical Engineering (PhD) (p. 294)
• Chemical Engineering (PhD) (p. 300)
• Civil Engineering (PhD) (p. 311)
• Computer Engineering (PhD) (p. 318)
• Computer Science (PhD) (p. 334)
• Electrical Engineering (PhD) (p. 344)
• Industrial Engineering (PhD) (p. 367)
• Materials Science and Engineering (PhD) (p. 376)
• Mechanical Engineering (PhD) (p. 383)
• Nuclear Engineering (PhD) (p. 390)

Minors

• Aerospace Engineering (Minor) (p. 286)
• Biomanufacturing (Minor) (p. 290)
• Biomedical Engineering (Minor) (p. 295)
• Chemical Engineering (Minor) (p. 302)
• Civil Engineering (Minor) (p. 313)
• Computer Engineering (Minor) (p. 320)
• Electrical Engineering (Minor) (p. 346)
• Industrial Engineering (Minor) (p. 368)
• Integrated Manufacturing Systems Engineering (Minor) (p. 371)
• Materials Science and Engineering (Minor) (p. 377)
• Mechanical Engineering (Minor) (p. 384)
• Nuclear Engineering (Minor) (p. 391)

Certificates

• 5G Technologies (Certificate) (p. 348)
• ASIC Design & Verification (Certificate) (p. 350)
• Computer Engineering (Certificate) (p. 322)
• Computer Science (Certificate) (p. 335)
• Data Science Foundations (Certificate) (p. 336)
• Downstream Biomanufacturing (Certificate) (p. 290)
• Electrical Engineering (Certificate) (p. 352)
• Graduate Certificates - College of Engineering (http://catalog.ncsu.edu/graduate/engineering/graduate-certificate/)
• Materials Science and Engineering (Certificate) (p. 379)
• Nano-Systems Engineering (Certificate) (p. 354)
• Nanobiotechnology (Certificate) (p. 296)
Aerospace Engineering

Graduate students in the Aerospace Engineering program focus on aircraft and space systems design, analysis, and manufacturing. Students can select course offerings and research programs in aerodynamics and applied aerodynamics; aerospace propulsion; computational fluid dynamics; dynamics and design of spacecraft and space systems; flight dynamics and control; and multifunctional materials and smart structures. Sub-areas include acoustics, sprays, composite materials, reactive and multiphase flows, stability, and transition to turbulence.

Admission Requirements

An applicant to the master's program must be a graduate of an accredited undergraduate program with a B.S. degree in either mechanical or aerospace engineering. Graduates of other accredited programs in engineering, physical sciences and mathematics may be considered but may be required to make up undergraduate deficiencies without graduate credit. Provisional admissions, as well as exceptions, are sometimes granted under special circumstances. The most qualified applicants are accepted first. Applicants to the Ph.D. program must have met the M.S. admission requirements and additionally must satisfy the Ph.D. admissions requirements. Applicants to the online, distance education M.S. program in mechanical or aerospace engineering are not required to take the GRE exam.

Master's Degree Requirements

The thesis-option M.S. degree programs in mechanical engineering and aerospace engineering require 21 hours of course credit and nine hours of thesis research. The non-thesis M.S. degree programs in mechanical engineering and aerospace engineering require 27 hours of course credit and a three credit-hour project. The non-thesis M.S. degree programs in mechanical engineering and aerospace engineering are offered on campus and off campus through distance education.

Ph.D. Degree Requirements

A minimum of 72 hours of credit are required to obtain the Ph.D. degree. A direct path to the Ph.D. from the B.S. is also available with which the student is granted the M.S. degree “enroute” to the Ph.D. The enroute Ph.D. (direct to Ph.D. path) requires a minimum of 3.5 undergraduate GPA.

Student Financial Support

Various types of assistantships and fellowships are available. Awards are made to the most qualified applicants first and generally are not available for all students.

Other Relevant Information

Each new student chooses an area of specialty, selects an advisor and committee, customizes a program of study and begins research in the first semester of residence. The Director of Graduate Programs acts as a temporary advisor initially and should be contacted with questions.

Degrees

- Aerospace Engineering (MS) (p. 284)
- Aerospace Engineering (PhD) (p. 285)
- Aerospace Engineering (Minor) (p. 286)

Faculty

Full Professors

Gregory D. Buckner
Tarek Echekki
Srinath Varadarajan Ekkad
Tiegang Fang
Ashok Gopalarathnam
Richard David Gould
Xiaoning Jiang
Richard F. Kettie
Clement Kleinstreuer
Andrey Valerevich Kuznetsov
James Woodrow Leach
Hong Luo
Kevin M. Lyons
Gracious Ngaile
Kara Jo Peters
Afsaneh Rabiei
Lawrence M. Silverberg
Juei Feng Tu
Fen Wu
Fuh-Gwo Yuan
Yong Zhu
Mohammed A. Zikry

Associate Professors

Michael A. Boles
Matthew Bryant
Jeffrey W. Eischen
Scott M. Ferguson
Charles Edward Hall Jr.
Aerospace Engineering (MS)

Hsiao-Ying Shadow Huang
Andre P. Mazzoleni
Marie Muller
Venkateswaran Narayanaswamy
Brendan Timothy O’Connor
Mark R. Pankow
Katherine Saul
Alexei V. Saveliev
Christopher Raymond Vermillion
Chengying Xu

Assistant Professors
Landon Grace
Kenneth Granlund
Timothy Joseph Horn
Arun Kumar Kota
Jun Liu
Pramod Kumar Veera Subbareddy
Jie Yin

Emeritus Faculty
Thomas A. Dow
Herbert Martin Eckerlin
Hassan A. Hassan
David S. McRae
Robert T. Nagel
John S. Strenkowski

Aerospace Engineering (MS)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Required Courses</td>
<td>27</td>
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<tr>
<td></td>
<td>Select a minimum of six MAE courses approved in conjunction with the academic committee</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Additional Courses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Students may take nine hours of additional courses outside MAE coursework approved in conjunction with the academic committee to meet 30 total hours</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Project Work</td>
<td>3</td>
</tr>
<tr>
<td>MAE 586</td>
<td>Project Work In Mechanical Engineering</td>
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<td>Thesis Option</td>
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</tr>
<tr>
<td></td>
<td>Required Courses</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Students must take 21 hours of 500- or 700-level courses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Additional Courses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Students may take nine hours of additional courses outside MAE coursework approved in conjunction with the academic committee to meet 30 total hours</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minor Courses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Students may take an optional minor approved in conjunction with the academic committee</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thesis Research Course</td>
<td>9</td>
</tr>
<tr>
<td>MAE 695</td>
<td>Master's Thesis Research</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Hours</td>
<td>30</td>
</tr>
</tbody>
</table>

Faculty

Full Professors
Gregory D. Buckner
Tarek Echekki
Srinath Varadarajan Ekkad
Tiegang Fang
Ashok Gopalarathnam
Richard David Gould
Xiaoning Jiang
Richard F. Keltie
Clement Kleinstreuer
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Hong Luo
Kevin M. Lyons
Gracious Ngaile
Kara Jo Peters
Afsaneh Rabiei
Lawrence M. Silverberg
Juei Feng Tu
Fen Wu
Fuh-Gwo Yuan
Yong Zhu
Degree Requirement

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Required Courses</td>
<td>39</td>
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<tr>
<td></td>
<td>Select a minimum of twelve 500- to 700-level courses</td>
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</tr>
<tr>
<td></td>
<td>Minor Courses (Optional)</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>“Minor Courses” are approved in conjunction with the academic committee</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Research Courses</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>MAE 895 Doctoral Dissertation Research</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Hours</td>
<td>72</td>
</tr>
</tbody>
</table>

1 “Required Courses” must consist of a minimum of two 700-level courses, and may consist of up to five non-MAE courses approved in conjunction with the academic committee.

Additional Requirements

- Students with a previous MS degree from NCSU:
  - without minor – may transfer up to 18 credit hours
  - with minor – may transfer up to 30 credit hours
- Students with a previous MS from outside NCSU:
  - without minor – may transfer up to 18 credit hours
  - with minor – may transfer up to 18 credit hours

Faculty

Full Professors

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- Landon Grace
- Kenneth Granlund
- Timothy Joseph Horn
- Arun Kumar Kota
- Jun Liu
- Pramod Kumar Veera Subbareddy
- Jie Yin

Emeritus Faculty

- Thomas A. Dow
- Herbert Martin Eckerlin
- Hassan A. Hassan
- David S. McRae
- Robert T. Nagel
- John S. Strenkowski

Aerospace Engineering (PhD)
Aerospace Engineering (Minor)

Plan Requirements
• 9 (MS student) or 12 (PhD student) credit hours

Faculty
Full Professors
Gregory D. Buckner
Tarek Echekki
Srinath Varadarajan Ekkad
Tiegang Fang
Ashok Gopalarathnam
Richard David Gould
Xiaoning Jiang
Richard F. Keltie
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Hassan A. Hassan
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Robert T. Nagel
John S. Strenkowski

Biomanufacturing
The Golden LEAF Biomanufacturing Training and Education Center (BTEC) offers two graduate degrees: a thesis-based Master of Science (MS) in Biomanufacturing and a Master of Biomanufacturing (MR). Both are Professional Science Master's (PSM) degrees, which provide advanced education and training in a specific discipline while simultaneously developing business skills highly valued by employers.

Both degrees offer students the choice of upstream (fermentation) or downstream (purification) concentrations to accompany courses in global regulatory affairs, protein characterization techniques, case studies in cGMP manufacturing of influenza vaccine, case studies in monoclonal antibody production, advanced biomanufacturing and biocatalysis, and an industry internship. Both degrees also include professional skills training in effective oral, electronic, and written communications for both technical and business careers. All MBA courses are taught by faculty from the Jenkins Graduate School of Management, a part of NC State's Poole College of Management.

Admission Requirements
Admission to the BIOM program requires completion of an undergraduate degree in engineering, life science or physical sciences, letters of recommendation, and a statement of career goals. A minimum overall grade point average of 3.0 and GRE scores in the 80th percentile are also required. Applicants with previous industry experience or working professionals are strongly encouraged to apply.

Master’s Degree Requirements
Master of Biomanufacturing: BIOM students will complete a minimum of 36 total credit hours including a summer biomanufacturing industry internship, 3 credits of industry practicum case studies, 3 credits of global regulatory affairs and 9 credits of MBA courses in project management, biosciences management and business foundations.

Master of Science: The Master of Science degree requires a minimum of 36 credit hours. Similar to the MR, the BIOM Master of Science curriculum will combine interdisciplinary coursework with 6 MBA credits including a course in project management. In addition, the BIOM Master of Science program will provide more experience in bioprocess development research to familiarize students with the methods, ideals and goals of independent investigation, the concepts of quality by design (QbD), and methods used in industry for design of experiments (DoE) to define design space for industrial processes. As a consequence of the stronger focus on research, BIOM Master of Science students will complete 4 credit hours of industry-focused process research mentored by their BIOM graduate advisor. Each student will submit a written thesis, which will be presented to the student’s BIOM graduate advisory committee.

Student Financial Support
A limited number of full-time participants in the Master of Biomanufacturing program may be eligible for teaching assistantships or industry-sponsored graduate scholarships.

Other Relevant Information
BIOM accepts students in spring and fall semesters. A 10 credit hour graduate minor is also available for NCSU students currently enrolled in thesis-based graduate programs. Two unique 12 credit Graduate Certificates: Upstream Biomanufacturing and Downstream Biomanufacturing are also offered for students currently enrolled in other non-thesis graduate programs. Individuals interested in the BIOM program looking for more information should contact: Dr. Danny Monroe, BIOM Academic Program Coordinator, dsmonroe@ncsu.edu.

Degrees
• Biomanufacturing (MR) (p. 288)
• Biomanufacturing (MS) (p. 289)
• Biomanufacturing (Minor) (p. 290)
• Downstream Biomanufacturing (Certificate) (p. 290)
• Upstream Biomanufacturing (Certificate) (p. 290)
Full Professors
Ruben G. Carbonell
Amy Michele Grunden
Harold Henry Lamb
Paul Edward Mozdziak
Balaji M. Rao
Heike Inge Ada Sederoff
John Douglas Sheppard

Associate Professors
Paul T. Hamilton
Gavin John Williams

Assistant Professors
Stefano Menegatti

Practice/Research/Teaching Professors
Kirill Efimenko
Gary Louis Gilleskie
Imara Yasmin Perera
John H. van Zanten

Emeritus Faculty
Michael Carl Flickinger

Biomanufacturing (MR)

Degree Requirements
Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Biomanufacturing" without focus area track specifications.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEC 575</td>
<td>Global Regulatory Affairs for Medical Products</td>
<td>2</td>
</tr>
<tr>
<td>BEC 577</td>
<td>Advanced Biomanufacturing and Biocatalysis</td>
<td>2</td>
</tr>
<tr>
<td>BEC 590</td>
<td>Industry Practicum in Biomanufacturing (two semesters)</td>
<td>2</td>
</tr>
<tr>
<td>BEC 601</td>
<td>Biomanufacturing Seminar (two semesters)</td>
<td>2</td>
</tr>
<tr>
<td>BEC 620</td>
<td>Leadership and Preparation for Industry Internship in Biomanufacturing</td>
<td>2</td>
</tr>
<tr>
<td>ST 511</td>
<td>Statistical Methods For Researchers I</td>
<td>2</td>
</tr>
<tr>
<td>BEC 515</td>
<td>Biopharmaceutical Product Characterization Techniques</td>
<td>2</td>
</tr>
</tbody>
</table>

Focus Area Track
Select courses from a category listed under "Focus Area Track Courses" below.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEC 588</td>
<td>Animal Cell Culture Engineering</td>
<td>2</td>
</tr>
</tbody>
</table>

Professional Courses
Select two of the following courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>MBA 585</td>
<td>Current Topics in BioSciences Management</td>
<td>2</td>
</tr>
<tr>
<td>MBA 586</td>
<td>Legal, Regulatory and Ethical Issues in Life Science Industries</td>
<td>2</td>
</tr>
<tr>
<td>MBA 590</td>
<td>Special Topics In Business Management</td>
<td>2</td>
</tr>
<tr>
<td>BUS 501</td>
<td>Strategic Management Foundations</td>
<td>2</td>
</tr>
<tr>
<td>COM 563</td>
<td>Public Relations Theory</td>
<td>2</td>
</tr>
<tr>
<td>COM 598</td>
<td>Special Topics In Communication (Intro to Science Communication: Theory/Practice)</td>
<td>2</td>
</tr>
</tbody>
</table>

Elective Courses
Select three credit hours from "Elective Courses" listed below each focus area category.

Total Hours 36

Focus Area Tracks

Upstream Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 563</td>
<td>Fermentation of Recombinant Microorganisms</td>
<td>2</td>
</tr>
<tr>
<td>BBS 526</td>
<td>Upstream Biomanufacturing Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>BEC 580</td>
<td>cGMP Fermentation Operations</td>
<td>2</td>
</tr>
<tr>
<td>Total Hours</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

Elective Courses
Select three credits of the following courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEC 525</td>
<td>Molecular Biology for Biomanufacturing</td>
<td>2</td>
</tr>
<tr>
<td>BEC 545</td>
<td>Cell Line Development for Biomanufacturing</td>
<td>2</td>
</tr>
<tr>
<td>BEC 532</td>
<td>Biological Processing Science</td>
<td>2</td>
</tr>
<tr>
<td>BEC 536</td>
<td>Introduction to Downstream Process Development</td>
<td>2</td>
</tr>
<tr>
<td>BEC 585</td>
<td>cGMP Downstream Operations</td>
<td>2</td>
</tr>
<tr>
<td>BEC 583</td>
<td>Tissue Engineering Technologies</td>
<td>2</td>
</tr>
<tr>
<td>BEC 595</td>
<td>Special Topics in Biomanufacturing</td>
<td>1-6</td>
</tr>
<tr>
<td>BIT 501</td>
<td>Ethical Issues in Biotechnology</td>
<td>1</td>
</tr>
<tr>
<td>BEC 669</td>
<td>Biomanufacturing Research Projects</td>
<td>1-4</td>
</tr>
<tr>
<td>BIT 510</td>
<td>Core Technologies in Molecular and Cellular Biology</td>
<td>4</td>
</tr>
<tr>
<td>BIT 566</td>
<td>Animal Cell Culture Techniques</td>
<td>2</td>
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</tbody>
</table>

Downstream Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEC 532</td>
<td>Biological Processing Science</td>
<td>2</td>
</tr>
<tr>
<td>BEC 536</td>
<td>Introduction to Downstream Process Development</td>
<td>2</td>
</tr>
<tr>
<td>BEC 585</td>
<td>cGMP Downstream Operations</td>
<td>2</td>
</tr>
<tr>
<td>Total Hours</td>
<td></td>
<td>6</td>
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</tbody>
</table>
Elective Courses

Select three credits of the following courses: 3

- BEC 525 Molecular Biology for Biomanufacturing 2
- BEC 545 Cell Line Development for Biomanufacturing 2
- CHE 563 Fermentation of Recombinant Microorganisms 2
- BBS 526 Upstream Biomanufacturing Laboratory 2
- BEC 580 cGMP Fermentation Operations 2
- BEC 583 Tissue Engineering Technologies 2
- BEC 595 Special Topics in Biomanufacturing 1-6
- BIT 501 Ethical Issues in Biotechnology 1
- BEC 669 Biomanufacturing Research Projects 1-4
- BIT 510 Core Technologies in Molecular and Cellular Biology 4
- BIT 566 Animal Cell Culture Techniques 2

Focus Area Tracks

Upstream Track

Select courses from a category listed under "Focus Area Track Courses" below

- CHE 563 Fermentation of Recombinant Microorganisms 2
- BBS 526 Upstream Biomanufacturing Laboratory 2
- BEC 580 cGMP Fermentation Operations 2

Total Hours 6

Elective Courses

Select three credits of the following courses: 3

- BEC 525 Molecular Biology for Biomanufacturing 2
- BEC 545 Cell Line Development for Biomanufacturing 2
- CHE 563 Fermentation of Recombinant Microorganisms 2
- BBS 526 Upstream Biomanufacturing Laboratory 2
- BEC 580 cGMP Fermentation Operations 2
- BEC 583 Tissue Engineering Technologies 2
- BEC 595 Special Topics in Biomanufacturing 1-6
- BIT 501 Ethical Issues in Biotechnology 1
- BEC 669 Biomanufacturing Research Projects 1-4

Total Hours 37

1. BEC 601 must be repeated twice for a total of two credit hours.
2. BEC 669 must be repeated twice for a total of four credit hours.

Biomanufacturing (MS)

Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: “Master of Science in Biomanufacturing” without focus area track specifications.

Core Courses

- BEC 575 Global Regulatory Affairs for Medical Products
- BEC 577 Advanced Biomanufacturing and Biocatalysis
- BEC 590 Industry Practicum in Biomanufacturing (two semesters)
- BEC 601 Biomanufacturing Seminar (two semesters) 1
- BEC 620 Leadership and Preparation for Industry Internship in Biomanufacturing
- ST 511 Statistical Methods For Researchers I
- BEC 669 Biomanufacturing Research Projects 2
- BEC 515 Biopharmaceutical Product Characterization Techniques
- or BEC 588 Animal Cell Culture Engineering

Total Hours 22

Focus Area Track

Select courses from a category listed under "Focus Area Track Courses" below

Professional Courses

- BUS 554 Project Management
- MBA 585 Current Topics in BioSciences Management
- MBA 586 Legal, Regulatory and Ethical Issues in Life Science Industries
- MBA 590 Special Topics In Business Management
- BUS 501 Strategic Management Foundations
- COM 563 Public Relations Theory
- COM 598 Special Topics In Communication (Intro to Science Communication: Theory/Practice)

Total Hours 6
Biomanufacturing (Minor)

Plan Requirements

Master's Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Required Courses</td>
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</tr>
<tr>
<td>BEC 669</td>
<td>Biomanufacturing Research Projects</td>
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</tbody>
</table>

Select a minimum of eight credit hours of courses listed under "Elective Courses" below

Total Hours: 9

PhD Requirements

<table>
<thead>
<tr>
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<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Required Courses</td>
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<tr>
<td>BEC 669</td>
<td>Biomanufacturing Research Projects</td>
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</tr>
</tbody>
</table>

Select a minimum of eight credit hours of courses listed under "Elective Courses" below

Total Hours: 12

Elective Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Select a minimum of eight of the following courses:</td>
<td>8</td>
</tr>
<tr>
<td>BBS 526</td>
<td>Upstream Biomanufacturing Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>BEC 515</td>
<td>Biopharmaceutical Product Characterization Techniques</td>
<td>2</td>
</tr>
<tr>
<td>BEC 525</td>
<td>Molecular Biology for Biomanufacturing</td>
<td>2</td>
</tr>
<tr>
<td>BEC 532</td>
<td>Biological Processing Science</td>
<td>2</td>
</tr>
<tr>
<td>BEC 536</td>
<td>Introduction to Downstream Process Development</td>
<td>2</td>
</tr>
<tr>
<td>BEC 545</td>
<td>Cell Line Development for Biomanufacturing</td>
<td>2</td>
</tr>
<tr>
<td>BEC 575</td>
<td>Global Regulatory Affairs for Medical Products</td>
<td>3</td>
</tr>
<tr>
<td>BEC 577</td>
<td>Advanced Biomanufacturing and Biocatalysis</td>
<td>3</td>
</tr>
<tr>
<td>BEC 580</td>
<td>cGMP Fermentation Operations</td>
<td>2</td>
</tr>
<tr>
<td>BEC 583</td>
<td>Tissue Engineering Technologies</td>
<td>2</td>
</tr>
<tr>
<td>BEC 585</td>
<td>cGMP Downstream Operations</td>
<td>2</td>
</tr>
<tr>
<td>BEC 588</td>
<td>Animal Cell Culture Engineering</td>
<td>2</td>
</tr>
<tr>
<td>BEC 590</td>
<td>Industry Practicum in Biomanufacturing</td>
<td>3</td>
</tr>
<tr>
<td>BEC 595</td>
<td>Special Topics in Biomanufacturing</td>
<td>1-6</td>
</tr>
<tr>
<td>BIT 566</td>
<td>Animal Cell Culture Techniques</td>
<td>2</td>
</tr>
<tr>
<td>CHE 563</td>
<td>Fermentation of Recombinant Microorganisms</td>
<td>2</td>
</tr>
</tbody>
</table>

Total Hours: 42-47

Downstream Biomanufacturing (Certificate)

Graduate students and working professionals can now earn a new credential to kick-start or advance their career in the biopharmaceutical industry. The Downstream Biomanufacturing graduate certificates offer NC State graduate students* and working professionals the opportunity for hands-on learning in BTEC’s industry-scale simulated cGMP facilities.

Each certificate requires 12 hours of graduate coursework, which can be transferred to the Master of Biomanufacturing program. The majority of BTEC’s graduate courses are offered in the evening or online to better accommodate working professionals.

The certificate can be completed in two part-time semesters.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Required Courses</td>
<td>9</td>
</tr>
<tr>
<td>BEC 532</td>
<td>Biological Processing Science</td>
<td></td>
</tr>
<tr>
<td>BEC 536</td>
<td>Introduction to Downstream Process Development</td>
<td></td>
</tr>
<tr>
<td>BEC 585</td>
<td>cGMP Downstream Operations</td>
<td></td>
</tr>
<tr>
<td>BEC 575</td>
<td>Global Regulatory Affairs for Medical Products</td>
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</tbody>
</table>

Elective Course

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>BEC 515</td>
<td>Biopharmaceutical Product Characterization Techniques</td>
<td></td>
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<tr>
<td>BEC 577</td>
<td>Advanced Biomanufacturing and Biocatalysis</td>
<td></td>
</tr>
<tr>
<td>BEC 590</td>
<td>Industry Practicum in Biomanufacturing</td>
<td></td>
</tr>
<tr>
<td>BUS 554</td>
<td>Project Management</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours: 12

Upstream Biomanufacturing (Certificate)

Graduate students and working professionals can now earn a new credential to kick-start or advance their career in the biopharmaceutical industry. The Upstream Biomanufacturing graduate certificates offer NC State graduate students and working professionals the opportunity for hands-on learning in BTEC’s industry-scale simulated cGMP facilities.

Each certificate requires 12 hours of graduate coursework, which can be transferred to the Master of Biomanufacturing program. The majority of BTEC’s graduate courses are offered in the evening or online to better accommodate working professionals.

The certificate can be completed in two part-time semesters.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Required Courses</td>
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<tr>
<td>CHE 563</td>
<td>Fermentation of Recombinant Microorganisms</td>
<td></td>
</tr>
<tr>
<td>BBS 526</td>
<td>Upstream Biomanufacturing Laboratory</td>
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</tr>
<tr>
<td>BEC 580</td>
<td>cGMP Fermentation Operations</td>
<td></td>
</tr>
<tr>
<td>BEC 577</td>
<td>Advanced Biomanufacturing and Biocatalysis</td>
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</tr>
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</table>

Elective Course

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
</table>

Total Hours: 3

*Graduate students" includes current NC State graduate students and working professionals enrolled in the Biomanufacturing program.
Biomedical Engineering

The Joint Biomedical Engineering Graduate Program is administered by the combined biomedical engineering graduate faculty from both North Carolina State University and University of North Carolina at Chapel Hill. The joint program also has close working relations with the Research Triangle Institute and industry within the Research Triangle area. These associations enable students to obtain research training in a wide variety of fields and facilitate the selection and performance of dissertation research. The department, thus, provides students with excellent opportunities to realize the goal of enhancing medical care through the application of modern technology.

Biomedical engineering is a dynamic field stressing the application of engineering techniques and mathematical analysis to biomedical problems. Faculty research programs are key to the program, and they include five primary research directions: rehabilitation engineering, regenerative medicine, biomedical imaging, microsystems engineering, and pharmacoeengineering. The department offers graduate education in biomedical engineering leading to the master of science and doctor of philosophy degrees.

Students enter this program with backgrounds in engineering, physical science, mathematics or biological science. Curricula are tailored to fit the needs and develop the potential of individual students. In addition, courses in statistics, mathematics, life sciences and engineering sciences provide a well-rounded background of knowledge and skills.

Admission Requirements

Students must satisfy all entrance requirements for The Graduate School of the University of North Carolina at Chapel Hill or the Graduate School at North Carolina State University, and must demonstrate interest and capability commensurate with the quality of the biomedical engineering program. Prospective students may apply to the graduate school at either UNC-Chapel Hill or NC State. All applicants are considered together as a group. Generally, applications should be submitted by December 11 for consideration for admission in the coming fall semester. Applicants are expected to present Graduate Record Examination (GRE) scores; verbal scores should be at or above the 50th percentile and quantitative scores should be at or above the 70th percentile to be competitive. Admitted students are expected to have an average grade of B (cumulative GPA 3.30) or better and are encouraged to have undergraduate research experience. The program requires that a one-to-three page personal statement about research interest and background be submitted.

Students should have a good working knowledge of mathematics at least through differential equations, plus two years of physical or engineering science and basic courses in biological science. Deficiencies in preparation can be made up in the first year of graduate training.

Doctoral Degree Requirements

A minimum of 52 semester hours of graduate work is required (beyond the Bachelor’s degree). Degree candidates in this program are expected to obtain experience working in a research laboratory during their residence and to demonstrate proficiency in research. The Ph.D. dissertation should be judged by the graduate committee to be of publishable quality. The student must meet the Graduate School’s residency requirement at UNC-CH or NC State as appropriate. Further information on the BME Ph.D. program can be found on the department website.

Required and highly recommended courses

Students are required to take a BME Seminar each semester which is offered at both UNC-CH and NC State. Students must also complete six credits of graduate engineering topics, six credits of graduate life science topics, three credits of engineering mathematics, and three credits of statistics. Students may choose from a number of courses to meet these requirements. Such choices are made in consultation with the student’s academic advisor and the Director of Graduate Programs/Studies.

Comprehensive and Qualifying Examinations

Doctoral students qualify for the Ph.D. degree by meeting grade requirements in their core courses, and then advance on to written and oral preliminary exams before admission to candidacy. Details can be found on the department website.

Degrees

- Biomedical Engineering (MS) (p. 292)
- Biomedical Engineering (MS): Translation Innovation and Entrepreneurship Concentration (p. 293)
- Biomedical Engineering (PhD) (p. 294)
- Biomedical Engineering (Minor) (p. 295)
- Nanobiotechnology (Certificate) (p. 296)

Faculty

Full Professors

Ke Cheng
Paul A. Dayton
Shawn Gomez
Edward Grant
He (Helen) Huang
Frances Smith Ligler
H. Troy Nagle Jr.
Roger Jagdish Narayan
J. Michael Ramsey
Koji Sode
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Ted Bateman
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Xiaogang Hu
Alon Greenbaum
Wesley Legant
Imran Rizvi
Michael Sano

Naji Hussein
George Todd Ligler
Hatice Orun Ozturk
Ross Petrella
Anka Veleva

**Biomedical Engineering (MS)**

**Degree Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Core Courses</strong></td>
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<td></td>
</tr>
<tr>
<td>BME 501</td>
<td>Biomedical Innovation and Entrepreneurship I - Needs Discovery</td>
<td></td>
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<tr>
<td>BME 502</td>
<td>Biomedical Innovation and Entrepreneurship II - Design and Regulation</td>
<td></td>
</tr>
<tr>
<td>MBA 576</td>
<td>Technology Entrepreneurship and Commercialization I</td>
<td></td>
</tr>
<tr>
<td>BME 551</td>
<td>Medical Device Design</td>
<td></td>
</tr>
<tr>
<td>BEC 575</td>
<td>Global Regulatory Affairs for Medical Products</td>
<td></td>
</tr>
<tr>
<td>BME 503</td>
<td>Biomedical Innovation and Entrepreneurship III - Product Development</td>
<td></td>
</tr>
<tr>
<td>MBA 577</td>
<td>Technology Entrepreneurship and Commercialization II</td>
<td></td>
</tr>
<tr>
<td>MBA 572</td>
<td>Venture Opportunity Analysis Analytics</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td><strong>BME Technology Elective</strong></td>
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<tr>
<td>BME 525</td>
<td>Bioelectricity</td>
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<tr>
<td>BME 540</td>
<td>Nanobiotechnology Processing, Characterization, and Applications</td>
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<tr>
<td>BME 544</td>
<td>Orthopaedic Biomechanics</td>
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</tr>
<tr>
<td>BME 560</td>
<td>Medical Imaging: X-ray, CT, and Nuclear Medicine Systems</td>
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<tr>
<td>BME 583</td>
<td>Tissue Engineering Technologies</td>
<td></td>
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<tr>
<td>BME 584</td>
<td>Fundamentals of Tissue Engineering</td>
<td></td>
</tr>
<tr>
<td>BME 790</td>
<td>Advanced Special Topics in Biomedical Engineering</td>
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</tr>
<tr>
<td>BME 590</td>
<td>Special Topics in Biomedical Engineering</td>
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</table>

**Total Hours** 30

**Faculty**

**Full Professors**
Ke Cheng
Paul A. Dayton
Shawn Gomez
Edward Grant
He (Helen) Huang
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Lianne A. Cartee
Kenneth Donnelly
Oleg V. Favorov
Richard L. Goldberg
Devin Hubbard
Naji Hussein
George Todd Ligler
Hatice Orun Ozturk
Ross Petrella
Anka Veleva

Biomedical Engineering (MS): Translation Innovation and Entrepreneurship Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
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<tr>
<td><strong>Core Courses</strong></td>
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</tr>
<tr>
<td>BME 501</td>
<td>Biomedical Innovation and Entrepreneurship I - Needs Discovery</td>
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<tr>
<td>BME 502</td>
<td>Biomedical Innovation and Entrepreneurship II - Design and Regulation</td>
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<td>MBA 576</td>
<td>Technology Entrepreneurship and Commercialization I</td>
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</tr>
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<td>BME 551</td>
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<td>BME 503</td>
<td>Biomedical Innovation and Entrepreneurship III - Product Development</td>
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<td>Technology Entrepreneurship and Commercialization II</td>
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<td>MBA 572</td>
<td>Venture Opportunity Analysis Analytics</td>
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<tbody>
<tr>
<td>BME 525</td>
<td>Bioelectricity</td>
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<tr>
<td>BME 544</td>
<td>Orthopaedic Biomechanics</td>
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<td>BME 790</td>
<td>Advanced Special Topics in Biomedical Engineering</td>
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<td>BME 590</td>
<td>Special Topics in Biomedical Engineering</td>
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<td><strong>Total Hours</strong></td>
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Biomedical Engineering (PhD) Degree Requirements

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<tr>
<td></td>
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<tr>
<td>BME 802</td>
<td>Advanced Seminar in Biomedical Engineering (each semester (except the semester prior to graduation))</td>
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</tr>
<tr>
<td>or BME 890</td>
<td>Doctoral Preliminary Examination</td>
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</tr>
<tr>
<td></td>
<td>Biology/Medicine: A two semester sequence covering core aspects of relevant biology and physiology</td>
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</tr>
<tr>
<td></td>
<td>Engineering: 6 hours</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Graduate-level mathematics: 3 hours</td>
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<tr>
<td></td>
<td>Graduate-level statistics: 3 hours</td>
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</tr>
<tr>
<td></td>
<td>Scientific/Technical Electives: 9 hours minimum</td>
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<tr>
<td></td>
<td>Dissertation Research: 6 hours minimum</td>
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<tr>
<td></td>
<td>Total Hours</td>
<td>52</td>
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</tbody>
</table>

Faculty
Full Professors
Ke Cheng
Paul A. Dayton
Shawn Gomez
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J. Michael Ramsey
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Naji Hussein
George Todd Ligler
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Ross Petrella
Anka Veleva

Biomedical Engineering (Minor)
Plan Requirements
• 9 (MS student) or 12 (PhD student) credit hours

Faculty
Full Professors
Ke Cheng
Paul A. Dayton
Shawn Gomez
Edward Grant
He (Helen) Huang
Frances Smith Ligler
H. Troy Nagle Jr.
Roger Jagdish Narayan
J. Michael Ramsey
Koji Sode

Associate Professors
Ted Bateman
Robert G. Dennis
Caterina M. Gallippi
Michael Gamcsik
Derek Gary Kamper
Nanobiotechnology (Certificate)

With financial support from the North Carolina Biotechnology Center, UNC-Chapel Hill and NC State University offer graduate certificates in nanobiotechnology. Tremendous advances in development of nanoscale, nanostructured, and nano-enabled materials for biotechnology applications are currently taking place. In particular, the development of advanced materials (e.g., electronic materials, optical materials, biologically-derived materials, and nanoscale materials) will allow for the development of next generation systems for use in medicine, homeland defense, and agriculture. These systems will provide integration of multiple functions, miniaturization of devices, an increase in stability, and a decrease in cost. In order for universities, companies, and governmental agencies to pursue this highly specialized work, students must be trained at the graduate level to perform work at the interface of nanoscale science and biotechnology. The nanobiotechnology certificates are aligned with the need for highly trained professionals to nurture rapid growth of nanobiotechnology infrastructure in North Carolina. The keystone of the certificates at both universities is a core nanobiotechnology course (BME 540, 3 credit hours), in which lectures, open discussion, and student presentations will be used to introduce students to this area of study.

Plan Requirements

<table>
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<tr>
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<tbody>
<tr>
<td>BME 540</td>
<td>Nanobiotechnology Processing, Characterization, and Applications</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Select nine hours of electives:</td>
<td>9</td>
</tr>
<tr>
<td>BEC/CHE 562</td>
<td>Fundamentals of Bio-Nanotechnology (courses also offered at UNC-CH)</td>
<td></td>
</tr>
<tr>
<td>CH 747</td>
<td>Nanobiotechnology</td>
<td></td>
</tr>
<tr>
<td>BIT 501</td>
<td>Ethical Issues in Biotechnology</td>
<td></td>
</tr>
<tr>
<td>BME 566</td>
<td>Polymeric Biomaterials Engineering</td>
<td></td>
</tr>
<tr>
<td>MSE 539</td>
<td>Advanced Materials</td>
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</tr>
<tr>
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<td>Total Hours</td>
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</table>

Chemical Engineering

Research activities in the department include: computational nanoscience and biology; biomolecular engineering and biotechnology; catalysis, combustion, kinetics and electrochemical engineering; biofuels and renewable energy technology; green chemistry and engineering; innovative textiles, polymers and colloids; nanoscience and nanoengineering; and thermodynamics and molecular simulation.

Admissions Requirements

Students admitted to the graduate program normally have a Bachelor’s degree in chemical engineering or its equivalent. Students with undergraduate degrees in chemistry, physics or other engineering disciplines may be admitted but will be required to make up undergraduate course work deficiencies in chemical engineering without graduate credit. The most promising candidates will be accepted up to the number of spaces available.

Master of Science Degree Requirements

The M.S. degree requires a minimum of 30 credit hours. A set of four core courses is required. Two options are provided. In the thesis option, the thesis must be defended in a final public oral examination. In the
non-thesis option, the student must satisfactorily complete a total of 10 graduate courses. A unique feature of the non-thesis option is the availability of a Distance Education Masters in which the students can complete all 30 credit hours remotely through online courses offered via streaming videos without being on campus.

Master of Chemical Engineering Degree Requirements

The M.Ch.E. degree requires a minimum of 30 credit hours. A set of four core courses is required. A three-credit project is also required.

Doctor of Philosophy Degree Requirements

Students normally take a set of five core courses, two advanced courses and at least 6 credits of dissertation research. A thesis is required; this must be defended in a final public oral examination. In addition, the candidate must: (1) submit and defend an original written proposition in any area of chemical engineering, and (2) submit and defend a proposal to perform his/her thesis research.

Degrees

- Chemical Engineering (MR) (p. 298)
- Chemical Engineering (MS) (p. 299)
- Chemical Engineering (PhD) (p. 300)
- Chemical Engineering (Minor) (p. 302)

Faculty

Full Professors

Ruben G. Carbonell
Joseph M. DeSimone
Michael David Dickey
Peter S. Fedkiw
Jan Genzer
Christine S. Grant
Keith E. Gubbins
Carol K. Hall
Jason M. Haugh
Hasan Jameel
Robert M. Kelly
Saad A. Khan
Harold Henry Lamb
Fanxing Li
Phooi K. Lim
Gregory N Parsons
Behnam Pourdeyhimi
Balaji M. Rao
Richard J. Spontak
Orlin Dimitrov Velev
Phillip R. Westmoreland

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Steven W. Peretti
Erik Emilio Santiso

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Nathan Crook
Chien Ching Lilian Hsiao
Albert Jun Qi Keung
Stefano Menegatti
Adriana San Miguel Delgado
Qingshan Wei

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Matthew Ellis Cooper
Kirill Efimenko
Gary Louis Gilleskie
Luke Neal
John H. van Zanten

Emeritus Faculty

Richard M. Felder
Michael Carl Flickinger
Harold B. Hopfenberg
David Frederick Ollis
Hubert Winston

Adjunct Faculty

Anthony L. Andrady
Christina Boi
Eric Muller Gomez
### Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>CHE 711</td>
<td>Chemical Engineering Process Modeling</td>
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</tr>
<tr>
<td>CHE 713</td>
<td>Thermodynamics I</td>
<td>3</td>
</tr>
<tr>
<td>CHE 715</td>
<td>Transport Phenomena</td>
<td>3</td>
</tr>
<tr>
<td>CHE 717</td>
<td>Chemical Reaction Engineering</td>
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<td><strong>Total Required Courses</strong></td>
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#### Elective Courses

- Select a minimum of six elective courses approved in conjunction with the academic committee

<table>
<thead>
<tr>
<th>Code</th>
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<tr>
<td>CHE 543</td>
<td>Polymer Science and Technology</td>
<td>3</td>
</tr>
<tr>
<td>CHE 551</td>
<td>Biochemical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CHE 560</td>
<td>Chemical Processing Of Electronic Materials</td>
<td>3</td>
</tr>
<tr>
<td>CHE 562</td>
<td>Fundamentals of Bio-Nanotechnology</td>
<td>3</td>
</tr>
<tr>
<td>CHE 563</td>
<td>Fermentation of Recombinant Microorganisms</td>
<td>2</td>
</tr>
<tr>
<td>CHE 568</td>
<td>Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems</td>
<td>3</td>
</tr>
<tr>
<td>CHE 577</td>
<td>Advanced Biomanufacturing and Biocatalysis</td>
<td>3</td>
</tr>
<tr>
<td>CHE 596</td>
<td>Special Topics in Chemical Engineering (Core Chemical Engineering Concepts I (required of all non ChE majors; not available for others))</td>
<td>1-3</td>
</tr>
<tr>
<td>CHE 596</td>
<td>Special Topics in Chemical Engineering (Core Chemical Engineering Concepts II (required of all non ChE majors; not available for others))</td>
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<tr>
<td>CHE 596</td>
<td>Special Topics in Chemical Engineering (Colloid Science &amp; Nanoscale Engineering)</td>
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<td>CHE 596</td>
<td>Special Topics in Chemical Engineering (Green Chemical Engineering)</td>
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<tr>
<td>CHE 596</td>
<td>Special Topics in Chemical Engineering (Molecular 1-3 Cell Engineering)</td>
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<tr>
<td>CHE 596</td>
<td>Special Topics in Chemical Engineering (Chemical 1-3 Process Engineering)</td>
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<tr>
<td>CHE 596</td>
<td>Special Topics in Chemical Engineering (Polymer Rheology and Processing)</td>
<td>1-3</td>
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<tr>
<td>CHE 596</td>
<td>Special Topics in Chemical Engineering (Drug Delivery Concepts)</td>
<td>1-3</td>
</tr>
<tr>
<td>CHE 597</td>
<td>Chemical Engineering Projects</td>
<td>1-3</td>
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<tr>
<td>MA 501</td>
<td>Advanced Mathematics for Engineers and Scientists I</td>
<td>3</td>
</tr>
<tr>
<td>CHE 761</td>
<td>Polymer Blends and Alloys</td>
<td>3</td>
</tr>
<tr>
<td>CHE 775</td>
<td>Multi-Scale Modeling of Matter</td>
<td>3</td>
</tr>
</tbody>
</table>

### CHE Courses

- Select a minimum of six elective courses approved in conjunction with the academic committee

### Faculty

#### Full Professors
- Ruben G. Carbonell
- Joseph M. DeSimone
- Michael David Dickey
- Peter S. Fedkiw
- Jan Genzer
- Christine S. Grant
- Keith E. Gubbins
- Carol K. Hall
- Jason M. Haugh
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NC State University

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Martin Schoen
Malgorzata Sliwinska-Bartowiak
Simeon D. Stoyanov

Chemical Engineering (MS)

Degree Requirements

Required Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>CHE 711</td>
<td>Chemical Engineering Process Modeling</td>
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<td>CHE 713</td>
<td>Thermodynamics I</td>
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<td>CHE 715</td>
<td>Transport Phenomena</td>
<td>3</td>
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Thesis Options

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<tr>
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<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>CHE 695</td>
<td>Master's Thesis Research</td>
<td>3</td>
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*"Elective Courses" will be determined in conjunction with the academic committee to meet the 30 total hour requirement.

Non-Thesis

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<tr>
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<th>Hours</th>
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<tbody>
<tr>
<td>CHE 695</td>
<td>Master's Thesis Research</td>
<td>3</td>
</tr>
</tbody>
</table>

*"Elective Courses" will be determined in conjunction with the academic committee to meet the 30 total hour requirement.

Total Hours: 30

- Non-CHE undergraduate majors are required to take CHE 596 Core Concepts I and CHE 596 Core Concepts II before they can take any 700-level courses.

CHE Courses

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<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
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<tr>
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<td>CHE 551</td>
<td>Biochemical Engineering</td>
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<tr>
<td>CHE 560</td>
<td>Chemical Processing Of Electronic Materials</td>
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<tr>
<td>CHE 562</td>
<td>Fundamentals of Bio-Nanotechnology</td>
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</tr>
<tr>
<td>CHE 563</td>
<td>Fermentation of Recombinant Microorganisms</td>
<td>2</td>
</tr>
<tr>
<td>CHE 568</td>
<td>Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems</td>
<td>3</td>
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<tr>
<td>CHE 577</td>
<td>Advanced Biomanufacturing and Biocatalysis</td>
<td>3</td>
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<tr>
<td>CHE 596</td>
<td>Special Topics in Chemical Engineering (Core Chemical Engineering Concepts I (required of all non ChE majors; not available for others))</td>
<td>1-3</td>
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<tr>
<td>CHE 596</td>
<td>Special Topics in Chemical Engineering (Core Chemical Engineering Concepts II (required of all non ChE majors; not available for others))</td>
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<tr>
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<tr>
<td>CHE 596</td>
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<td>Special Topics in Chemical Engineering (Polymer Rheology and Processing)</td>
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<td>Special Topics in Chemical Engineering (Drug Delivery Concepts)</td>
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<td>CHE 597</td>
<td>Chemical Engineering Projects</td>
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<td>CHE 715</td>
<td>Transport Phenomena</td>
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<tr>
<td>CHE 717</td>
<td>Chemical Reaction Engineering</td>
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<tr>
<td>CHE 761</td>
<td>Polymer Blends and Alloys</td>
<td>3</td>
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<td>CHE 775</td>
<td>Multi-Scale Modeling of Matter</td>
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</tr>
<tr>
<td>MA 501</td>
<td>Advanced Mathematics for Engineers and Scientists I</td>
<td>3</td>
</tr>
</tbody>
</table>
**Faculty**

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**Chemical Engineering (PhD)**

**Degree Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>CHE 701</td>
<td>Introduction to Chemical Engineering Research</td>
<td>16</td>
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<tr>
<td>CHE 702</td>
<td>Chemical Engineering Research Proposition</td>
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<tr>
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<td>Chemical Reaction Engineering</td>
<td></td>
</tr>
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</table>

| Additional Courses | 6 |
Select six additional credit hours at 500 or 700 level in any technical discipline approved in conjunction with the academic committee.

**Dissertation Research Course**
6

**CHE 895**  Doctoral Dissertation Research

**Elective Courses**
44

“Elective Courses” are determined in conjunction with the academic committee to meet the 72 total credit hours.

**Preliminary Exam**
The Preliminary Exam is taken in the 4th semester, however, it requires an annual progress report.

Total Hours 72

### Elective Courses

<table>
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John H. van Zanten

**Emeritus Faculty**

Richard M. Felder
Chemical Engineering (Minor)

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Harold B. Hopfenberg
David Frederick Ollis
Hubert Winston

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Martin Schoen
Małgorzata Sliwinska-Bartowiak
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Chemical Engineering (Minor)

Plan Requirements
- 9 (MS student) or 12 (PhD student) credit hours

Faculty
Full Professors
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Hubert Winston

Adjunct Faculty
Anthony L. Andrady
Civil Engineering

Graduate programs are offered in coastal and water resources engineering, computing and systems, construction engineering and management, environmental engineering, geotechnical and geoenvironmental engineering, mechanics and materials, structural engineering and mechanics, transportation engineering and materials.

Admission Requirements

Normal minimum GPA requirements include 3.0 overall and in the major. Students who do not meet these academic requirements may take graduate courses through the Non Degree Studies program to demonstrate academic ability, but consultation with the Director of Graduate Programs is strongly advised. Applicants without academic experience in civil engineering, construction engineering, or environmental engineering may be required to take undergraduate courses to remove deficiencies, but graduate credit is not given for these courses. The Graduate Record Examination is required for all international applicants and all applicants to the MSCE or MSENE degree programs.

Master's Degree Requirements

Four Master's degrees, requiring a minimum of 30 or 31 credit hours, are available. At least two-thirds of a Master's program should be in a well-defined major area of concentration. The MCE is a non-thesis (Option B) degree with other requirements, such as independent projects or core courses, specified in some areas of specialization. A formal minor is not permitted. The MCE is available both on-campus and through distance education. The MSCE degree requires a thesis and a formal minor is optional. Requirements for the MENE and MSENE are the similar to those for the CE degrees.

Doctoral Degree Requirements

The Ph.D. typically requires one year of full-time course work beyond the master's degree and research culminating in a dissertation. The program must develop a well-defined major area of concentration and may include supporting courses outside the major or a formal minor in a related field. All specialty areas, including Environmental Engineering, are included in the one Ph.D. program.

Student Financial Support

Departmental teaching and research assistantships are available including coverage of tuition and health insurance. Fellowships -- full or supplemental to an assistantship -- are available for exceptional applicants. All financial aid recipients are selected on merit-based competition with other applicants. Applications requesting financial aid (both U.S. and international) should be submitted early: February 1 for Fall admission and by July 15 for Spring admission.

Degrees

- Civil Engineering (MR) (p. 304)
- Civil Engineering (MS) (p. 308)
- Civil Engineering (PhD) (p. 311)
- Civil Engineering (Minor) (p. 313)

Faculty

Full Professors

Sankarasubramanian Arumugam
Morton A. Barlaz
John W. Baugh Jr.
Emily Zechman Berglund
Francis Lajara De Los Reyes III
Joel Ducoste
Henry C. Frey
Mohammed Awad Gabr
Murthy N. Guddati
Abhinav Gupta
Tasnim Hassan
Edward J. Jaselskis
Youngsoo R. Kim
Detlef R. Knappe
Mervyn J. Kowalsky
George F. List
Min Liu
Gnanamanikam Mahinthakumar
James M. Nau
Margery F. Overton
Ranji Ranjithan
William John Rasdorf
Nagu M. Roupahl
Rudolf Seracino
Akhtarhusein A. Tayebali
Billy Merle Williams Jr.
Associate Professors
Cassandra Alison Castorena
Joseph F. DeCarolis
Joel Casey Dietrich
Andrew P. Grieshop
Jeremiah Johnson
Brina Mortensen Montoya
Mohammad Pour-Ghaz
Benjamin Shane Underwood

Assistant Professors
Alex Albert
Tarek Aziz
Eleni Bardaka
Ashly Margot Cabas Mijares
Douglas Franklin Call
Fernando Garcia Menendez
Ali Hajibabaie
Kook Han
Angela Rose Harris
Jordan Kern
Daniel R. Obenour
Jason Fredrick Patrick
Giorgio Talotti Proestos

Practice/Research/Teaching Professors
Florentino Banaag De La Cruz
Billy L. Edge
Meagan Kittle Autry
James William Levis
Gregory W. Lucier
Elizabeth J. Sciaudone

Emeritus Faculty
Michael Amein
William L. Bingham
Robert C. Borden
Roy H. Borden
Earl Downey Brill Jr
Allen C. Chao
John F. Ely
John S. Fisher
Ajaya K. Gupta
John M. Hanson
Kerry S. Havner
Clinton L. Heimbach
Yasuyuki Horie
David West Johnston
Narendra P. Khosla
Michael Lloyd Leming
Vernon C. Matzen
Stephens W. Nunnally
M. Shamimur Rahman
Sami Rizkalla
J. C. Smith
John R. Stone
Chi C. Tung
Harvey E. Wahls
Paul Z. Zia

Civil Engineering (MR)
Degree Requirements
Students may choose from the specializations below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Civil Engineering" without specialization specifications.

Computing & Systems Specialization
• Select at least 6 courses in the CE department

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>CE 536</td>
<td>Introduction to Numerical Methods for Civil Engineers</td>
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<tr>
<td>CE 537</td>
<td>Computer Methods and Applications</td>
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<tr>
<td>CE 591</td>
<td>Special Topics in Civil Engineering Computing</td>
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</tr>
<tr>
<td>CE 737</td>
<td>Computer-Aided Engineering Systems</td>
<td></td>
</tr>
</tbody>
</table>
CE 791 Advanced Topics in Civil Engineering Computing
  (High performance computer modeling)

CE 791 Advanced Topics in Civil Engineering Computing
  (Evolutionary computation)

CE 791 Advanced Topics in Civil Engineering Computing
  (Inverse modeling)

CE 791 Advanced Topics in Civil Engineering Computing
  (Advanced methods for systems analysis)

CE 7XX Complex adaptive systems analysis

Electives 1

CE 775 Modeling and Analysis Of Environmental Systems 3
CE 776 Advanced Water Management Systems 3
CE 796 Advanced Topics in Water Resource and Environmental Engineering (Stochastic Methods)
CE 724 Probabilistic Methods Of Structural Engineering 3
CE 721 Matrix and Finite Element Structural Analysis 3

Electives 2

ISE 501 Introduction to Operations Research 3
MA/ISE 505 Linear Programming 3
ISE 708 Integer Programming 3
ISE 709 Dynamic Programming 3
ISE 712 Bayesian Decision Analysis For Engineers and Managers 3
MA 501 Advanced Mathematics for Engineers and Scientists I 3
MA 502 Advanced Mathematics for Engineers and Scientists II 3
MA/CSC 580 Numerical Analysis I 3
MA/CSC 583 Introduction to Parallel Computing 3
MA 584 Numerical Solution of Partial Differential Equations—Finite Difference Methods 3
MA 587 Numerical Solution of Partial Differential Equations—Finite Element Method 3
MA/ST 706 Nonlinear Programming 3
CSC 501 Operating Systems Principles 3
CSC 548 Parallel Systems 3

Total Hours 63

1 Other relevant departmental courses
2 Other recommended courses

Construction Engineering Specialization

Select a minimum of seven courses with CON prefix 21
Select one non-CON prefix civil engineering course: 3

CE 675 Civil Engineering Projects (3 hours maximum) 3

Total Hours 30

Environmental, Water Resources, and Coastal Engineering Specialization

• 30 graduate-level credit hours

Geotechnical and Geoenvironmental Engineering Specialization

• 30 graduate-level credit hours
Civil Engineering Projects (Independent Study) 3

 Structural Engineering and Mechanics Specialization

<table>
<thead>
<tr>
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<td>Civil Engineering Projects (Independent Study)</td>
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Total Hours 3

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<thead>
<tr>
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<tr>
<td>CE 515</td>
<td>Advanced Strength of Materials</td>
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<td>CE 526</td>
<td>Finite Element Method in Structural Engineering</td>
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<tr>
<td>CE 527</td>
<td>Structural Dynamics</td>
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Select one of the following SEM Behavior and Design courses: 3

<table>
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<tbody>
<tr>
<td>CE 522</td>
<td>Theory and Design Of Prestressed Concrete</td>
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<tr>
<td>CE 523</td>
<td>Theory and Behavior Of Steel Structures</td>
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<tr>
<td>CE 524</td>
<td>Analysis and Design Of Masonry Structures</td>
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<tr>
<td>CE 528</td>
<td>Structural Design in Wood</td>
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<tr>
<td>CE 529</td>
<td>FRP Strengthening and Repair of Concrete Structures</td>
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<tr>
<td>CE 726</td>
<td>Advanced Theory Of Concrete Structures</td>
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</tr>
<tr>
<td>CE 794</td>
<td>Advanced Topics in Structures and Mechanics</td>
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</tbody>
</table>

Select two of the following additional SEM courses: 6

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>CE 525</td>
<td>Structural Analysis II</td>
<td>3</td>
</tr>
<tr>
<td>CE 721</td>
<td>Matrix and Finite Element Structural Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CE 530</td>
<td>Properties of Concrete and Advanced Cement-Based Composites</td>
<td>3</td>
</tr>
<tr>
<td>CE 714</td>
<td>Stress Waves</td>
<td>3</td>
</tr>
<tr>
<td>CE 718</td>
<td>Constitutive Modeling of Engineering Materials</td>
<td>3</td>
</tr>
<tr>
<td>CE 730</td>
<td>Mechanics and Failure of Quasi-Brittle Materials</td>
<td>3</td>
</tr>
<tr>
<td>CE 723</td>
<td>Advanced Structural Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>CE 724</td>
<td>Probabilistic Methods Of Structural Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CE 725</td>
<td>Earthquake Structural Engineering</td>
<td>3</td>
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<td>FRP Strengthening and Repair of Concrete Structures</td>
<td>3</td>
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<td>FRP Strengthening of Concrete Structures</td>
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Electives

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<td>CE 502</td>
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<td>CE 503</td>
<td>Highway Design</td>
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<td>CE 504</td>
<td>Airport Planning and Design</td>
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<tr>
<td>CE 506</td>
<td>Transportation Engineering Data Collection and Analysis</td>
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<tr>
<td>CE 594</td>
<td>Special Topics in Structures and Mechanics</td>
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</table>

Transportation Materials and Systems Specialization

- 30-31 graduate credit hours
- 24/30 credits at 500-level or higher

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>CE 501</td>
<td>Transportation Systems Engineering</td>
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<td>CE 504</td>
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<td>CE 594</td>
<td>Special Topics in Structures and Mechanics</td>
<td>1-6</td>
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</table>
CE 595 Special Topics in Transportation Engineering (Asphalt/Bituminous Materials) 1-6
CE 595 Special Topics in Transportation Engineering (Sensors and Instrumentation) 1-6
CE 595 Special Topics in Transportation Engineering (Railroad Engineering) 1-6
CE 595 Special Topics in Transportation Engineering (Unconventional Intersection and Interchange Design) 1-6
CE 701 Urban Transportation Planning 3
CE 702 Traffic Flow Theory 3
CE 705 Intelligent Transportation Systems 3
CE 706 Advanced Traffic Control 3
CE 707 Transportation Policy and Funding 3
CE 755 Highway Pavement Design 3
CE 757 Pavement Management Systems 3
CE 759 Inelastic Behavior Of Construction Materials 3
CE 795 Advanced Topics in Transportation Engineering (Transportation Economics) 1-3
CE 795 Advanced Topics in Transportation Engineering (Transportation Logistics) 1-3

Faculty

Full Professors
Sankarasubramanian Arumugam
Morton A. Barlaz
John W. Baugh Jr.
Emily Zechman Berglund
Francis Lajara De Los Reyes III
Joel Ducoste
Henry C. Frey
Mohammed Awad Gabr
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Practice/Research/Teaching Professors
Florentino Banaag De La Cruz
Billy L. Edge
Meagan Kittle Autry
**Civil Engineering (MS)**

**Degree Requirements**

Students may choose from the specializations below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Science in Civil Engineering" without specialization specifications.

---

### Computing & Systems Specialization

- Select at least five courses in the CE department

<table>
<thead>
<tr>
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<tr>
<td>CE 536</td>
<td>Introduction to Numerical Methods for Civil Engineers</td>
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<tr>
<td>CE 537</td>
<td>Computer Methods and Applications</td>
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<tr>
<td>CE 591</td>
<td>Special Topics in Civil Engineering Computing</td>
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<tr>
<td>CE 737</td>
<td>Computer-Aided Engineering Systems</td>
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<td>Advanced Topics in Civil Engineering Computing (High</td>
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<td>Advanced Topics in Civil Engineering Computing (Evolutionary</td>
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<td>Advanced Topics in Civil Engineering Computing (Advanced</td>
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<td>CE 7XX</td>
<td>Complex adaptive systems analysis</td>
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<td>CE 775</td>
<td>Modeling and Analysis Of Environmental Systems</td>
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<td>CE 776</td>
<td>Advanced Water Management Systems</td>
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<td>CE 796</td>
<td>Advanced Topics in Water Resource and Environmental</td>
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<td>Engineering (Stochastic Methods)</td>
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<td>Probabilistic Methods Of Structural Engineering</td>
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<td>CE 721</td>
<td>Matrix and Finite Element Structural Analysis</td>
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<tr>
<td>MA 501</td>
<td>Advanced Mathematics for Engineers and Scientists I</td>
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<td>MA 502</td>
<td>Advanced Mathematics for Engineers and Scientists II</td>
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<td>MA/CSC 580</td>
<td>Numerical Analysis I</td>
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<td>MA/CSC 583</td>
<td>Introduction to Parallel Computing</td>
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<td>MA 584</td>
<td>Numerical Solution of Partial Differential Equations–Finite</td>
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<td>MA 587</td>
<td>Numerical Solution of Partial Differential Equations–Finite</td>
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<td>MA/ST 706</td>
<td>Nonlinear Programming</td>
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<td>Operating Systems Principles</td>
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<td>CSC 548</td>
<td>Parallel Systems</td>
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**Electives**

- Other relevant departmental courses
- Other recommended courses

**Total Hours**: 66-69
## Construction Engineering Specialization

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<tr>
<td>CE 536</td>
<td>Introduction to Numerical Methods for Civil Engineers</td>
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<tr>
<td>CE 537</td>
<td>Computer Methods and Applications</td>
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<tr>
<td>CE 538</td>
<td>Information Technology and Modeling</td>
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<td>CE 592</td>
<td>Special Topics in Construction Engineering</td>
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<tr>
<td>CE 522</td>
<td>Theory and Design Of Prestressed Concrete</td>
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<tr>
<td>CE 523</td>
<td>Theory and Behavior Of Steel Structures</td>
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<tr>
<td>CE 524</td>
<td>Analysis and Design Of Masonry Structures</td>
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<tr>
<td>CE 528</td>
<td>Structural Design in Wood</td>
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<tr>
<td>CE 548</td>
<td>Engineering Properties Of Soils I</td>
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<td>CE 549</td>
<td>Soil and Site Improvement</td>
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<td>CE 755</td>
<td>Highway Pavement Design</td>
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<td>CE 590</td>
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<tr>
<td>ISE 501</td>
<td>Introduction to Operations Research</td>
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<td>Applied Engineering Economy</td>
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<td>ISE 562</td>
<td>Simulation Modeling</td>
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<td>ST 515</td>
<td>Experimental Statistics for Engineers I</td>
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<td>ST 516</td>
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<tr>
<td>CE 675</td>
<td>Civil Engineering Projects (3 hours maximum)</td>
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<tr>
<td>CE 695</td>
<td>Master's Thesis Research</td>
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Total Hours: 33

## Structural Engineering and Mechanics Specialization

### Core Courses

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<tr>
<td>CE 515</td>
<td>Advanced Strength of Materials</td>
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<td>CE 526</td>
<td>Finite Element Method in Structural Engineering</td>
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<td>CE 527</td>
<td>Structural Dynamics</td>
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Select one of the following SEM Behavior and Design courses: 3

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<td>Analysis and Design Of Masonry Structures</td>
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<td>CE 528</td>
<td>Structural Design in Wood</td>
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<tr>
<td>CE 529</td>
<td>FRP Strengthening and Repair of Concrete Structures</td>
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<td>CE 726</td>
<td>Advanced Theory Of Concrete Structures</td>
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<tr>
<td>CE 794</td>
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Select two of the following additional SEM courses: 6

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<td>CE 721</td>
<td>Matrix and Finite Element Structural Analysis</td>
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<td>CE 530</td>
<td>Properties of Concrete and Advanced Cement-Based Composites</td>
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<td>CE 714</td>
<td>Stress Waves</td>
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<td>CE 718</td>
<td>Constitutive Modeling of Engineering Materials</td>
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<tr>
<td>CE 730</td>
<td>Mechanics and Failure of Quasi-Brittle Materials</td>
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<td>CE 723</td>
<td>Advanced Structural Dynamics</td>
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<td>CE 724</td>
<td>Probabilistic Methods Of Structural Engineering</td>
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<td>CE 725</td>
<td>Earthquake Structural Engineering</td>
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Electives

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<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>CE 695</td>
<td>Master's Thesis Research</td>
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Total Hours: 19-24

## Electives

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<tr>
<td>CE 525</td>
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<td>CE 723</td>
<td>Advanced Structural Dynamics</td>
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## Environmental, Water Resources, and Coastal Engineering Specialization

- 30 graduate-level credit hours

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<th>Title</th>
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Total Hours: 2-7

## Geotechnical and Geoenvironmental Engineering Specialization

- 30 graduate-level credit hours

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<tbody>
<tr>
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<td>Master's Thesis Research</td>
<td>1-6</td>
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Total Hours: 19-24

## Mechanics and Materials Specialization

- 30 graduate-level credit hours

<table>
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<tbody>
<tr>
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<td>Master's Thesis Research</td>
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</table>

Total Hours: 6
Transportation Materials and Systems Specialization

- 30-31 graduate credit hours
- 24/30 credits at 500-level or higher

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>CE 501</td>
<td>Transportation Systems Engineering</td>
<td>3</td>
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<tr>
<td>CE 502</td>
<td>Traffic Operations</td>
<td>3</td>
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<tr>
<td>CE 503</td>
<td>Highway Design</td>
<td>3</td>
</tr>
<tr>
<td>CE 504</td>
<td>Airport Planning and Design</td>
<td>3</td>
</tr>
<tr>
<td>CE 506</td>
<td>Transportation Engineering Data Collection and Analysis</td>
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<td>CE 509</td>
<td>Highway Safety</td>
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<tr>
<td>CE 594</td>
<td>Special Topics in Structures and Mechanics (Nondestructive Testing)</td>
<td>1-6</td>
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</tbody>
</table>

**Faculty**

**Full Professors**

Sankarasubramanian Arumugam
Morton A. Barlaz
John W. Baugh Jr.
Emily Zechman Berglund
Francis Lajara De Los Reyes III
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Henry C. Frey
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Murthy N.Guddati
Abhinav Gupta
Tasnimee Hassan
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Earl Downey Brill Jr
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Yasuyuki Horie
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Vernon C. Matzen
Stephens W. Nunnally
M. Shamimur Rahman
Sami Rizkalla
J. C. Smith
John R. Stone
Chi C. Tung
Harvey E. Wahls
Paul Z. Zia

Civil Engineering (PhD)

Degree Requirements
Students may choose from the specializations below to complete coursework within a focus area.
Degrees earned will be distributed as: “Doctor of Philosophy in Civil Engineering” without specialization specifications.

- 54 graduate credit hours beyond master's
- Areas of Specialization
  - Computing and Systems
  - Construction Engineering
  - Environmental, Water Resources, and Coastal Engineering
  - Geotechnical/Geoenvironmental Engineering
  - Mechanics and Materials
  - Structural Engineering and Mechanics
  - Transportation Materials and Systems

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Nagui M. Rouphail
Rudolf Seracino
Akhtarhusein A. Tayebali
Billy Merle Williams Jr.

Civil Engineering (Minor)

Plan Requirements
• 9 (MS student) or 12 (PhD student) credit hours

Faculty

Full Professors
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Joel Casey Dietrich
Andrew P. Grieshop
Jeremiah Johnson
Brina Mortensen Montoya
Mohammad Pour-Ghaz
Benjamin Shane Underwood

Assistant Professors
Alex Albert
Tarek Aziz
Eleni Bardaka
Ashly Margot Cabas Mijares
Douglas Franklin Call
The Master of Science in Computer Engineering may be earned with thesis option or through the non-thesis option. Either option may be used as preparation for further graduate study or employment in industrial research, development or design.

Also a strong Ph.D. program is available for those who wish to pursue a research and/or teaching career in Industry, Government or Academia.

Admissions Requirements

Admission to the M.S. program requires a B.S. in electrical engineering, computer engineering or computer science, and an overall undergraduate GPA of at least 3.0. For non-native English speakers, the minimum acceptable TOEFL score for admission to the M.S. program is 90 (minimum 18 in each area, with minimum of 19 on Speaking). The GRE is required for all programs of study but may be waived upon request for graduates from US Universities (see below). Admission is further limited by available room in the elected program of study. Meeting the above minimum requirements alone does not guarantee admission.

Applicants to the Master’s and PhD programs who do not have a Bachelor’s degree in Electrical Engineering or Computer Engineering, but have a closely related degree from an accredited college or university, must have taken the following pre-requisite courses: courses equivalent to ECE 109, ECE 209, ECE 212, ECE 220, ECE 301, ECE 302, ECE 309 and CSC 226.

GRE scores within the last four years of the date of anticipated admission. Guideline for minimal GRE percentile scores are 70 percentile verbal, 90 percentile quantitative, and 50 percentile analytical or writing. GRE scores for students who are graduates from NCSU may be waived. They also might be waived for graduates from US ABET accredited programs with good GPAs.

All international applicants from non English speaking countries must submit TOEFL scores. The TOEFL must have been taken within two years of the date of anticipated admission. On the TOEFL IBT, students must have a minimum of 18 on each section of the test with a minimum total of 90. Scores on previous versions of the TOEFL are considered with the same qualitative standard. On the IELTS, we require a minimum score of 6.5 in each section. This requirement also applies to US citizens whose principal language of instruction has not been English (for example, most applicants from Puerto Rico and the Virgin Islands).

TOEFL - institution code 5496; department code 66
GRE - institution code 5496; department code 1203

Admission to the Ph.D. program requires a B.S. or M.S. in electrical engineering, computer engineering or computer science with an
expectation of an overall GPA of at least 3.25. The minimum acceptable TOEFL score for admission to the Ph.D. program is 90 (minimum 18 in each area, with minimum of 19 on Speaking). The GRE is required for all programs of study but might be waived for NCSU graduates or graduates from other US ABET accredited schools with good GPAs. Admission is further limited by available room in the elected program of study, and meeting the minimum requirements as given above does not guarantee admission.

**Master's Degree Requirements**

Thirty-one (31) credit hours; a thesis is optional. Students must have at least 21 hours of ECE courses that cover at least three specialty areas and have at least three credit hours of advanced-level (700-level) ECE courses. Students electing the Option B non-thesis option must meet core course requirements; have ECE courses that cover at least three specialty areas' and have at least three credit hours of 700-level ECE courses.

The Master's degree is offered online through Engineering OnLine. Applications to these MS on-line programs are through the ECE Department and all students must comply with ECE program requirements.

**Doctoral Degree Requirements**

Approximately 54 credit hours are required beyond the M.S. degree or 72 credit hours beyond the B.S. degree. For those with an NCSU MS degree in our department, no additional courses are required. For those with an NCSU MS degree in another department, 6 credit hours are required in our department. For those with a non NCSU MS degree, 12 credit hours of coursework are required. For those with only a Bachelors degree 30 credit hours of coursework are required. The remaining credit hours are research.

The department wishes to evaluate a Ph.D. student's research potential as quickly as possible. Consequently, all Ph.D. students are required to pass a qualifying review before the end of their third semester of study. This review is based on the student’s academic performance to date and the results of a project with one of their committee members. Results are presented to the committee in both written and oral form. Based on this review, the committee will decide if the student may continue in the Ph.D. program.

**Student Financial Support**

The department offers financial support to qualified students in the form of teaching assistantships, research assistantships, and fellowships. These sources of support generally include coverage of tuition and fees.

**Degrees**

- Computer Engineering (MS) (p. 316)
- Computer Engineering (PhD) (p. 318)
- Computer Engineering (Minor) (p. 320)
- Computer Engineering (Certificate) (p. 322)

**Faculty**

**Full Professors**

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Wesley E. Snyder

**Computer Engineering (MS)**
### Degree Requirements

Degrees earned will be distributed as: "Master of Science in Computer Engineering" without specialty or option specifications.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td><strong>Required Courses</strong></td>
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</tr>
<tr>
<td></td>
<td>ECE 600</td>
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<tr>
<td></td>
<td>ECE Graduate Orientation</td>
<td></td>
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<tr>
<td></td>
<td><strong>Core Courses</strong></td>
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<td><em>Core Courses</em> are approved in conjunction with the academic committee</td>
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<td>Depth Courses</td>
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<tr>
<td></td>
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<td>Major Courses</td>
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<tr>
<td></td>
<td>Select at least 15 credit hours of EE courses</td>
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</tr>
<tr>
<td></td>
<td>Breadth Course</td>
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<tr>
<td></td>
<td>Select at least three credit hours in different ECE specialties</td>
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<tr>
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<td><strong>Additional Courses</strong></td>
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<td><em>Additional Courses</em> are approved in conjunction with the academic committee to meet 31 total hours</td>
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</tr>
<tr>
<td></td>
<td><strong>Total Hours</strong></td>
<td>31</td>
</tr>
</tbody>
</table>

1 Students are only allowed three credit hours of ECE 633, ECE 634, ECE 650, ECE 695 (for Thesis students).

### Faculty

#### Full Professors

- B. Jayant Baliga
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Computer Engineering (PhD)

Degree Requirements

Degrees earned will be distributed as: "Doctor of Philosophy Computer Engineering" without track specifications.

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<td><strong>Required Courses</strong></td>
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<td>Select a minimum of two 700-level ECE courses</td>
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<td>Select a Master's Track</td>
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<td>Individual Topics In Electrical Engineering</td>
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<td></td>
<td>ECE 834</td>
<td>Individual Studies In Electrical Engineering</td>
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<tr>
<td></td>
<td>ECE 895</td>
<td>Doctoral Dissertation Research</td>
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Master's Track

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<td><strong>Non-NCSU Masters Requirements</strong></td>
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<td>Select six credit hours</td>
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<td>Select six additional credit hours (ECE or other)</td>
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<table>
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<th>Title</th>
<th>Hours</th>
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<tr>
<td></td>
<td><strong>Requirements for Students w/out Master's Degree</strong></td>
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<td>Select 18 ECE credit hours</td>
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<td></td>
<td>Select 12 additional credit hours (ECE or other)</td>
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</tr>
<tr>
<td></td>
<td>Total Hours</td>
<td>30</td>
</tr>
</tbody>
</table>
Faculty

Full Professors

B. Jayant Baliga
Mesut E. Baran
Salah M. A. Bedair
Subhashish Bhattacharya
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Chengying Xu

Assistant Professors

Aydin Aysu
Michael Daniele
Yaoyao Jia
Shih-Chun Lin
### Computer Engineering (Minor)

#### Plan Requirements

**Master's Course Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td>Required Courses</td>
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</tr>
<tr>
<td></td>
<td>Select at least three 500- or 700-level courses approved in conjunction with the academic committee</td>
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<tr>
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</table>

**PhD Course Requirements**

<table>
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<th>Code</th>
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<tbody>
<tr>
<td></td>
<td>Required Courses</td>
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<tr>
<td></td>
<td>Select at least four 500-level or above courses approved in conjunction with the academic committee</td>
<td></td>
</tr>
<tr>
<td><strong>Total Hours</strong></td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

#### Faculty

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---

**Practice/Research/Teaching Professors**

- Gregory Edward Bottomley
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---

**Emeritus Faculty**

- Winser E. Alexander
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- David H. Covington
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Computer Engineering
(Certificate)

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Required Courses</td>
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<tr>
<td>Select a minimum of four ECE courses at the 500- or 700-level</td>
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<tr>
<td>Total Hours</td>
<td></td>
<td>12</td>
</tr>
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</table>

* Courses are limited to Computer Engineering or cross-listed courses. Excludes Special Topics Courses: ECE 592, ECE 791, and ECE 792.

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**Computer Networking**

The Master of Science in computer networking may be earned through the M.S. with thesis option or through the non-thesis option. Either option may be used as preparation for further graduate study or employment in industrial research, development or design environment, although students planning to continue on for a Ph.D. should discuss the option selected with their advisors.

The Master of Science in Computer Networking is also available as an online degree program. This degree has a non-thesis option, does not require on campus attendance, and may be used in preparation for further graduate student or employment in an industrial research, development or design environment. The program is available to USA residents and to United States military personnel serving...
overseas and it is offered online through Engineering Online (https://www.engineeringonline.ncsu.edu/).

Admission Requirements
Admissions criteria will adhere to those currently listed on the program website (https://www.networking.ncsu.edu/).

Master's Degree Requirements
Computer networking core courses constitute 9 of the 30 minimum credit hours. Students take 12 additional credit hours of computer networking courses from one of four currently defined technical concentration areas: network design, network hardware, network software, or networking services. The remaining 9 credit hours may be taken from an approved management concentration sequence, as additional courses in the computer networking technical concentration areas, or as 6 hours of thesis and 3 credit hours from the list of approved computer networking courses. At least 6 of the 30 credits must come from the 700 level, and non-letter graded courses such as individual studies courses may account for a maximum of 3 credit hours.

Degrees
- Computer Networking (MS) (p. 325)

Faculty

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Daryoosh Vashaee
John Victor Veliadis
Ioannis Viniotis
Wenye Wang
Huiyang Zhou
### Assistant Professors
- Aydin Aysu
- Michael Daniele
- Yaoyao Jia
- Shih-Chun Lin
- Spyridon Pavlidis
- Bradley Galloway Reaves
- Muhammad Shahzad
- Wenyuan Tang
- Chau-Wai Wong
- Tianfu Wu

### Practice/Research/Teaching Professors
- Gregory Edward Bottomley
- Laura J. Bottomley
- James Paul Dieffenderfer
- Robert Joseph Evans
- Douglas C. Hopkins
- Steven Wade Hunter
- Steven D. Jackson
- Bongmook Lee
- David Lee Lubkeman
- Robert Dwight Oden Jr.
- Hatice Orun Ozturk
- Elena Nicolescu Veety
- Leonard Wilson White
- Donna G. Yu
- Wensong Yu

### Computer Networking (MS)

#### Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Core Courses</strong></td>
<td>9</td>
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<tr>
<td></td>
<td>Select at least three courses from &quot;Core Courses&quot; listed below</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Theory Courses</strong></td>
<td>3</td>
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<tr>
<td></td>
<td>Select at least one course from &quot;Theory Courses&quot; listed below</td>
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<tr>
<td></td>
<td><strong>Required Courses</strong></td>
<td>4</td>
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<tr>
<td></td>
<td>CSC 600  Computer Science Graduate Orientation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>or ECE 600  ECE Graduate Orientation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Select at least one 700-level course</td>
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<tr>
<td></td>
<td><strong>Additional Courses</strong></td>
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<tr>
<td></td>
<td>&quot;Additional Courses&quot; are approved in conjunction with the academic committee</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Thesis Option Courses</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CSC 630  Master's Independent Study (Non-Thesis Option)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>or ECE 634  Individual Studies In Electrical Engineering</td>
<td></td>
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<tr>
<td></td>
<td>CSC 695  Master's Thesis Research (Thesis Option)</td>
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<td></td>
<td>or ECE 695  Master's Thesis Research</td>
<td></td>
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<tr>
<td></td>
<td><strong>Total Hours</strong></td>
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</table>

### Core Courses

Select at least three courses from the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC/ECE 570</td>
<td>Computer Networks</td>
<td>3</td>
</tr>
<tr>
<td>CSC/ECE 573</td>
<td>Internet Protocols</td>
<td>3</td>
</tr>
</tbody>
</table>
### Theory Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>CSC/ECE 574</td>
<td>Computer and Network Security</td>
<td>3</td>
</tr>
<tr>
<td>CSC/ECE 575</td>
<td>Introduction to Wireless Networking</td>
<td>3</td>
</tr>
<tr>
<td>CSC/ECE 577</td>
<td>Switched Network Management</td>
<td>3</td>
</tr>
</tbody>
</table>

Select a minimum of one course below:

- CSC 505  Design and Analysis Of Algorithms 3
- CSC 565  Graph Theory 3
- CSC 579  Introduction to Computer Performance Modeling 3
  or ECE 579  Introduction to Computer Performance Modeling 3
- CSC/ECE 776  Design and Performance Evaluation of Network Systems and Services 3
- ECE 766  Signal Processing for Communications & Networking 3
- CSC/ECE 777  Telecommunications Network Design 3

### Faculty

#### Full Professors
- B. Jayant Baliga
- Mesut E. Baran
- Salah M. A. Bedair
- Subhashish Bhattacharya
- Alper Yusuf Bozkurt
- Gregory T. Byrd
- Rada Yuryevna Chirkova
- Mo-Yuen Chow
- Huaiyu Dai
- William Rhett Davis
- Alexandra Duel-Hallen
- Michael James Escuti
- Do Young Eun
- Brian Allan Floyd
- Paul D. Franzon
- John J. Grainger
- Edward Grant
- Brian L Hughes
- Iqbal Husain
- Ki Wook Kim
- Frederick Anthony Kish Jr.
- Robert Michael Kolbas
- Hamid Krim
- Ning Lu
- Srdjan Miodrag Lukic
- Leda Lunardi
- Thomas Kenan Miller III
- Veena Misra
- Rainer Frank Mueller
- John F. Muth
- H. Troy Nagle Jr.
- Arne Nilsson
- Omer Oralkan
- Mehmet Cevdet Ozturk
- Harilaos George Perros
- Douglas Stephen Reeves
- Eric Rotenberg
- Mihail Lorin Sichitiu
- Daniel D. Stancil
- Michael B. Steer
- J K Townsend
- James Tuck
- Daryoosh Vashaee
- John Victor Veliadis
- Ioannis Viniotis
- Wenye Wang
- Huiyang Zhou

#### Associate Professors
- Jacob James Adams
- Samuel T. Alexander
- Dror Zeev Baron
- Michela Becchi
- Aranya Chakrabortty
- Alexander G. Dean
- Ismail Guvenc
- Khaled Abdel Hamid Harfoush
- Michael W. Kudenov
Computer Science

The flagship degree is the Ph.D. in Computer Science, which prepares students for leadership positions in academia, industry research labs, and government. Alternatively, the master's degree program offers the Master of Science (thesis) and the Master of Computer Science (non-thesis, available via either distance learning or on-campus enrollment). There is also a Master of Computer Networking degree provided jointly through the Computer Science and the Electrical and Computer Engineering departments (see Computer Networking). Our graduate students also benefit from access to specialized career services. This includes the Corporate & Career Services suite, with opportunities for on-campus interviews, small group career workshops, virtual practice interviews, and individual career advising.

Admissions Requirements

Minimum application requirements include an accredited Bachelor’s degree with at least a B average and, for non-Computer Science majors, strong academic performance in computer science and mathematics. Applicants must also submit the GRE General Test scores and international applicants must provide TOEFL or IELTS scores, as proof of English proficiency. We also ask for a Statement of Purpose to be included with the application as well as three professional or academic recommendations.

Those interested in developing their computer science knowledge and skills, but not ready to commit to a degree program, might consider one of our graduate certificates. Refer to the Graduate Certificate Programs listed in the selection under Computer Science.

Student Financial Support

Financial aid is offered to all admitted PhD students. Masters students are not eligible for graduate assistantships until they have completed their first or second semester with a 3.0 or higher average. However, students in our masters program have the opportunity to secure rewarding summer and winter internships.
For additional information about our degree programs, visit our Future Students (https://www.csc.ncsu.edu/academics/graduate/future-students.php) page.

**Degrees**

- Computer Science (MR) (p. 329)
- Computer Science (MS) (p. 332)
- Computer Science (PhD) (p. 334)
- Computer Science (Certificate) (p. 335)
- Data Science Foundations (Certificate) (p. 336)

**Faculty**

**Full Professors**
Tiffany M. Barnes  
Donald L. Bitzer  
Rada Yuryevna Chirkova  
Jon Doyle  
Rudra Dutta  
Edward F. Gehringer  
Xiaohui Gu  
Christopher Graham Healey  
James C. Lester II  
Timothy James Menzies  
Rainer Frank Mueller  
Harilaos George Perros  
Michael A. Rappa  
Douglas S. Reeves  
Gregg Evan Rothermel  
Georgios N. Rouskas  
Nagiza Faridovna Samatova  
Carla Diane Savage  
Xipeng Shen  
Munindar P. Singh  
Matthias F. M. Stallmann  
Mladen Alan Vouk  
Laurie A. Williams

**Associate Professors**
Dennis R. Bahler  
Min Chi  
William H. Enck  
Vincent W. Freeh  
Khaled Abdel Hamid Harfoush  
Steffen Heber  
Arnav Harish Jhala  
Noboru Matsuda  
K. Anyanwu Ogan  
David L. Roberts  
Donald R. Sheehy  
Ranga Raju Vatsavai  
Benjamin Allen Watson

**Assistant Professors**
Anupam Das  
Guoliang Jin  
Alexandros Kapravelos  
Xu Liu  
Collin Francis Lynch  
Christopher Robin Martens  
John-Paul William Ore  
Christopher Joseph Parnin  
Thomason William Price  
Bradley Galloway Reaves  
Alessandra Scafuro  
Muhammad Shahzad  
Kathryn Thomasset Stolee  
Ruozhou Yu

**Practice/Research/Teaching Professors**
Bita Akram  
Suzanne M. Balik  
Tzvetelina Battestilli  
Ignacio Xavier Dominguez  
Patrick A. Dreher  
Sarah Smith Heckman  
Jamie Allison Jennings
## Computer Science (MR)

### Degree Requirements

Degrees earned will be distributed as: "Master of Computer Science" without track specifications. Students may request a department letter upon successful completion of a track curriculum.

### Master of Computer Science (MR)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td><strong>Core Courses</strong></td>
<td><strong>9</strong></td>
</tr>
<tr>
<td></td>
<td>Select a minimum of three courses from &quot;Core Courses&quot; listed below</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Required Course</strong></td>
<td><strong>1</strong></td>
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<tr>
<td>CSC 600</td>
<td>Computer Science Graduate Orientation</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Electives Courses</strong></td>
<td><strong>12</strong></td>
</tr>
<tr>
<td>CSC 500 or 700-level courses</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Electives or Other Restricted Electives</strong></td>
<td><strong>9</strong></td>
</tr>
<tr>
<td></td>
<td>Take any combination of 500- or 700-level courses in Computer Science, the College of Engineering or the College of Sciences</td>
<td></td>
</tr>
</tbody>
</table>

**Total Hours**

### Core Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC 503</td>
<td>Computational Applied Logic</td>
<td>3</td>
</tr>
<tr>
<td>CSC 505</td>
<td>Design and Analysis Of Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>CSC 512</td>
<td>Compiler Construction</td>
<td>3</td>
</tr>
<tr>
<td>CSC 514</td>
<td>Foundations of Cryptography</td>
<td>3</td>
</tr>
</tbody>
</table>

### Systems Category

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC 501</td>
<td>Operating Systems Principles</td>
<td>3</td>
</tr>
<tr>
<td>CSC 506</td>
<td>Architecture Of Parallel Computers</td>
<td>3</td>
</tr>
<tr>
<td>CSC 510</td>
<td>Software Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CSC 520</td>
<td>Artificial Intelligence I</td>
<td>3</td>
</tr>
<tr>
<td>or CSC 720</td>
<td>Artificial Intelligence II</td>
<td></td>
</tr>
<tr>
<td>CSC 540</td>
<td>Database Management concepts and Systems</td>
<td>3</td>
</tr>
<tr>
<td>CSC 561</td>
<td>Principles of Computer Graphics</td>
<td>3</td>
</tr>
<tr>
<td>CSC 570</td>
<td>Computer Networks</td>
<td>3</td>
</tr>
<tr>
<td>or CSC 573</td>
<td>Internet Protocols</td>
<td></td>
</tr>
<tr>
<td>CSC 574</td>
<td>Computer and Network Security</td>
<td>3</td>
</tr>
</tbody>
</table>

### Data Science Track

#### Master of Computer Science (MR) with Data Science Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC 591</td>
<td>Special Topics In Computer Science (Foundations of Data Science)</td>
<td>4</td>
</tr>
<tr>
<td>CSC 600</td>
<td>Computer Science Graduate Orientation</td>
<td></td>
</tr>
</tbody>
</table>

#### Required Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC 505</td>
<td>Design and Analysis Of Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>CSC 520</td>
<td>Artificial Intelligence I</td>
<td>3</td>
</tr>
<tr>
<td>CSC 522</td>
<td>Automated Learning and Data Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CSC 570</td>
<td>Computer Networks</td>
<td>3</td>
</tr>
<tr>
<td>or CSC 573</td>
<td>Internet Protocols</td>
<td></td>
</tr>
<tr>
<td>CSC 574</td>
<td>Computer and Network Security</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Data Science

Any two courses from the "Algorithmics" Category listed below

#### Data Science Electives

Select three courses from at least two categories listed below

#### Computer Science Core Courses, Graduate Electives or Restricted Electives

Take any combination from the available categories listed below

**Total Hours**

### Algorithmics Category

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>CSC 505</td>
<td>Design and Analysis Of Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>CSC 520</td>
<td>Artificial Intelligence I</td>
<td>3</td>
</tr>
<tr>
<td>CSC 522</td>
<td>Automated Learning and Data Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CSC 570</td>
<td>Computer Networks</td>
<td>3</td>
</tr>
<tr>
<td>or CSC 573</td>
<td>Internet Protocols</td>
<td></td>
</tr>
</tbody>
</table>

Special Topics In Computer Science (Topics include: Graph Data Mining; Spatial and Temporal Data Mining; Machine Learning for User Adaption; Advanced Algorithms; Algorithms for Data Guided Business Intelligence)

Advanced Topics In Computer Science (Topics include: Graph Data Mining; Spatial and Temporal Data Mining; Machine Learning for User Adaption; Advanced Algorithms; Algorithms for Data Guided Business Intelligence)

Advanced Topics In Computer Science (Topics include: Graph Data Mining; Spatial and Temporal Data Mining; Machine Learning for User Adaption; Advanced Algorithms; Algorithms for Data Guided Business Intelligence)

Advanced Topics In Computer Science (Topics include: Graph Data Mining; Spatial and Temporal Data Mining; Machine Learning for User Adaption; Advanced Algorithms; Algorithms for Data Guided Business Intelligence)
### Systems Category

<table>
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<th>Code</th>
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<th>Hours</th>
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<tr>
<td>CSC 541</td>
<td>Advanced Data Structures</td>
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</tr>
<tr>
<td>CSC 547</td>
<td>Cloud Computing Technology</td>
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<tr>
<td>CSC 548</td>
<td>Parallel Systems</td>
<td>3</td>
</tr>
<tr>
<td>CSC 591</td>
<td>Special Topics In Computer Science</td>
<td>1-6</td>
</tr>
<tr>
<td>CSC 724</td>
<td>Advanced Distributed Systems</td>
<td>3</td>
</tr>
<tr>
<td>CSC 742</td>
<td>Database Management Systems</td>
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</tr>
<tr>
<td>CSC 750</td>
<td>Service-Oriented Computing</td>
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### Applications Category

<table>
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<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>CSC 530</td>
<td>Computational Methods for Molecular Biology</td>
<td>3</td>
</tr>
<tr>
<td>CSC 554</td>
<td>Human-Computer Interaction</td>
<td>3</td>
</tr>
<tr>
<td>CSC 555</td>
<td>Social Computing and Decentralized Artificial Intelligence</td>
<td>3</td>
</tr>
<tr>
<td>CSC 561</td>
<td>Principles of Computer Graphics</td>
<td>3</td>
</tr>
<tr>
<td>CSC 591</td>
<td>Special Topics In Computer Science (Topics Include: Spoken Dialogue Systems; Intelligent Game Learning; Educational Data Mining)</td>
<td>1-6</td>
</tr>
</tbody>
</table>

### Master of Computer Science (MR) with Security Track

**Required Courses**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC 574</td>
<td>Computer and Network Security</td>
<td>3</td>
</tr>
<tr>
<td>CSC 600</td>
<td>Computer Science Graduate Orientation</td>
<td>3</td>
</tr>
</tbody>
</table>

**Security Core Courses**

Select three courses from the Security Core Courses listed below

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC 514</td>
<td>Foundations of Cryptography</td>
<td>3</td>
</tr>
<tr>
<td>CSC 515</td>
<td>Software Security</td>
<td>3</td>
</tr>
<tr>
<td>CSC 705</td>
<td>Operating Systems Security</td>
<td>3</td>
</tr>
<tr>
<td>CSC 774</td>
<td>Advanced Network Security</td>
<td>3</td>
</tr>
<tr>
<td>CSC 533</td>
<td>Privacy in the Digital Age</td>
<td>3</td>
</tr>
<tr>
<td>CSC 591</td>
<td>Special Topics In Computer Science (Specifically: Systems Attacks and Defenses)</td>
<td>1-6</td>
</tr>
</tbody>
</table>

### Security Foundation Courses

Select three courses from at least two categories below:

**Systems Foundations**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC 501</td>
<td>Operating Systems Principles</td>
<td>3</td>
</tr>
<tr>
<td>CSC 510</td>
<td>Software Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CSC 540</td>
<td>Database Management concepts and Systems</td>
<td>3</td>
</tr>
<tr>
<td>CSC 548</td>
<td>Parallel Systems</td>
<td>3</td>
</tr>
<tr>
<td>CSC 570</td>
<td>Computer Networks</td>
<td>3</td>
</tr>
<tr>
<td>CSC 573</td>
<td>Internet Protocols</td>
<td>3</td>
</tr>
<tr>
<td>CSC 575</td>
<td>Introduction to Wireless Networking</td>
<td>3</td>
</tr>
<tr>
<td>CSC 712</td>
<td>Software Testing and Reliability</td>
<td>3</td>
</tr>
<tr>
<td>CSC 724</td>
<td>Advanced Distributed Systems</td>
<td>3</td>
</tr>
</tbody>
</table>

**Theory Foundations**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC 505</td>
<td>Design and Analysis Of Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>CSC 512</td>
<td>Compiler Construction</td>
<td>3</td>
</tr>
<tr>
<td>CSC 541</td>
<td>Advanced Data Structures</td>
<td>3</td>
</tr>
<tr>
<td>CSC 565</td>
<td>Graph Theory</td>
<td>3</td>
</tr>
<tr>
<td>CSC 707</td>
<td>Automata, Languages and Computability Theory</td>
<td>3</td>
</tr>
<tr>
<td>CSC 722</td>
<td>Advanced Topics in Machine Learning</td>
<td>3</td>
</tr>
</tbody>
</table>

**Privacy Foundations**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC 522</td>
<td>Automated Learning and Data Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CSC 554</td>
<td>Human-Computer Interaction</td>
<td>3</td>
</tr>
<tr>
<td>CSC 555</td>
<td>Social Computing and Decentralized Artificial Intelligence</td>
<td>3</td>
</tr>
<tr>
<td>CSC 591</td>
<td>Special Topics In Computer Science (Specifically: Foundations of Data Science)</td>
<td>1-6</td>
</tr>
</tbody>
</table>

### Master of Computer Science (MR) with Software Engineering Track

**Required Courses**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC 510</td>
<td>Software Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CSC 600</td>
<td>Computer Science Graduate Orientation</td>
<td>3</td>
</tr>
</tbody>
</table>

**Software Science Courses**

Select three courses from the Software Science Courses listed below

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC 514</td>
<td>Foundations of Cryptography</td>
<td>3</td>
</tr>
<tr>
<td>CSC 515</td>
<td>Software Security</td>
<td>3</td>
</tr>
<tr>
<td>CSC 705</td>
<td>Operating Systems Security</td>
<td>3</td>
</tr>
<tr>
<td>CSC 774</td>
<td>Advanced Network Security</td>
<td>3</td>
</tr>
<tr>
<td>CSC 533</td>
<td>Privacy in the Digital Age</td>
<td>3</td>
</tr>
<tr>
<td>CSC 591</td>
<td>Special Topics In Computer Science (Specifically: Systems Attacks and Defenses)</td>
<td>1-6</td>
</tr>
</tbody>
</table>

**Software Foundations Courses**

Select two courses from the Software Foundations Courses listed below

**Computer Science Core Courses, Graduate Electives or Restricted Electives**

Take any combination from the available categories listed below

**Thesis Research Projects**

Thesis Research Project opportunities will be communicated by faculty

**Total Hours** 27
## Software Science Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>CSC 515</td>
<td>Software Security</td>
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<tr>
<td>CSC 519</td>
<td>DevOps: Modern Software Engineering Practices</td>
<td>3</td>
</tr>
<tr>
<td>CSC 591</td>
<td>Special Topics In Computer Science</td>
<td>1-6</td>
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<tr>
<td>CSC 710</td>
<td>Software Engineering as a Human Activity</td>
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<td>CSC 712</td>
<td>Software Testing and Reliability</td>
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</tr>
<tr>
<td>CSC 791</td>
<td>Advanced Topics In Computer Science</td>
<td>1-6</td>
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**(Specifically: Automated Software Engineering)**

## Software Foundations

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<td>CSC 503</td>
<td>Computational Applied Logic</td>
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<tr>
<td>CSC 512</td>
<td>Compiler Construction</td>
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</tr>
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<td>CSC 517</td>
<td>Object-Oriented Design and Development</td>
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<td>CSC 520</td>
<td>Artificial Intelligence I</td>
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<td>CSC 522</td>
<td>Automated Learning and Data Analysis</td>
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<tr>
<td>CSC 540</td>
<td>Database Management concepts and Systems</td>
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<tr>
<td>CSC 547</td>
<td>Cloud Computing Technology</td>
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<td>CSC 554</td>
<td>Human-Computer Interaction</td>
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<tr>
<td>CSC 750</td>
<td>Service-Oriented Computing</td>
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## Additional Requirements

1. At least 21 hours must be in graduate 500- and 700-level Computer Science courses (note: the Graduate School does not allow 500- and 700-level courses to be taken pass-fail).
2. "Restricted elective" courses may be any graduate letter-graded (500- or 700-level) course within the College of Engineering (including Computer Science), or within the College of Sciences. Exceptions that will "not" count towards graduation:
   - ST 511 (if taken after Spring 2014)
   - special topics courses (including EGR 590) in departments other than Computer Science (if taken after Fall 2012).
3. All Computer Science credits must be at or above the 500 level.
4. To graduate, a student must have at least a 3.00 grade point average (GPA). In addition, for students beginning their degree on or after Fall 2013, the GPA in the group of courses used to satisfy the core course requirement must be at least 3.0 as well. For additional Graduate School requirements regarding degree completion see the Graduate School Handbook (https://grad.ncsu.edu/students/rules-and-regulations/handbook/3-7-masters-degree-summary-of-procedures/).
5. A maximum of four special topics courses (either CSC 591 or CSC 791) may be counted towards graduation (for students beginning Fall 2012 or later).
6. Registration by MCS students in Independent Study (CSC 630) requires approval by the faculty member who will supervise the work, followed by submission to the DGP of a one page written description of the topic and expected outputs, and approval of the DGP. A grade of “S” will require submission of a report describing the work done, and the results obtained. A maximum of three credits of CSC 630 may be counted towards graduation.
7. Minors are neither required nor permitted.

## Faculty

### Full Professors
- Tiffany M. Barnes
- Donald L. Bitzer
- Rada Yuryevna Chirkova
- Jon Doyle
- Rudra Dutta
- Edward F. Gehringer
- Xiaohui Gu
- Christopher Graham Healey
- James C. Lester II
- Timothy James Menzies
- Rainer Frank Mueller
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- Khaled Abdel Hamid Harfoush
- Steffen Heber
- Arnab Harish Jhala
- Noboru Matsuda
- K. Anyanwu Ogan
Computer Science (MS)

**Assistant Professors**

- Anupam Das
- Guoliang Jin
- Alexandros Kapravelos
- Xu Liu
- Collin Francis Lynch
- Christopher Robin Martens
- John-Paul William Ore
- Christopher Joseph Parnin
- Thomason William Price
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- Jamie Allison Jennings
- Shuyin Jiao
- Jason Tyler King
- Jessica Young Schmidt
- David Brian Sturgill

**Emeritus Faculty**

- Wu-show Chou
- Edward Willmore Davis Jr.

---

**Degree Requirements**

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**Core Courses**

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<td>CSC 505</td>
<td>Design and Analysis Of Algorithms</td>
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<td>CSC 512</td>
<td>Compiler Construction</td>
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<td>Foundations of Cryptography</td>
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<td>CSC 565</td>
<td>Graph Theory</td>
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<td>Introduction to Computer Performance Modeling</td>
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<td>CSC 580</td>
<td>Numerical Analysis I</td>
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<td>CSC 501</td>
<td>Operating Systems Principles</td>
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<td>Architecture Of Parallel Computers</td>
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<td>Software Engineering</td>
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<td>CSC 561</td>
<td>Principles of Computer Graphics</td>
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<td>Computer Networks</td>
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<tr>
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<td>CSC 574</td>
<td>Computer and Network Security</td>
<td>3</td>
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</table>
Faculty

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Robert Joseph Fornaro
Thomas Lynn Honeycutt
David Franklin McAllister
Woodrow Robbins
William James Stewart
Alan Lee Tharp
David J. Thuente

Computer Science (PhD)

Doctor of Philosophy in Computer Science (PhD)

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Core Courses

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<td>CSC 503</td>
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<td>CSC 580</td>
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<td>Architecture Of Parallel Computers</td>
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<td>Software Engineering</td>
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<tr>
<td>CSC 520</td>
<td>Artificial Intelligence I</td>
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<tr>
<td>or CSC 720</td>
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<td>CSC 540</td>
<td>Database Management concepts and Systems</td>
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<td>CSC 561</td>
<td>Principles of Computer Graphics</td>
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<tr>
<td>CSC 570</td>
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<td>or CSC 573</td>
<td>Internet Protocols</td>
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</tr>
<tr>
<td>CSC 574</td>
<td>Computer and Network Security</td>
<td>3</td>
</tr>
</tbody>
</table>

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Computer Science (Certificate)

Those interested in developing their computer science knowledge and skills, but not ready to commit to a degree program, might consider the online/on-campus Computer Science Graduate Certificate. Students who complete the certificate will gain in-depth knowledge in Computer Science concepts, methods and tools. Applicants are expected to have an accredited Bachelor of Science degree in Computer Science or any sciences or engineering discipline. A minimum GPA of 3.0, on a 4-point scale, is also expected. The GRE is not required for admission.

Financial aid is not available through our program. Interested applicants will need to review other means of assistance, if needed.

For additional information, visit our Certificate Program in Computer Science (https://www.csc.ncsu.edu/academics/graduate/degrees/cs.php) page.

Certificate in Computer Science

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Computer Science Foundations Track

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**Networking Track**

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<td>CSC 574</td>
<td>Computer and Network Security</td>
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<tr>
<td>CSC 575</td>
<td>Introduction to Wireless Networking</td>
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<td>CSC 577</td>
<td>Switched Network Management</td>
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<tr>
<td>CSC 591</td>
<td>Special Topics In Computer Science (Topics Include: Internet of Things Analytics; Software Defined Networking; Internet of Things: Application and Implementation; Internet of Things: A Primer; Network Design and Management; Network Science;)</td>
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**Security/Privacy Track**

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**Systems Track**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC 501</td>
<td>Operating Systems Principles</td>
<td></td>
</tr>
<tr>
<td>CSC 548</td>
<td>Parallel Systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Core Courses</strong></td>
<td><strong>3-6</strong></td>
</tr>
<tr>
<td>CSC 506</td>
<td>Architecture Of Parallel Computers</td>
<td></td>
</tr>
<tr>
<td>CSC 512</td>
<td>Compiler Construction</td>
<td></td>
</tr>
<tr>
<td>CSC 547</td>
<td>Cloud Computing Technology</td>
<td></td>
</tr>
<tr>
<td>CSC 568</td>
<td>Enterprise Storage Architecture</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Elective Courses</strong></td>
<td><strong>6-9</strong></td>
</tr>
<tr>
<td>CSC 591</td>
<td>Special Topics In Computer Science</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total Hours</strong></td>
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</tr>
</tbody>
</table>

**Data Science Foundations (Certificate)**

This online/on-campus program is well suited for working professionals who have some formal training in Computer Science and/or Statistics and wish to acquire a basic understanding of data science. Applicants are expected to have an accredited Bachelor of Science degree in either a sciences or engineering discipline, Computer Science or Statistics. A minimum GPA of 3.0, on a 4-point scale, is also expected. The GRE is not required for admission.

Financial aid is not available through our program. Interested applicants will need to review other means of assistance, if needed.

For additional information, visit our Certificate Program in Data Science Foundations (https://www.csc.ncsu.edu/academics/graduate/degrees/dsf.php) page.

**Certificate in Data Science Foundations**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>CSC 505</td>
<td>Design and Analysis Of Algorithms</td>
<td></td>
</tr>
<tr>
<td>CSC 541</td>
<td>Advanced Data Structures</td>
<td></td>
</tr>
<tr>
<td>ST 517</td>
<td>Applied Statistical Methods I</td>
<td></td>
</tr>
<tr>
<td>ST 563</td>
<td>Introduction to Statistical Learning</td>
<td></td>
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<td><strong>Total Hours</strong></td>
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**Required Courses**

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<tr>
<td>CSC 522</td>
<td>Automated Learning and Data Analysis</td>
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<tr>
<td>CSC 540</td>
<td>Database Management concepts and Systems</td>
<td></td>
</tr>
<tr>
<td>CSC 591</td>
<td>Special Topics In Computer Science (Topics include: Data Driven Business Intelligence; Graph Data Mining; Spatial and Temporal Data Mining)</td>
<td></td>
</tr>
<tr>
<td>ST 540</td>
<td>Applied Bayesian Analysis</td>
<td></td>
</tr>
</tbody>
</table>
Students must take at least one ST and one CSC course
Credit cannot be given for both CSC 522 Automated Learning and Data Analysis and ST 563 Introduction to Statistical Learning

Faculty

Full Professors
Tiffany M. Barnes
Donald L. Bitzer
Rada Yuryevna Chirkova
Jon Doyle
Rudra Dutta
Edward F. Gehringer
Xiaohui Gu
Christopher Graham Healey
James C. Lester II
Timothy James Menzies
Rainer Frank Mueller
Harilaos George Perros
Michael A. Rappa
Douglas S. Reeves
Gregg Evan Rothermel
Georgios N. Rouskas
Nagiza Faridovna Samatova
Carla Diane Savage
Xipeng Shen
Munindar P. Singh
Matthias F. M. Stallmann
Mladen Alan Vouk
Laurie A. Williams

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Guoliang Jin
Alexandros Kapravelos
Xu Liu
Collin Francis Lynch
Christopher Robin Martens
John-Paul William Ore
Christopher Joseph Parnin
Thomason William Price
Bradley Galloway Reaves
Alessandra Scafuro
Muhammad Shahzad
Kathryn Thomasset Stolee
Ruozhou Yu

Practice/Research/Teaching Professors
Bita Akram
Suzanne M. Balik
Tzvetelina Battestilli
Ignacio Xavier Dominguez
Patrick A. Dreher
Sarah Smith Heckman
Jamie Allison Jennings
Shuyin Jiao
Jason Tyler King
Jessica Young Schmidt
David Brian Sturgill
Electric Power Systems Engineering

The Master of Science in Electric Power Systems Engineering (MS-EPSE) gives students a thorough understanding of the tools, methods, and practice of electric power engineering. It is both focused and practical in its orientation, with the goal of providing an education that is directly applicable to a career in industry.

The MS-EPSE degree is an accelerated program suitable for a new or recent graduate, as well as experienced professionals who want to receive the necessary retraining to change careers. The program is offered both in-class and as an online degree.

Admission Requirements

Students must have a bachelor's degree from an accredited college or university in electrical engineering with an overall GPA of at least 3.0. Students who do not have a bachelor's degree from an accredited college or university in electrical engineering must satisfy:

1. Completion of the following ECE courses (or electrical engineering courses equivalent to ECE 200, 211, 220, 301, and 303.
2. Applicants must have also completed the following courses or equivalent courses: three semesters of calculus, one semester of probability/statistics, two semesters of physics, and one semester of chemistry.

GRE scores within the last four years of the date of anticipated admission. Guideline for minimal GRE percentile scores are 70 percentile verbal, 90 percentile quantitative, and 50 percentile analytical or writing. GRE scores for students who are graduates from NCSU may be waived.

Three strong recommendations from persons able to comment on the applicant's qualifications for graduate study.

All non-US citizen applicants (i.e., non-resident aliens and permanent residents) must demonstrate proficiency in English at a level necessary to be successful in a graduate program at NC State University. The TOEFL or IELTS test must have been taken within two years of the date of anticipated admission. On the TOEFL iBT, students must have a minimum score of 18 on the Listening, Reading and Writing sections, 19 on the Speaking section, and a minimum Overall Band Score of 6.5. Scores on previous versions of the TOEFL and IELTS are considered with the same qualitative standard. The TOEFL and IELTS tests will be waived if the applicant is a citizen of a country where English is an official language and the language of instruction in higher education or if the applicant has successfully completed at least one year of full-time study in a degree program at a four-year US college or university.

TOEFL - institution code 5496; department code 66.
GRE - institution code 5496; department code 1203.

Master’s Degree Requirements

The MS-EPSE program requires 30 credit hours of graduate coursework. Twenty-seven credits include four core electric power engineering courses; two interdisciplinary courses on power electronics, data communications, cyber security and environmental issues associated with electric power systems; professional skills training on project management, communication skills, and the business aspects of electric power utilities, and solid hands-on experience through laboratories and a capstone project. This program provides a one-to-one interaction with industry partners.

Student Financial Support: Student scholarships are available through an application process. Please contact the program manager for further information.

Other Relevant Information

To further promote integration of concepts and provide hands on experience, the program includes a capstone project. The project will be an industry sponsored smart grid application, and the students will be asked to prototype a method or device and implement it on the 1 MW Green Hub available at the FREEDM Systems Center for smart grid applications.

Degrees

• Electric Power Systems Engineering (MS) (p. 339)
• Electric Power Systems Engineering (MS): Wide Bandgap Power Electronics Concentration (p. 339)

Full Professors

Mesut E. Baran
Subhashish Bhattacharya
Aranya Chakrabortty
Iqbal Husain
Ning Lu
Srdjan M. Lukic
Daryoosh Vashaee
John Victor Veliadis
Wenyue Wang

Associate Professors

Zeljko Pantic
Assistant Professors
Spyridon Pavlidis
Wenyuan Tang

Practice/Research/Teaching Professors
Douglas C. Hopkins
David Lee Lubkeman
Leonard Wilson White
Wensong Yu

Electric Power Systems Engineering (MS)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
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<tr>
<td></td>
<td><strong>Core Courses</strong></td>
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</tr>
<tr>
<td>ECE 550</td>
<td>Power System Operation and Control</td>
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</tr>
<tr>
<td>ECE 551</td>
<td>Smart Electric Power Distribution Systems</td>
<td></td>
</tr>
<tr>
<td>ECE 552</td>
<td>Renewable Electric Energy Systems</td>
<td></td>
</tr>
<tr>
<td>ECE 583</td>
<td>Electric Power Engineering Practicum I</td>
<td></td>
</tr>
<tr>
<td>ECE 584</td>
<td>Electric Power Engineering Practicum II</td>
<td></td>
</tr>
<tr>
<td>ECE 534</td>
<td>Power Electronics</td>
<td></td>
</tr>
<tr>
<td>or ECE 587</td>
<td>Power System Transients Analysis</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Elective Courses</strong></td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Select a minimum of four of the following:</td>
<td></td>
</tr>
<tr>
<td>ECE 516</td>
<td>System Control Engineering</td>
<td></td>
</tr>
<tr>
<td>ECE 534</td>
<td>Power Electronics</td>
<td></td>
</tr>
<tr>
<td>ECE 535</td>
<td>Design of Electromechanical Systems</td>
<td></td>
</tr>
<tr>
<td>ECE 554</td>
<td>Electric Motor Drives</td>
<td></td>
</tr>
<tr>
<td>ECE 581</td>
<td>Electric Power System Protection</td>
<td></td>
</tr>
<tr>
<td>ECE 585</td>
<td>The Business of the Electric Utility Industry</td>
<td></td>
</tr>
<tr>
<td>ECE 586</td>
<td>Communication and SCADA Systems for Smart Grid</td>
<td></td>
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<tr>
<td>ECE 587</td>
<td>Power System Transients Analysis</td>
<td></td>
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<tr>
<td>ECE 589</td>
<td>Solid State Solar and Thermal Energy Harvesting</td>
<td></td>
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<tr>
<td>ECE 592</td>
<td>Special Topics In Electrical Engineering</td>
<td></td>
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<tr>
<td>ECE 726</td>
<td>Advanced Feedback Control</td>
<td></td>
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<tr>
<td>ECE 732</td>
<td>Dynamics and Control of Electric Machines</td>
<td></td>
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<td>ECE 736</td>
<td>Power System Stability and Control</td>
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<tr>
<td>ECE 753</td>
<td>Computational Methods for Power Systems</td>
<td></td>
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<tr>
<td>CE 578</td>
<td>Energy and Climate</td>
<td></td>
</tr>
<tr>
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<td><strong>Total Hours</strong></td>
<td>30</td>
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</tbody>
</table>

Full Professors
Mesut E. Baran
Subhashish Bhattacharya
Aranya Chakraborty

Associate Professors
Zeljko Pantic

Assistant Professors
Spyridon Pavlidis
Wenyuan Tang

Practice/Research/Teaching Professors
Douglas C. Hopkins
David Lee Lubkeman
Leonard Wilson White
Wensong Yu

Electric Power Systems Engineering (MS): Wide Bandgap Power Electronics Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Core Curriculum</strong></td>
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<tr>
<td>ECE 534</td>
<td>Power Electronics</td>
<td></td>
</tr>
<tr>
<td>ECE 553</td>
<td>Semiconductor Power Devices</td>
<td></td>
</tr>
<tr>
<td>ECE 592</td>
<td>Special Topics In Electrical Engineering</td>
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</tr>
<tr>
<td>ECE 583</td>
<td>Electric Power Engineering Practicum I</td>
<td></td>
</tr>
<tr>
<td>ECE 792</td>
<td>Special Topics In Electrical Engineering</td>
<td></td>
</tr>
<tr>
<td>ECE 584</td>
<td>Electric Power Engineering Practicum II</td>
<td></td>
</tr>
<tr>
<td>or ECE 592</td>
<td>Special Topics In Electrical Engineering</td>
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</tr>
<tr>
<td></td>
<td><strong>Wide Band Gap Concentration</strong></td>
<td>12</td>
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<tr>
<td>ECE 511</td>
<td>Analog Electronics</td>
<td></td>
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<tr>
<td>ECE 516</td>
<td>System Control Engineering</td>
<td></td>
</tr>
<tr>
<td>ECE 533</td>
<td>Power Electronics Design &amp; Packaging</td>
<td></td>
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<tr>
<td>ECE 536</td>
<td>Digital Control System Projects</td>
<td></td>
</tr>
<tr>
<td>ECE 552</td>
<td>Renewable Electric Energy Systems</td>
<td></td>
</tr>
<tr>
<td>ECE 554</td>
<td>Electric Motor Drives</td>
<td></td>
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<tr>
<td>ECE 561</td>
<td>Embedded System Design</td>
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<tr>
<td>ECE 732</td>
<td>Dynamics and Control of Electric Machines</td>
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<tr>
<td>ECE 734</td>
<td>Power Management Integrated Circuits</td>
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</table>
Electrical Engineering

The Master of Science in Electrical Engineering may be earned with thesis option or non-thesis option. Either option may be used as preparation for further graduate study or employment in industrial research, development or design.

Also a strong Ph.D. program is available for those who wish to pursue a research and/or teaching career in Industry, Government or Academia.

Admissions Requirements

Admission to the M.S. program requires a B.S. in electrical engineering, computer engineering or computer science, and an overall undergraduate GPA of at least 3.0. For non-native English speakers, the minimum acceptable TOEFL score for admission to the M.S. program is 90 (minimum 18 in each area, with minimum of 19 on Speaking). The GRE is required for all programs of study but may be waived upon request for graduates from US Universities (see below). Admission is further limited by available room in the elected program of study. Meeting the above minimum requirements alone does not guarantee admission.

Applicants to the Master’s and PhD programs who do not have a Bachelor’s degree in Electrical Engineering or Computer Engineering, but have a closely related degree from an accredited college or university, Bachelor’s degree in Electrical Engineering or Computer Engineering, but meeting the minimum requirements as given above does not guarantee admission.

Master’s Degree Requirements

Thirty-one (31) credit hours; a thesis is optional. Students must have at least 21 hours of ECE courses that cover at least three specialty areas and have at least three credit hours of advanced-level (700-level) ECE courses. Students electing the Option B non-thesis option must meet core course requirements; have ECE courses that cover at least three specialty areas and have at least three credit hours of 700-level ECE courses.

The Master’s degree is offered online through Engineering OnLine. Applications to these MS on-line programs are through the ECE Department and all students must comply with ECE program requirements.

Doctoral Degree Requirements

Approximately 54 credit hours are required beyond the M.S. degree or 72 credit hours beyond the B.S. degree. For those with an NCSU MS degree in our department, no additional courses are required. For those with an NCSU MS degree in another department, 6 credit hours are required in our department. For those with a non NCSU MS degree, 12 credit hours of coursework are required. For those with only a Bachelors degree 30 credit hours of coursework are required. The remaining credit hours are research.

All international applicants from non English speaking countries must submit TOEFL scores. The TOEFL must have been taken within two years of the date of anticipated admission. On the TOEFL iBT, students must have a minimum of 18 on each section of the test with a minimum total of 90. Scores on previous versions of the TOEFL are considered with the same qualitative standard. On the IELTS, we require a minimum score of 6.5 in each section. This requirement also applies to US citizens whose principal language of instruction has not been English (for example, most applicants from Puerto Rico and the Virgin Islands).

All international applicants from non English speaking countries must submit TOEFL scores. The TOEFL must have been taken within two years of the date of anticipated admission. On the TOEFL iBT, students must have a minimum of 18 on each section of the test with a minimum total of 90. Scores on previous versions of the TOEFL are considered with the same qualitative standard. On the IELTS, we require a minimum score of 6.5 in each section. This requirement also applies to US citizens whose principal language of instruction has not been English (for example, most applicants from Puerto Rico and the Virgin Islands).

GRE scores within the last four years of the date of anticipated admission. Guideline for minimal GRE percentile scores are 70 percentile verbal, 90 percentile quantitative, and 50 percentile analytical or writing. GRE scores for students who are graduates from NCSU may be waived. They also might be waived for graduates from US ABET accredited programs with good GPAs.

Admission to the Ph.D. program requires a B.S. or M.S. in electrical engineering, computer engineering or computer science with an expectation of an overall GPA of at least 3.25. The minimum acceptable TOEFL score for admission to the Ph.D. program is 90 (minimum 18 in each area, with minimum of 19 on Speaking). The GRE is required for all programs of study but might be waived for NCSU graduates or graduates from other US ABET accredited schools with good GPAs. Admission is further limited by available room in the elected program of study, and

Student Financial Support

The department offers financial support to qualified students in the form of teaching assistantships, research assistantships, and fellowships. These sources of support generally include coverage of tuition and fees.

Degrees

- Electrical Engineering (MS) (p. 342)
- Electrical Engineering (PhD) (p. 344)
- Electrical Engineering (Minor) (p. 346)
- 5G Technologies (Certificate) (p. 348)
- ASIC Design & Verification (Certificate) (p. 350)
- Electrical Engineering (Certificate) (p. 352)
- Nano-Systems Engineering (Certificate) (p. 354)

Faculty

Full Professors

David E Aspnes
B. Jayant Baliga
Mesut E. Baran
Salah M. A. Bedair
Subhashish Bhattacharya
Donald L. Bitzer
Alper Yusuf Bozkurt
Gregory T Byrd
Rada Yuryevna Chirkova
Mo-Yuen Chow
Huaiyu Dai
William Rhett Davis
Alexandra Duel-Hallen
Michael James Escuti
Do Young Eun
Brian Allan Floyd
Paul D. Franzon
Edward F. Gehringer
John J. Grainger
Edward Grant
Brian L Hughes
Iqbal Husain
Ki Wook Kim
Frederick Anthony Kish Jr.
Robert Michael Kolbas
Hamid Krim
Ning Lu
Srdjan Miodrag Lukic
Leda Lunardi
Thomas Kenan Miller III
Veena Misra
Rainer Frank Mueller
John F. Muth
H. Troy Nagle Jr.
Jagdish Narayan
Arne Nilsson
Omer Oralcan
Mehmet Cevdet Ozturk
Harilaos George Perros
Douglas Stephen Reeves
Eric Rotenberg
Georgios Rouskas
Xipeng Shen
Mihail Lorin Sichitiu
Zlatko Sitar
Matthias F. M. Stallmann
Daniel D. Stancil
Michael B. Steer
J. K. Townsend
Henry J. Trussell
James Tuck
Daryoosh Vashaee
John Victor Veliadis
Ioannis Viniotis
Mladen Alan Vouk
Wenye Wang
Fen Wu
Huixiang Zhou

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Samuel T. Alexander
Dror Zeev Baron
Michela Becchi
Aranya Chakrabortty
Alexander G. Dean
Ismail Guvenc
Khaled Abdel Hamid Harfoush
Michael W. Kudenov
David S. Lalush
Edgar Lobaton
Zeljko Pantic
David Ricketts
Cranos M. Williams
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Michael Daniele
Caterina M. Gallippi
Yaoyao Jia
Shih-Chun Lin
Spyridon Pavlidis
Bradley Galloway Reaves
Muhammad Shahzad
Wenyuan Tang
Chau-Wai Wong
Tianfu Wu

Practice/Research/Teaching Professors
Gregory Edward Bottomley
Laura J Bottomley
James Paul Dieffenderfer
Robert Joseph Evans
Rachana Ashok Gupta
Seth E. Hollar
Douglas C. Hopkins
Andrew J. Rindos III
Steven D. Jackson
Robert Dwight Oden Jr.
Bongmook Lee
David Lee Lubkeman
Hatice Orun Ozturk
Tania Milkova Paskova
Elena Nicolescu Veety
Leonard Wilson White
Donna G Yu
Wensong Yu

Professors Emeritus
George F. Bland
John R. Hauser

Adjunct Faculty
Mihail Devetsikiotis
Yan Solihin

Electrical Engineering (MS)

Degree Requirements
Degrees earned will be distributed as: "Master of Science in Electrical Engineering" without specialty or option specifications.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Required Courses</td>
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</tr>
<tr>
<td>ECE 600</td>
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<tr>
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<tr>
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<td>&quot;Core Courses&quot; are approved in conjunction with the academic committee</td>
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<tr>
<td></td>
<td>Depth Courses</td>
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<tr>
<td></td>
<td>Select at least three credit hours of 700-level courses</td>
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</tr>
<tr>
<td></td>
<td>Major Courses</td>
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<tr>
<td></td>
<td>Select at least 15 credit hours of EE courses</td>
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</tr>
<tr>
<td></td>
<td>Breadth Course</td>
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</tr>
<tr>
<td></td>
<td>Select at least three credit hours in different ECE specialties</td>
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<tr>
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<td>Additional Courses</td>
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</tr>
<tr>
<td></td>
<td>&quot;Additional Courses&quot; are approved in conjunction with the academic committee to meet 31 total hours</td>
<td></td>
</tr>
<tr>
<td></td>
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<td>31</td>
</tr>
</tbody>
</table>

1 Students are only allowed three credit hours of ECE 633, ECE 634, ECE 650, ECE 695 (for Thesis students).

Faculty

Full Professors
David E Aspnes
B. Jayant Baliga
Mesut E. Baran
Salah M. A. Bedair
Subhashish Bhattacharya
Donald L. Bitzer
Alper Yusuf Bozkurt

Wilbur Carroll Peterson
Winser E. Alexander PhD
Tildon H Glisson Jr
Michael A. Littlejohn
Carlton M. Osburn
Sarah Ann Rajala
Wesley E. Snyder
Gregory T Byrd
Rada Yuryevna Chirkova
Mo-Yuen Chow
Huiyai Dai
William Rhett Davis
Alexandra Duel-Hallen
Michael James Escuti
Do Young Eun
Brian Allan Floyd
Paul D. Franzon
Edward F. Gehringer
John J. Grainger
Edward Grant
Brian L Hughes
Iqbal Husain
Ki Wook Kim
Frederick Anthony Kish Jr.
Robert Michael Kolbas
Hamid Krim
Ning Lu
Srdjan Miodrag Lukic
Leda Lunardi
Thomas Kenan Miller III
Veena Misra
Rainer Frank Mueller
John F. Muth
H. Troy Nagle Jr.
Jagdish Narayan
Aranya Chakrabortty
Alexander G. Dean
Ismail Guvenc
Khaled Abdel Hamid Harfoush
Mladen Alan Vouk
Wenyue Wang
Fen Wu
Huiyang Zhou

Associate Professors
Jacob James Adams
Samuel T. Alexander
Dror Zeev Baron
Michela Becchi
Aranya Chakrabortty
Alexander G. Dean
Ismail Guvenc
Khaled Abdel Hamid Harfoush
Michael W. Kudenov
David S. Lalush
Edgar Lobaton
Zeljko Pantic
David Ricketts
Cranos M. Williams

Assistant Professors
Aydin Aysu
Michael Daniele
Caterina M. Gallippi
### Practice/Research/Teaching Professors

- Yaoyao Jia
- Shih-Chun Lin
- Spyridon Pavlidis
- Bradley Galloway Reaves
- Muhammad Shahzad
- Wenyuan Tang
- Chau-Wai Wong
- Tianfu Wu

### Professors Emeritus

- George F. Bland
- John R. Hauser
- Wilbur Carroll Peterson
- Winser E. Alexander PhD
- Tildon H Glisson Jr
- Michael A. Littlejohn
- Carlton M. Osburn
- Sarah Ann Rajala
- Wesley E. Snyder

### Adjunct Faculty

- Mihail Devetsikiotis
- Yan Solihin

### Electrical Engineering (PhD)

#### Degree Requirements

Degrees earned will be distributed as: "Doctor of Philosophy Electrical Engineering" without track specifications.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
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<tr>
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<tr>
<td>ECE 600</td>
<td>ECE Graduate Orientation</td>
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<td>Select a minimum of two 700-level ECE courses</td>
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<tr>
<td>ECE 833</td>
<td>Individual Topics In Electrical Engineering</td>
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<tr>
<td>ECE 834</td>
<td>Individual Studies In Electrical Engineering</td>
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<tr>
<td>ECE 895</td>
<td>Doctoral Dissertation Research</td>
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Total Hours: 72

#### Master's Tracks

- **Non-NCSU Masters Requirements**
  - Select six credit hours: 6
  - Select six additional credit hours (ECE or other): 6
  Total Hours: 12

#### Requirements for Students w/out Master's Degree

- Select 18 ECE credit hours: 18
- Select 12 additional credit hours (ECE or other): 12
  Total Hours: 30

### Faculty

#### Full Professors

- David E Aspnes
- B. Jayant Baliga
- Mesut E. Baran
- Salah M. A. Bedair
- Subhashish Bhattacharya
- Donald L. Bitzer
- Alper Yusuf Bozkurt
- Gregory T Byrd
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- Spyridon Pavlidis
- Bradley Galloway Reaves
- Muhammad Shahzad
- Wenyuan Tang
- Chau-Wai Wong
- Tianfu Wu
- Gregory Edward Bottomley
- Laura J Bottomley
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- Bongmook Lee
- David Lee Lubkeman
- Hatice Orun Ozturk
- Tania Milkova Paskova
- Elena Nicolescu Veety
- Leonard Wilson White
- Donna G Yu
- Wensong Yu

### Professors Emeritus

- George F. Bland
- John R. Hauser
- Wilbur Carroll Peterson
- Winser E. Alexander PhD
- Tildon H Glisson Jr
- Michael A. Littlejohn
- Carlton M. Osburn

### Masters Course Requirements

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<td>Select at least three 500- or 700-level courses approved in conjunction with the academic committee</td>
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### PhD Course Requirements

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<td>Select at least four 500-level or above courses approved in conjunction with the academic committee</td>
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<td>Total Hours</td>
<td>12</td>
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</table>

### Adjunct Faculty

- Mihail Devetsikiotis
- Yan Solihin

### Electrical Engineering (Minor)

### Faculty

#### Full Professors

- David E Aspnes
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Plan Requirements

Students may choose from the course tracks below to complete coursework within a focus area.

Certificates earned will be distributed as: "Graduate Certificate in 5G Technologies" without focus area track specifications.

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<thead>
<tr>
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<th>Hours</th>
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<tbody>
<tr>
<td>ECE 592</td>
<td>Special Topics In Electrical Engineering (LTE and 5G Communications)</td>
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Select a course sequence under any track area listed under "Focus Area Tracks"

Total Hours 12

Focus Area Tracks

Circuits

Course Sequence

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<tr>
<td>ECE 511</td>
<td>Analog Electronics</td>
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<td>ECE 712</td>
<td>Integrated Circuit Design for Wireless Communications</td>
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</tr>
<tr>
<td>ECE 792</td>
<td>Special Topics In Electrical Engineering (Design of Millimeter-Wave Circuits and Systems)</td>
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Microwave Systems and Applied EM

Course Sequence

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<tr>
<td>ECE 524</td>
<td>Radio System Design</td>
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<tr>
<td>ECE 549</td>
<td>RF Design for Wireless</td>
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<tr>
<td>ECE 592</td>
<td>Special Topics In Electrical Engineering (Antennas and Arrays)</td>
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Communications

Course Sequence

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<th>Code</th>
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<tr>
<td>ECE 575</td>
<td>Introduction to Wireless Networking</td>
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<td>ECE 766</td>
<td>Signal Processing for Communications &amp; Networking</td>
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<tr>
<td>ECE 570</td>
<td>Computer Networks</td>
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</tbody>
</table>

Faculty

Full Professors

David E. Aspnes
B. Jayant Baliga
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<tr>
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<td></td>
</tr>
</tbody>
</table>

### Associate Professors

| Jacob James Adams                      |                        |
| Samuel T. Alexander                    |                        |
| Dror Zeev Baron                        |                        |
| Michela Becchi                         |                        |
| Aranya Chakrabortty                    |                        |
| Alexander G. Dean                      |                        |
| Ismail Guvenc                          |                        |
| Khaled Abdel Hamid Harfous             |                        |
| Michael W. Kudenov                     |                        |
| David S. Lalush                        |                        |
| Edgar Lobaton                          |                        |
| Zeljko Pantic                          |                        |
| David Ricketts                         |                        |
| Cranos M. Williams                    |                        |

### Assistant Professors

| Aydin Aysu                              |                        |
| Michael Daniele                         |                        |
| Caterina M. Gallippi                    |                        |
 ASIC Design & Verification (Certificate)

Practice/Research/Teaching Professors
Gregory Edward Bottomley
Laura J Bottomley
James Paul Dieffenderfer
Robert Joseph Evans
Rachana Ashok Gupta
Seth E. Hollar
Douglas C. Hopkins
Andrew J. Rindos III
Steven D. Jackson
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Donna G Yu
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George F. Bland
John R. Hauser
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Tildon H Glisson Jr
Michael A. Littlejohn

Carlton M. Osburn
Sarah Ann Rajala
Wesley E. Snyder

Adjunct Faculty
Mihai Devetsikiotis
Yan Solihin

ASIC Design & Verification (Certificate)

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<tr>
<td>ECE 564</td>
<td>ASIC and FPGA Design with Verilog</td>
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<tr>
<td>ECE 745</td>
<td>ASIC Verification</td>
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<tr>
<td>ECE 748</td>
<td>Advanced Functional Verification with Universal Verification Methodology</td>
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<tr>
<td>ECE 546</td>
<td>VLSI Systems Design</td>
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<tr>
<td>or ECE 720</td>
<td>Electronic System Level and Physical Design</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 12

Faculty
Full Professors
David E Aspnes
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Muhammad Shahzad
Wenyuan Tang
Chau-Wai Wong
Tianfu Wu

**Practice/Research/Teaching Professors**
Gregory Edward Bottomley
Laura J Bottomley
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<td>Select a minimum of four ECE courses at the 500- or 700-level</td>
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<tr>
<td>Total Hours</td>
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Courses must be Electrical Engineering or cross-listed as either. Excludes Special Topics Courses: ECE 592, ECE 791, and ECE 792.

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Nano-Systems Engineering (Certificate)

Plan Requirements

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<tr>
<td>ECE/CHE 568</td>
<td>Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems</td>
<td>3</td>
</tr>
<tr>
<td>MBA 576</td>
<td>Technology Entrepreneurship and Commercialization I</td>
<td>3</td>
</tr>
<tr>
<td>Micro-Machined Sensors and Actuators</td>
<td>Select six credit hours of the following Core Electives:</td>
<td>6</td>
</tr>
<tr>
<td>BME 590</td>
<td>Special Topics in Biomedical Engineering (Nanobiotechnology)</td>
<td></td>
</tr>
<tr>
<td>BME 590</td>
<td>Special Topics in Biomedical Engineering (Biosensors)</td>
<td></td>
</tr>
<tr>
<td>CHE 596</td>
<td>Special Topics in Chemical Engineering (Nanoscale films and surfaces)</td>
<td></td>
</tr>
<tr>
<td>CHE 596</td>
<td>Special Topics in Chemical Engineering (Colloid Science and Nano-Scale Engineering)</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 15

Renewable Electric Energy Systems (Certificate)

The Graduate Certificate in Renewable Electric Energy Systems provides graduate students with the opportunity to develop expertise in renewable electric energy systems and advanced electric power grid technology in addition to their major area of graduate study.

Admissions

Applicants with appropriate background must meet one of the three following requirements:

* be a graduate of an accredited four-year college or university, and have a GPA of at least 3.0 on a 4-point scale in their last 60 credit hours of undergraduate study;
* be a degree student in good standing in an NC State University graduate program; or
* have a Master’s degree in a related field of study.

A student may obtain more than one graduate certificate in a different field. Each certificate must have at least nine (9) credit hours that are unique to it.
Requirements

The Graduate Certificate in Renewable Electric Energy Systems requires a minimum of 12 hours, including one 3-hour core course and 9 credit hours of electives to be selected from a list that contains relevant courses for the certificate. Students must maintain a minimum overall GPA of B (3.0).

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 552</td>
<td>Renewable Electric Energy Systems</td>
<td>3</td>
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<tr>
<td>Select three of the following Advanced Courses:</td>
<td></td>
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<tr>
<td>ECE 550</td>
<td>Power System Operation and Control</td>
<td></td>
</tr>
<tr>
<td>ECE 581</td>
<td>Electric Power System Protection</td>
<td></td>
</tr>
<tr>
<td>ECE 534</td>
<td>Power Electronics</td>
<td></td>
</tr>
<tr>
<td>ECE 551</td>
<td>Smart Electric Power Distribution Systems</td>
<td></td>
</tr>
<tr>
<td>ECE 535</td>
<td>Design of Electromechanical Systems</td>
<td></td>
</tr>
<tr>
<td>ECE 585</td>
<td>The Business of the Electric Utility Industry</td>
<td></td>
</tr>
<tr>
<td>ECE 589</td>
<td>Solid State Solar and Thermal Energy Harvesting</td>
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<tr>
<td>ECE 738</td>
<td>Power System Stability and Control</td>
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</tbody>
</table>

Total Hours 12

Engineering

The Master of Engineering (MR) distance education degree program is designed for students with an undergraduate degree in engineering or a closely related field who wish to pursue a graduate degree in engineering. The program was created to address the needs of students whose schedule or location does not allow on-campus study, working professionals who wish to obtain an advanced degree or those who wish to change fields within engineering.

Convenience and flexibility are the key advantages of this interdisciplinary degree program that can be earned totally at a distance with no GRE, thesis, or final oral exam requirements. The Master of Engineering degree allows students to choose from different subplans from the many disciplines of engineering within the College of Engineering or to design their own degree plans that best meet their career or employment goals. For additional information please look at our Master of Engineering (https://www.engr.ncsu.edu/academics/grad/degrees/master-of-engineering/) program site.

The program does not offer financial assistance. The Office of Scholarships and Financial Aid (OSFA) (https://studentservices.ncsu.edu/your-money/financial-aid/) assists students in applying for and securing financial assistance for educational expenses. OSFA can help with all questions about financial aid, and guide students to available scholarships, grants, and loans.

Degrees

- Engineering (MR) (p. 356)
- Engineering (MR): Aerospace Engineering Concentration (p. 356)
- Engineering (MR): Chemical Engineering Concentration (p. 356)
- Engineering (MR): Computer Engineering Concentration (p. 356)
- Engineering (MR): Computer Science Concentration (p. 357)
- Engineering (MR): Engineering Management Concentration (p. 357)
- Engineering (MR): Industrial Engineering Concentration (p. 357)
- Engineering (MR): Materials Science and Engineering Concentration (p. 357)
- Engineering (MR): Mechanical Engineering Concentration (p. 358)
- Engineering (MR): Nuclear Engineering Concentration (p. 358)

Full Professors

Morton A. Barlaz
Mohamed Abdelhay Bourham
Mo-Yuen Chow
Jerome J. Cuomo
Alexandra Duel-Hallen
Yahya Fathi
Paul D. Franzon
Edward F. Gehringer
Jan Genzer
Richard David Gould
Christine S. Grant
Saad A. Khan
Carl C. Koch
James M. Nau
Gregory N. Parsons
Harilaos George Perros
Sanmugavadivel Ranjithan
Douglas Stephen Reeves
Georgios Rouskas
Lawrence M. Silverberg
Munindar P. Singh
J. K. Townsend
Henry J. Trussell
Ioannis Viniotis
Mladen Alan Vouk

Associate Professors

Jeffrey W. Eischen
Jerome Philip Lavelle

Practice/Research/Teaching Professors

Lisa G. Bullard
Adjunct Faculty

Linda D. Krute

Engineering (MR)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
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<td>Required Courses</td>
<td>3-12</td>
<td>“Required Courses” are approved in conjunction with the academic committee</td>
</tr>
<tr>
<td>Concentration Courses</td>
<td>9-18</td>
<td>“Concentration Courses” are approved in conjunction with the academic committee</td>
</tr>
<tr>
<td>Additional Online Courses</td>
<td>9</td>
<td>“Additional Online Courses” are approved in conjunction with the academic committee to meet 30 total hours</td>
</tr>
</tbody>
</table>

Total Hours: 30

* Courses can be from Engineering or from related fields (Science, Business, Math, etc. with ONLY ONE class allowed in Business) with Advisor Approval

Engineering (MR): Chemical Engineering Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Courses</td>
<td>3-12</td>
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<tr>
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<td>9-18</td>
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<tr>
<td>Additional Online Courses</td>
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<td>“Additional Online Courses” are approved in conjunction with the academic committee to meet 30 total hours</td>
</tr>
</tbody>
</table>

Total Hours: 30

* Courses can be from Engineering or from related fields (Science, Business, Math, etc. with ONLY ONE class allowed in Business) with Advisor Approval

Concentration Requirements

• 30 graduate level, letter graded credit hours
• 21/30 hours engineering classes
• 18/30 hours from College of Engineering, must be from more than one discipline
• 3-6 courses from Chemical Engineering

Engineering (MR): Computer Engineering Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Courses</td>
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</tr>
</tbody>
</table>

Total Hours: 30

* Courses can be from Engineering or from related fields (Science, Business, Math, etc. with ONLY ONE class allowed in Business) with Advisor Approval

Concentration Requirements

• 30 graduate level, letter graded credit hours
• 21/30 hours engineering classes
• 18/30 hours from College of Engineering, must be from more than one discipline
• 3-6 courses from Computer Engineering
Engineering (MR): Computer Science Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
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<tr>
<td>Additional Online Courses</td>
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<tr>
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<td>30</td>
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</table>

* Courses can be from Engineering or from related fields (Science, Business, Math, etc. with ONLY ONE class allowed in Business) with Advisor Approval

Concentration Requirements

- 30 graduate level, letter graded credit hours
- 21/30 hours engineering classes
- 18/30 hours from College of Engineering, must be from more than one discipline
- 3-6 courses from Computer Science

Engineering (MR): Industrial Engineering Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
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</tr>
<tr>
<td>Concentration Courses</td>
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</tr>
<tr>
<td>Additional Online Courses</td>
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</tr>
<tr>
<td>Total Hours</td>
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<td>30</td>
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</tbody>
</table>

* Courses can be from Engineering or from related fields (Science, Business, Math, etc. with ONLY ONE class allowed in Business) with Advisor Approval

Concentration Requirements

- 30 graduate level, letter graded credit hours
- 21/30 hours engineering classes
- 18/30 hours from College of Engineering, must be from more than one discipline
- 3-6 courses from Industrial Engineering

Engineering (MR): Materials Science and Engineering Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Courses</td>
<td>“Required Courses” are approved in conjunction with the academic committee</td>
<td>3-12</td>
</tr>
<tr>
<td>Concentration Courses</td>
<td>“Concentration Courses” are approved in conjunction with the academic committee</td>
<td>9-18</td>
</tr>
<tr>
<td>Additional Online Courses</td>
<td>“Additional Online Courses” are approved in conjunction with the academic committee to meet 30 total hours</td>
<td>9</td>
</tr>
<tr>
<td>Total Hours</td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>

* Courses can be from Engineering or from related fields (Science, Business, Math, etc. with ONLY ONE class allowed in Business) with Advisor Approval

Concentration Requirements

- 30 graduate level, letter graded credit hours
- 21/30 hours engineering classes
- 18/30 hours from College of Engineering, must be from more than one discipline
- 3-6 courses from Materials Science and Engineering
Engineering (MR): Mechanical Engineering Concentration

Concentration Requirements
- 30 graduate level, letter graded credit hours
- 21/30 hours engineering classes
- 18/30 hours from College of Engineering, must be from more than one discipline
- 3-6 courses from Materials Science and Engineering

Additional Online Courses
- 9

Total Hours
- 30

Courses can be from Engineering or from related fields (Science, Business, Math, etc. with ONLY ONE class allowed in Business) with Advisor Approval

Engineering (MR): Nuclear Engineering Concentration

Concentration Requirements
- 30 graduate level, letter graded credit hours
- 21/30 hours engineering classes
- 18/30 hours from College of Engineering, must be from more than one discipline
- 3-6 courses from Nuclear Engineering

Environmental Engineering

Graduate programs are offered in coastal and water resources engineering, computing and systems, construction engineering and management, environmental engineering, geotechnical and geoenvironmental engineering, mechanics and materials, structural engineering and mechanics, transportation engineering and materials.

Admission Requirements
Normal minimum GPA requirements include 3.0 overall and in the major. Students who do not meet these academic requirements may take graduate courses through the Non Degree Studies program to demonstrate academic ability, but consultation with the Director of Graduate Programs is strongly advised. Applicants without academic experience in civil engineering, construction engineering, or environmental engineering may be required to take undergraduate courses to remove deficiencies, but graduate credit is not given for these courses. The Graduate Record Examination is required for all international applicants and all applicants to the MSCE or MSENE degree programs.

Master's Degree Requirements
Four Master's degrees, requiring a minimum of 30 or 31 credit hours, are available. At least two-thirds of a Master's program should be in a well-defined major area of concentration. The MCE is a non-thesis (Option B) degree with other requirements, such as independent projects or core courses, specified in some areas of specialization. A formal minor is not permitted. The MCE is available both on-campus and through distance education. The MSCE degree requires a thesis and a formal minor is optional. Requirements for the MENE and MSENE are similar to those for the CE degrees.

Doctoral Degree Requirements
The Ph.D. typically requires one year of full-time course work beyond the master's degree and research culminating in a dissertation. The program must develop a well-defined major area of concentration and may include supporting courses outside the major or a formal minor in a related field. All specialty areas, including Environmental Engineering, are included in the one Ph.D. program.
Student Financial Support
Departmental teaching and research assistantships are available including coverage of tuition and health insurance. Fellowships -- full or supplemental to an assistantship -- are available for exceptional applicants. All financial aid recipients are selected on merit-based competition with other applicants. Applications requesting financial aid (both U.S. and international) should be submitted early: February 1 for Fall admission and by July 15 for Spring admission.

Degrees
- Environmental Engineering (MR) (p. 359)
- Environmental Engineering (MS) (p. 362)

Full Professors
Sankarasubramanian Arumugam
Morton A. Barlaz
Emily Zechman Berglund
Francis Lajara De Los Reyes III
Joel Ducoste
Henry C. Frey
Mohammed Awad Gabr
Detlef R. Knappe
Gnanamanikam Mahinthakumar
Margery Frances Overton
Ranji Ranjithan

Associate Professors
Joseph F. DeCarolis
Joel Casey Dietrich
Andrew P. Grieshop
Brina Mortensen Montoya
Benjamin Shane Underwood

Assistant Professors
Tarek Aziz
Douglas Franklin Call
Fernando Garcia Menendez
Angela Rose Harris
Jordan Kern
Daniel R. Obenour

Practice/Research/Teaching Professors
Florentino Banaag De La Cruz
Meagan Kittle Autry
James William Levis
Gregory W. Lucier
Elizabeth J. Sciaudone

Emeritus Faculty
Robert C. Borden
Earl Downey Brill Jr.

Adjunct Faculty
Michael Scott Breen
Anderson Rodrigo de Queiroz
Daniel J. Findley
Alejandra C. Geiger-Ortiz

Environmental Engineering (MR)

Degree Requirements
Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: “Master of Environmental Engineering” without specialization specifications.

Air Pollution Engineering Specialization

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 576</td>
<td>Engineering Principles Of Air Pollution Control</td>
<td>3</td>
</tr>
<tr>
<td>CE 579</td>
<td>Principles of Air Quality Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CE 772</td>
<td>Environmental Exposure and Risk Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CE 779</td>
<td>Advanced Air Quality</td>
<td>3</td>
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</table>

Core Electives

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 596</td>
<td>Special Topics in Water Resource and Environmental Engineering (Energy and Climate)</td>
<td>3</td>
</tr>
<tr>
<td>CE 775</td>
<td>Modeling and Analysis Of Environmental Systems</td>
<td>3</td>
</tr>
<tr>
<td>CE 776</td>
<td>Advanced Water Management Systems</td>
<td>3</td>
</tr>
<tr>
<td>CHE 575</td>
<td>Advances in Pollution Prevention: Environmental Management for the Future</td>
<td>3</td>
</tr>
<tr>
<td>MEA 510</td>
<td>Air Pollution Meteorology</td>
<td>3</td>
</tr>
<tr>
<td>MEA 580</td>
<td>Air Quality Modeling and Forecasting</td>
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</table>

Total Hours 12
### Technical Electives

<table>
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<tr>
<th>Code</th>
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<tbody>
<tr>
<td>CE 536</td>
<td>Introduction to Numerical Methods for Civil Engineers</td>
<td>3</td>
</tr>
<tr>
<td>CE 537</td>
<td>Computer Methods and Applications</td>
<td>3</td>
</tr>
<tr>
<td>CE 538</td>
<td>Information Technology and Modeling</td>
<td>3</td>
</tr>
<tr>
<td>CE 571</td>
<td>Physical Principles of Environmental Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CE 577</td>
<td>Engineering Principles Of Solid Waste Management</td>
<td>3</td>
</tr>
<tr>
<td>GIS 510</td>
<td>Fundamentals of Geospatial Information Science and Technology</td>
<td>3</td>
</tr>
<tr>
<td>MAE 406</td>
<td>Energy Conservation in Industry</td>
<td>3</td>
</tr>
<tr>
<td>MAE 408</td>
<td>Internal Combustion Engine Fundamentals</td>
<td>3</td>
</tr>
<tr>
<td>MAE 412</td>
<td>Design of Thermal System</td>
<td>3</td>
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<tr>
<td>PA 550</td>
<td>Environmental Policy</td>
<td>3</td>
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<tr>
<td>ST 515</td>
<td>Experimental Statistics for Engineers I</td>
<td>3</td>
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<tr>
<td>ST 516</td>
<td>Experimental Statistics For Engineers II</td>
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### Engineering: Coastal Engineering Specialization

#### Typical Course Selections

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<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>CE 583</td>
<td>Engineering Aspects Of Coastal Processes</td>
<td>3</td>
</tr>
<tr>
<td>CE 596</td>
<td>Special Topics in Water Resource and Environmental Engineering (Introduction to Coastal and Ocean Engineering)</td>
<td>1-6</td>
</tr>
<tr>
<td>CE 596</td>
<td>Special Topics in Water Resource and Environmental Engineering (Coastal Hydrodynamics)</td>
<td>1-6</td>
</tr>
<tr>
<td>CE 596</td>
<td>Special Topics in Water Resource and Environmental Engineering (Coastal Structures)</td>
<td>1-6</td>
</tr>
<tr>
<td>CE 596</td>
<td>Special Topics in Water Resource and Environmental Engineering (Fluid Mechanics in Natural Environments)</td>
<td>1-6</td>
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<tr>
<td>MEA 540</td>
<td>Principles of Physical Oceanography</td>
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<tr>
<td>MEA 562</td>
<td>Marine Sediment Transport</td>
<td>3</td>
</tr>
<tr>
<td>MEA/GIS 582</td>
<td>Geospatial Modeling</td>
<td>3</td>
</tr>
<tr>
<td>MEA 792</td>
<td>Advanced Special Topics in Earth Sciences (Advanced Geospatial Modeling with Open Source GIS)</td>
<td>3</td>
</tr>
<tr>
<td>MA 501</td>
<td>Advanced Mathematics for Engineers and Scientists I</td>
<td>3</td>
</tr>
<tr>
<td>MA 534</td>
<td>Introduction To Partial Differential Equations</td>
<td>3</td>
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<tr>
<td>ST 515</td>
<td>Experimental Statistics for Engineers I</td>
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<tr>
<td>ST 730</td>
<td>Applied Time Series Analysis</td>
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</table>

### Energy Systems Analysis Specialization

#### Suggested Core Courses

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<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>CE 537</td>
<td>Computer Methods and Applications</td>
<td>3</td>
</tr>
<tr>
<td>CE 578</td>
<td>Energy and Climate</td>
<td>3</td>
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### Core Electives

<table>
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<tr>
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<th>Hours</th>
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<tbody>
<tr>
<td>CE 537</td>
<td>Computer Methods and Applications</td>
<td>3</td>
</tr>
<tr>
<td>CE 576</td>
<td>Engineering Principles Of Air Pollution Control</td>
<td>3</td>
</tr>
<tr>
<td>CE 577</td>
<td>Engineering Principles Of Solid Waste Management</td>
<td>3</td>
</tr>
<tr>
<td>CE 584</td>
<td>Hydraulics Of Ground Water</td>
<td>3</td>
</tr>
<tr>
<td>CE 588</td>
<td>Water Resources Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CE 596</td>
<td>Special Topics in Water Resource and Environmental Engineering (Water and Sanitation for Developing Countries)</td>
<td>1-6</td>
</tr>
<tr>
<td>CE 771</td>
<td>Physical-Chemical Water Treatment Processes</td>
<td>3</td>
</tr>
<tr>
<td>CE 774</td>
<td>Environmental Bioprocess Technology</td>
<td>3</td>
</tr>
<tr>
<td>CE 775</td>
<td>Modeling and Analysis Of Environmental Systems</td>
<td>3</td>
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### Technical Electives

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<tr>
<td>CE 538</td>
<td>Information Technology and Modeling</td>
<td>3</td>
</tr>
<tr>
<td>CE 573</td>
<td>Biological Principles of Environmental Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CE 574</td>
<td>Chemical Principles of Environmental Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CE 576</td>
<td>Engineering Principles Of Air Pollution Control</td>
<td>3</td>
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<tr>
<td>CE 577</td>
<td>Engineering Principles Of Solid Waste Management</td>
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<td>CE 579</td>
<td>Principles Of Air Quality Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CE 582</td>
<td>Coastal Hydrodynamics</td>
<td>3</td>
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<tr>
<td>CE 584</td>
<td>Hydraulics Of Ground Water</td>
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<tr>
<td>CE 586</td>
<td>Engineering Hydrology</td>
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<tr>
<td>CE 588</td>
<td>Water Resources Engineering</td>
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<tr>
<td>CE 596</td>
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<tr>
<td>CE 596</td>
<td>Special Topics in Water Resource and Environmental Engineering (Coastal Hydrodynamics)</td>
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### Environmental, Water Resources, and Coastal Engineering Specialization

- 30 graduate-level credit hours

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<tr>
<td>CE 596</td>
<td>Special Topics in Water Resource and Environmental Engineering (Energy and Climate)</td>
<td>3</td>
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<tr>
<td>CE 784</td>
<td>Ground Water Contaminant Transport</td>
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<td>CE 796</td>
<td>Advanced Topics in Water Resource and Environmental Engineering (Hydroclimatology)</td>
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### Modeling and Systems Analysis Specialization

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<tr>
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<td>Modeling and Analysis Of Environmental Systems</td>
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<tr>
<td>CE 776</td>
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<td>CE 791</td>
<td>Advanced Topics in Civil Engineering Computing</td>
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<td>(Complex Adaptive Systems Analysis)</td>
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### Core Electives

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<tr>
<td>CE 536</td>
<td>Introduction to Numerical Methods for Civil Engineers</td>
<td>3</td>
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<tr>
<td>CE 537</td>
<td>Computer Methods and Applications</td>
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<td>CE 737</td>
<td>Computer-Aided Engineering Systems</td>
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<tr>
<td>CE 772</td>
<td>Environmental Exposure and Risk Analysis</td>
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<tr>
<td></td>
<td>(Evolutionary Computation)</td>
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<tr>
<td>CE 791</td>
<td>Advanced Topics in Civil Engineering Computing</td>
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<tr>
<td></td>
<td>(High Performance Computer Modeling)</td>
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<td>CE 796</td>
<td>Advanced Topics in Water Resource and Environmental Engineering (Statistical Methods)</td>
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### Technical Electives

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<td>ECG 715</td>
<td>Environmental and Resource Economics</td>
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<td>ECG 716</td>
<td>Topics In Environmental and Resource Economics</td>
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<td>FOR 734</td>
<td>Advanced Forest Management Planning</td>
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<td>OR 501</td>
<td>Introduction to Operations Research</td>
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<td>OR 504</td>
<td>Introduction to Mathematical Programming</td>
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<td>OR 505</td>
<td>Linear Programming</td>
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<td>OR 506</td>
<td>Algorithmic Methods in Nonlinear Programming</td>
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<td>OR 565</td>
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<td>OR 706</td>
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<td>OR 708</td>
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<td>ST 515</td>
<td>Experimental Statistics for Engineers I</td>
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### Environmental Engineering (MS) Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area.

**Degrees earned will be distributed as: “Master of Science in Environmental Engineering” without specialization specifications.**

---

#### Environmental, Water Resources, and Coastal Engineering Specialization

**Core Electives**

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<td>CE 596</td>
<td>Special Topics in Water Resource and Environmental Engineering (Coastal Hydrodynamics)</td>
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<td>CE 571</td>
<td>Physical Principles of Environmental Engineering</td>
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<td>CE 574</td>
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<td>Design of Structural Stormwater Best Management Practices</td>
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<td>BAE 576</td>
<td>Watershed Monitoring and Assessment</td>
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<td>BAE 581</td>
<td>Open Channel Hydraulics for Natural Systems</td>
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<td>BAE 584</td>
<td>Introduction to Fluvial Geomorphology</td>
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<td>Theory Of Drainage--Saturated Flow</td>
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#### Water Resources Engineering Specialization

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<td>CE 584</td>
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<td>CE 586</td>
<td>Engineering Hydrology</td>
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### Environmental, Water Resources, and Coastal Engineering Specialization

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</table>
**Industrial Engineering**

The graduate faculty of the Edward P. Fitts Department of Industrial and Systems Engineering supports academic and research interests in four areas:

1. manufacturing systems (manufacturing processes, medical device manufacturing systems, CAM, CIM, robotics, automation, rapid prototyping and concurrent engineering);
2. production systems (logistics systems, supply chain management, scheduling, inventory control, materials handling, facility design, furniture manufacturing and management, quality control, and engineering economics);
3. systems analysis and optimization (health systems, stochastic processes, simulation, mathematical programming, and soft computing); and
4. ergonomics (human performance, occupational safety, and biomechanics). The department faculty actively supports independent graduate degree programs in operations research, integrated manufacturing systems engineering, textile technology and management, and financial mathematics.

**Admission Requirements**

Applications are accepted from undergraduate majors in engineering and in the behavioral, physical and mathematical sciences who meet prerequisites in calculus and linear algebra, computer science, and statistics.

**Master's Degree Requirements**

The M.S. degree requires 30 credit hours and involves depth of study in a specified area of concentration, nine hours in a minor, and six hours of research credit. The Master of Industrial Engineering (M.IE.) degree may be obtained by course work only; project work is optional. A minimum of 33 credit hours is required for the M.IE.

**Doctoral Degree Requirements**

This degree requires 72 credit hours of course and research work beyond the Bachelor's degree. Undergraduate students with superior credentials may apply directly to the doctoral program and bypass the master's degree. For students who have completed the Master's degree, typically 30 to 36 hours of additional course work are required. A departmental written qualifying examination is required.

**Student Financial Support**

Research and teaching assistantships are available on a competitive basis to early applicants. Fellowships that supplement assistantship stipends are available to U.S. applicants with superior credentials. Award priority is given to Ph.D. and then to M.S. applicants.

**Degrees**

- Industrial Engineering (MR) (p. 364)
- Industrial Engineering (MS) (p. 365)
- Industrial Engineering (PhD) (p. 367)
- Industrial Engineering (Minor) (p. 368)

**Faculty**

**Full Professors**

Paul Cohen  
Shu-Cherng Fang  
Yahya Fathi  
Ola Lars Anders Harrysson  
Julie Simmons Ivy  
Russell E. King  
Yuan-Shin Lee  
Maria Esther Mayorga  
Chan S. Nam  
Binil Starly  
Julie Swann  
Reha Uzsoy

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Jingyan Dong  
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Yunan Liu  
Osman Yalin Ozaltin  
Rohan Ajit Shirwaiker
Hong Wan

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Leila Hajibabai Dizaji
Sara Shashaani
Xu Xu

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Brandon Mark McConnell
Kanton Tyrone Reynolds
Javad Taheri
Harvey A. West II

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Richard Harold Bernhard
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Thom Joel Hodgson
Henry Nuttle
Richard G. Pearson
Stephen Dean Roberts
Ezat Sanli
Clarence Smith Jr.
James Reed Wilson
Richard Wysk
Robert E. Young

Industrial Engineering (MR)

Degree Requirements

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<tr>
<td>ISE 601</td>
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"Technical Elective Courses" will be determined in conjunction with the academic committee

Additional Technical Elective Courses

Additional Technical Elective Courses are approved in conjunction with the academic committee

Total Hours

Breadth Requirement Courses

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<td>ISE 510</td>
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<td>ISE 712</td>
<td>Bayesian Decision Analysis For Engineers and Managers</td>
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<td>ISE 731</td>
<td>Multi-Attribute Decision Analysis</td>
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<td>Group B: Human Factors and Ergonomics Category</td>
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<tr>
<td>ISE 540</td>
<td>Human Factors In Systems Design</td>
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<td>ISE 541</td>
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<td>ISE 544</td>
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<td>Group C: Manufacturing Systems Category</td>
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<tr>
<td>ISE 515</td>
<td>Manufacturing Process Engineering</td>
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<td>ISE 714</td>
<td>Product Manufacturing Engineering for the Medical Device Industry</td>
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<td>ISE 716</td>
<td>Automated Systems Engineering</td>
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<td>ISE 552</td>
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<td>ISE 723</td>
<td>Production Planning, Scheduling and Inventory Control</td>
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<td>OR 504</td>
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<td>Queues and Stochastic Service Systems</td>
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<tr>
<td>CSC 520</td>
<td>Artificial Intelligence I</td>
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Faculty

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Industrial Engineering (MS)

Degree Requirements

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<tr>
<td>ISE 714</td>
<td>Product Manufacturing Engineering for the Medical Device Industry</td>
</tr>
<tr>
<td>ISE 716</td>
<td>Automated Systems Engineering</td>
</tr>
<tr>
<td>ISE 519</td>
<td>Database Applications in Industrial and Systems Engineering</td>
</tr>
</tbody>
</table>

Group D: Production Systems Category

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>ISE 552</td>
<td>Design and Control of Production and Service Systems</td>
</tr>
<tr>
<td>ISE 723</td>
<td>Production Planning, Scheduling and Inventory Control</td>
</tr>
<tr>
<td>ISE 726</td>
<td>Theory of Activity Networks</td>
</tr>
<tr>
<td>ISE 748</td>
<td>Quality Engineering</td>
</tr>
<tr>
<td>ISE 754</td>
<td>Logistics Engineering</td>
</tr>
</tbody>
</table>

Group E: Systems Analytics and Optimization Category

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>ISE 501</td>
<td>Introduction to Operations Research</td>
</tr>
<tr>
<td>OR 504</td>
<td>Introduction to Mathematical Programming</td>
</tr>
<tr>
<td>ISE 505</td>
<td>Linear Programming</td>
</tr>
<tr>
<td>ISE 560</td>
<td>Stochastic Models in Industrial Engineering</td>
</tr>
<tr>
<td>ISE 562</td>
<td>Simulation Modeling</td>
</tr>
<tr>
<td>ISE 709</td>
<td>Dynamic Programming</td>
</tr>
<tr>
<td>ISE 760</td>
<td>Applied Stochastic Models in Industrial Engineering</td>
</tr>
<tr>
<td>ISE 761</td>
<td>Queues and Stochastic Service Systems</td>
</tr>
<tr>
<td>ISE 762</td>
<td>Computer Simulation Techniques</td>
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Select one course from the following: 3

Group F: Computer Science, Mathematics, and Statistics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>CSC 513</td>
<td>Electronic Commerce Technology</td>
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<tr>
<td>CSC 520</td>
<td>Artificial Intelligence I</td>
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<td>CSC 570</td>
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<td>CSC 742</td>
<td>Database Management Systems</td>
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<td>MA 520</td>
<td>Linear Algebra</td>
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<td>MA 580</td>
<td>Numerical Analysis I</td>
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<td>ST 516</td>
<td>Experimental Statistics For Engineers II</td>
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<tr>
<td>ST 711</td>
<td>Design Of Experiments</td>
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</table>

Total Hours 12

Faculty

**Full Professors**

Paul Cohen
Shu-Cherng Fang
Yahya Fathi
Ola Lars Anders Harrysson

Julie Simmons Ivy
Russell E. King
Yuan-Shin Lee
Maria Esther Mayorga
Chan S. Nam
Binil Starly
Julie Swann
Reha Uzsoy

**Associate professors**

Jingyan Dong
Michael G. Kay
Yunan Liu
Osman Yalin Ozaltln
Rohan Ajit Shirwaiker
Hong Wan

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Xiaolei Fang
Leila Hajibabai Dizaji
Sara Shashaani
Xu Xu

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Brandon Mark McConnell
Kanton Tyrone Reynolds
Javad Taheri
Harvey A. West II

**Emeritus Faculty**

Mahmoud A. Ayoub
Richard Harold Bernhard
Charles Thomas Culbreth Jr.
Thom Joel Hodgson
Henry Nuttle
Industrial Engineering (PhD)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
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<tr>
<td>ISE 801</td>
<td>Seminar</td>
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<tr>
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| Elective / Research Courses                  | 54    |
| "Elective / Research Courses" are approved in conjunction with the academic committee |

Total Hours = 73

Core Courses

<table>
<thead>
<tr>
<th>Code</th>
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<tr>
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<tr>
<td>Human Factors and Ergonomics Category</td>
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<tr>
<td>ISE 540</td>
<td>Human Factors In Systems Design</td>
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<tr>
<td>ISE 541</td>
<td>Occupational Safety Engrg</td>
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<td>ISE 544</td>
<td>Occupational Biomechanics</td>
<td></td>
</tr>
<tr>
<td>ISE 744</td>
<td>Human Information Processing</td>
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<td>ISE 745</td>
<td>Human Performance Modeling</td>
<td></td>
</tr>
<tr>
<td>Manufacturing Systems Category</td>
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<tr>
<td>ISE 515</td>
<td>Manufacturing Process Engineering</td>
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</tr>
<tr>
<td>ISE 519</td>
<td>Database Applications in Industrial and Systems Engineering</td>
<td></td>
</tr>
<tr>
<td>ISE 714</td>
<td>Product Manufacturing Engineering for the Medical Device Industry</td>
<td></td>
</tr>
<tr>
<td>ISE 716</td>
<td>Automated Systems Engineering</td>
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<tr>
<td>Production Systems Category</td>
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<td></td>
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<tr>
<td>ISE 552</td>
<td>Design and Control of Production and Service Systems</td>
<td></td>
</tr>
<tr>
<td>ISE 723</td>
<td>Production Planning, Scheduling and Inventory Control</td>
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<td>ISE 726</td>
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<tr>
<td>ISE 748</td>
<td>Quality Engineering</td>
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<td>ISE 754</td>
<td>Logistics Engineering</td>
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<tr>
<td>Systems Analytics and Optimization Category</td>
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</tr>
<tr>
<td>ISE 501</td>
<td>Introduction to Operations Research</td>
<td></td>
</tr>
<tr>
<td>OR 504</td>
<td>Introduction to Mathematical Programming</td>
<td></td>
</tr>
<tr>
<td>ISE 505</td>
<td>Linear Programming</td>
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</table>

ISE 560 Stochastic Models in Industrial Engineering
ISE 562 Simulation Modeling
ISE 709 Dynamic Programming
ISE 760 Applied Stochastic Models in Industrial Engineering
ISE 761 Queues and Stochastic Service Systems
ISE 762 Computer Simulation Techniques

Total Hours = 9

Faculty

Full Professors
Paul Cohen
Shu-Cherng Fang
Yahya Fathi
Ola Lars Anders Harrysson
Julie Simmons Ivy
Russell E. King
Yuan-Shin Lee
Maria Esther Mayorga
Chan S. Nam
Binil Starly
Julie Swann
Reha Uzsoy

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Rohan Ajit Shirwalik
Hong Wan

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Leila Hajibabai Dizaji
Sara Shashaani
Xu Xu
**Practice/Research/Teaching Professors**

Steven D. Jackson  
Brandon Mark McConnell  
Kanton Tyrone Reynolds  
Javad Taheri  
Harvey A. West II

---

**Emeritus Faculty**

Mahmoud A. Ayoub  
Richard Harold Bernhard  
Charles Thomas Culbreth Jr.  
Thom Joel Hodgson  
Henry Nuttle  
Richard G. Pearson  
Stephen Dean Roberts  
Ezat Sanli  
Clarence Smith Jr.  
James Reed Wilson  
Richard Wysk  
Robert E. Young  

---

**Industrial Engineering (Minor)**

**Plan Requirements**

**Master's Course Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>Required Courses</td>
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<tr>
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<td>9</td>
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**PhD Course Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>Required Courses</td>
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</tr>
<tr>
<td>Select at least four 500-level or above courses approved in conjunction with the academic committee</td>
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<td></td>
</tr>
<tr>
<td>Total Hours</td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

---

**Faculty**

**Full Professors**

Paul Cohen  
Shu-Cherng Fang

---

**Associate professors**

Jingyan Dong  
Michael G. Kay  
Yunan Liu  
Osman Yalin Ozaltin  
Rohan Ajit Shirwaiker  
Hong Wan

---

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Sara Shashaani  
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---

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Steven D. Jackson  
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Kanton Tyrone Reynolds  
Javad Taheri  
Harvey A. West II

---

**Emeritus Faculty**

Mahmoud A. Ayoub  
Richard Harold Bernhard  
Charles Thomas Culbreth Jr.
Integrated Manufacturing Systems Engineering

The Integrated Manufacturing Systems Engineering (IMSE) Institute was established in 1984. IMSE provides multidisciplinary graduate-level education and practical training opportunities in the theory and practice of integrated manufacturing systems engineering at the masters level. IMSE focuses on providing a manufacturing presence and a program environment in the College of Engineering where faculty, graduate students, and industry can engage cooperatively in multidisciplinary graduate education, basic and applied research, and technology transfer in areas of common interest related to modern manufacturing systems technology. The objective of the IMSE program is to offer students with traditional discipline backgrounds in engineering and the physical sciences an opportunity to broaden their understanding of the multidisciplinary area of manufacturing systems. Core areas of concentration are offered in manufacturing systems, logistics, mechatronics, and advanced manufacturing.

Admission Requirements

Admission to the IMSE master's program requires a B.S. degree from an accredited institution in engineering, physics, mathematics, or computer science. Check with the Institute if your degree is in a field other than these listed.

Master's Degree Requirements

The IMSE program requires a minimum of 27 hours of graduate course work and six hours of research project. The graduate course work includes five required core courses that provide a multidisciplinary overview of subject materials basic to manufacturing systems, logistics, mechatronics, and advanced manufacturing. Specialization is provided in the student's elective courses. The six hours of research project is performed either individually or in teams in areas that compliment and reinforce the graduate course work.

The IMSE degree is now available through Engineering Online as a distance program. Application to the IMSE Distance Education program is the same as the on-campus program. More information is available via the IMSE Institute (https://www.imsei.ncsu.edu/) (wjirwin@ncsu.edu, 919-515-3808).

Student Financial Support

Assistantships and internships are available to qualified students. The full financial support package covers tuition and health insurance. Internships are also undertaken directly with host companies.

Internship

The IMSE internship program was established to provide a cooperative industrial and academic experience for some IMSE students and our industrial sponsors. Several Internship awards are made available every year for special training in IMSE host companies. Students who are selected to participate in the internship program may receive financial support for up to four semesters and one summer. Typically, the student attends classes for two semesters (fall and spring), works at the sponsor company for the following summer and fall semester, and completes the IMSE course requirements the following spring semester. The student uses the experience at the sponsor company as the basis for their IMSE research project.

Other Relevant Information

IMSE Students are supported by companies across the country during their internships. Both full-time and part-time internship support is provided depending on availability. These companies have included: ABB, ABCO Automation, Applied Materials, AT&T, Bayer, BSH, Bosch, Biogen, Castle Hill Technologies, Caterpillar, Closure Medical, Corning Cable Systems, CSX, Cummins, Disney, Dupont, Daimler Trucks, Eljay, Ford, GE, GKN, GSK, IBM, Ingersoll Rand, Intel, John Deere, Mack Trucks, Mayne Pharma, Michelin, Morganite, MTS Systems, Nepton Technologies, Rubbermaid, RxMedic, Samsung Semiconductor, Schwanns, Snap-On, Tesla, UPS, Volvo Trucks, and ZF Corporation and many others.

Degrees

- Integrated Manufacturing Systems Engineering (MR) (p. 370)
- Integrated Manufacturing Systems Engineering (Minor) (p. 371)

Full Professors

Roger L. Barker
Michael D. Boyette
Marianne Bradford
Gregory D. Buckner
Yuang Sung Al Chen
Mo-Yuen Chow
Timothy Gladstone Clapp
Elizabeth Carol Dickey
Yahya Fathi
Tushar K. Ghosh
Robert B. Handfield
Ola Lars Anders Harrysson
Thom Joel Hodgson
Integrated Manufacturing Systems Engineering (MR)

Associate Professors
Jacob James Adams
Dennis R. Bahler
Pamela Banks-Lee
Kristin Anne Barletta
Ramon R. Collazo
Jingyan Dong
George Lawrence Hodge
Hsiao-Ying Shadow Huang
Michael G. Kay
Karlyn Mitchell
Daniel Erique Saloni
Donald P. Warsing

Assistant Professors
Timothy Joseph Horn

Practice/Research/Teaching Professors
Semra Sebnem Ahiska King
Billy L. Edge
Steven D. Jackson
David Lee Lubkeman
Brandon Mark McConnell

Henry Lee Nuttle
Tania Milkova Paskova
Claude Lewis Reynolds Jr.
Javad Taheri

Emeritus Faculty
Roy E. Carawan
Stephen N. Chapman
Charles Thomas Culbreth Jr.
Perry L. Grady
Thom Joel Hodgson
Thomas Johnson
Stephen Dean Roberts
Ezat Sanii
William A. Smith Jr.
James Reed Wilson
Richard Allen Wysk
Robert E. Young
Carl Frank Zorowski

Adjunct Faculty
Brian Denton
Mihail Devetsikiotis
Tania Milkova Paskova

Integrated Manufacturing Systems Engineering (MR)

Degree Requirements
Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: “Master of Integrated Manufacturing Systems Engineering” without focus area specifications.

<table>
<thead>
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<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
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<tr>
<td></td>
<td>Select one course from each area of the “Focus Area Categories” listed below</td>
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Project Course | 6 |
## Focus Area Categories

### Manufacturing

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<tr>
<td><strong>Area 1</strong></td>
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<tr>
<td>CSC 510</td>
<td>Software Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ISE 562</td>
<td>Simulation Modeling</td>
<td>3</td>
</tr>
<tr>
<td>ISE 519</td>
<td>Database Applications in Industrial and Systems Engineering</td>
<td>3</td>
</tr>
<tr>
<td><strong>Area 2</strong></td>
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<tr>
<td>ISE 510</td>
<td>Applied Engineering Economy</td>
<td>3</td>
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<td>BUS 501</td>
<td>Strategic Management Foundations</td>
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<td><strong>Area 3</strong></td>
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<tr>
<td>ISE 707</td>
<td>Real-Time Control of Automated Manufacturing</td>
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<td>ISE 515</td>
<td>Manufacturing Process Engineering</td>
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</tr>
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<td>ISE 716</td>
<td>Automated Systems Engineering</td>
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<td><strong>Area 4</strong></td>
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<tr>
<td>ISE 552</td>
<td>Design and Control of Production and Service Systems</td>
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<td>ISE 723</td>
<td>Production Planning, Scheduling and Inventory Control</td>
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<tr>
<td><strong>Area 5</strong></td>
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<td>TE 533</td>
<td>Lean Six Sigma Quality</td>
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<td>EGR 590</td>
<td>Special Topics in Engineering</td>
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### Logistics / Supply Chain

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<tr>
<td>CSC 510</td>
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<td>ISE 519</td>
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<tr>
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<td>ISE 510</td>
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<td>BUS 501</td>
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<td>MBA 541</td>
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</tr>
<tr>
<td>ISE 552</td>
<td>Design and Control of Production and Service Systems</td>
<td>3</td>
</tr>
<tr>
<td>ISE 723</td>
<td>Production Planning, Scheduling and Inventory Control</td>
<td>3</td>
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<td><strong>Area 5</strong></td>
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<tr>
<td>MBA 549</td>
<td>Supply Chain Management Practicum</td>
<td>3</td>
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<tr>
<td>ISE 754</td>
<td>Logistics Engineering</td>
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</tbody>
</table>
Plan Requirements

Master’s Course Requirements

<table>
<thead>
<tr>
<th>Code</th>
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PhD Course Requirements

<table>
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<tr>
<th>Code</th>
<th>Title</th>
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</tr>
</thead>
<tbody>
<tr>
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<td>Required Courses</td>
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</tr>
<tr>
<td></td>
<td>Select at least four 500-level or above courses approved in conjunction with the academic committee</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Hours</td>
<td>12</td>
</tr>
</tbody>
</table>

Materials Science & Engineering

Materials enable all of the engineering and high-technology fields that are an integral part of our society. Graduate programs in this department focus on understanding the structure, structure modification and properties of materials and the development of new or improved materials and advanced processing methods that are critical links between the design and the realization of new systems for manufacturing, nanotechnology, energy, and biomaterials.

The M.S. and Ph.D. programs are research-based degree programs focusing on faculty-mentored, state-of-the-art materials research that leads to a thesis or dissertation.

The Master of Materials Science and Engineering is a non-thesis degree program designed for students from a variety of technical backgrounds interested in furthering their understanding of materials processing, characterization and properties. This program is appropriate for distance-education Masters students.

The Master of Nanoengineering is a multidisciplinary non-thesis degree program designed so students can declare a concentration in one of the following three areas:

1. Materials Science in Nanoengineering;
2. Nanoelectronics and Nanophotonics; or
3. Biomedical Sciences in Nanoengineering.

This program is appropriate for distance-education Masters students.

Admission Requirements

In addition to the general admission requirements as set by the Graduate School, the department requires submission of GRE scores. Non-native English speakers also require a minimum TOEFL score as established by the Graduate School.

Master’s Degrees Requirements

The Master of Science degree (M.S.) requires 30 credit hours of coursework/research and a research thesis. The Master of Materials Science and Engineering degree (M.M.S.E.) requires 30 credit hours of coursework only. The Master of Nanoengineering (M.NAE.) requires 30 credit hours of coursework only.

Doctoral Degree Requirements

The doctoral degree (Ph.D.) requires 72 credit hours of coursework/research, a qualifying exam, and a research dissertation.

Student Financial Support

Students in the M.S. and Ph.D. graduate programs normally receive financial support in the form of research or teaching assistantships or fellowships.

Other Relevant Information

The department reflects the interdisciplinary nature of the field of Materials Science and Engineering. A substantial number of current graduate students majored in fields other than but related to materials, and the department has associated graduate faculty from other departments supervising thesis and dissertation research.

Degrees

- Materials Science and Engineering (MR) (p. 373)
- Materials Science and Engineering (MS) (p. 375)
- Materials Science and Engineering (PhD) (p. 376)
- Materials Science and Engineering (Minor) (p. 377)
- Materials Science and Engineering (Certificate) (p. 379)

Faculty

Full Professors

Harald Ade
David E. Aspnes
Charles M. Balik
Salah M. A. Bedair
Donald Wayne Brenner
Jerome J. Cuomo
Elizabeth Carol Dickey
Michael David Dickey
Nadia A. El-Masry
Jan Genzer
Russell E. Gorga
Carol K. Hall
Ola Lars Anders Harrysson
Ayman I. Hawari
Albena Ivanisevic
Jacob L. Jones
Carl C. Koch
Jacqueline Krim
Thomas H. LaBean
Harold Henry Lamb
Frances Smith Ligler
James D. Martin
Veena Misra
Korukonda Linga Murty
Jagdish Narayan
Roger Jagdish Narayan
Gregory N. Parsons
Melissa Anne Pasquinelli
Zlatko Sitar
Franky So
Richard J. Spontak
Joseph B. Tracy
Daryoosh Vashaee
Orlin Dimitrov Velev
Yaroslava G Yingling
Xiangwu Zhang
Yong Zhu

Associate Professors
Aram Amassian
Ashley Carson Brown
Ramon R. Collazo
Douglas Lee Irving
Jesse Stephen Jur
Djamal Kaoumi
Jagannadham Kasichainula
Divine Philip Kumah

Assistant Professors
Kaveh Ahadi
Veronica Augustyn
Wenpei Gao
Srikanth Patala

Ge Yang

Practice/Research/Teaching Professors
Charles Richard Guarnieri
Claude Lewis Reynolds Jr.

Emeritus Faculty
John A. Bailey
Hans Conrad
Robert F. Davis
John Valentine Hamme
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Gerald Lucovsky
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Khosrow L. Moazed
Ronald O. Scattergood
John S. Strenkowski

Adjunct Professors
James Michael LeBeau
Tania Milkova Paskova
John T. Prater
Justin Schwartz
Fumio Shimura
Victor Zhironov

Materials Science and Engineering (MR)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>Required Courses</td>
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<tr>
<td>Select a minimum of 15 credit hours of 500- to 700-level MSE courses approved in conjunction with the academic committee</td>
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<td>Additional Courses</td>
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<td>&quot;Additional Courses&quot; are approved in conjunction with the academic committee and may come from graduate-level courses in MSE or other technical disciplines</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 30
Faculty

Full Professors
Harald Ade
David E. Aspnes
Charles M. Balik
Salah M. A. Bedair
Donald Wayne Brenner
Jerome J. Cuomo
Elizabeth Carol Dickey
Michael David Dickey
Nadia A. El-Masry
Jan Genzer
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Victor Zhirnov

Materials Science and Engineering (MS)

Degree Requirements

<table>
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Materials Science and Engineering (PhD)

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Materials Science and Engineering (PhD)

Degree Requirements

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Additional Courses

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<td>Doctoral Dissertation Research</td>
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Total Hours 72

Faculty

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Materials Science and Engineering (Minor)

Plan Requirements

Master's Course Requirements

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PhD Course Requirements

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</tr>
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</tr>
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Victor Zhirnov
Materials Science and Engineering (Certificate)

The Graduate Certificate Program (GCP) in Materials Science and Engineering (MSE) is designed for working professionals who do not have formal training in MSE, but wish to acquire a basic understanding of materials science to improve their on-the-job experience and knowledge. Most people will enroll in this program as distance education students through the Engineering Online (EOL) office at NC State University. Students can customize their particular certificate programs to focus on specific areas of materials science that interest them.

Program of Study

The MSE GCP requires a total of 12 credit hours, including MSE 500 (3 credit hours) and three MSE elective courses (9 credit hours) selected by the student. MSE 500 is a fast-paced overview of the field of materials science and engineering and is designed for students who do not have a formal background in MSE, such as those with BS degrees in chemistry, physics and other fields of engineering. MSE 500 also provides the foundation for more specialized MSE graduate courses.

The courses available to students in the MSE GCP are shown here. Each course is 3 credit hours and most courses are offered at least once per year through the EOL office. By judicious selection of elective courses, students can customize their GCP to focus on areas of interest to them.

Requirements for admission

To be admitted to the MSE Graduate Certificate Program, a student must have a BS degree in the sciences or engineering from a regionally accredited four-year college or university, and have an overall (or major) GPA of at least 3.0 on a 4-point scale.

All new students must complete the NCSU Graduate School application for admission to the MSE GCP. The GRE exam is NOT required for admission to the GCP. Application deadlines are March 1 for summer and fall admission, and October 1 for spring admission. Students can begin study in the fall, spring or summer semester immediately following their acceptance into the program. Registration procedures, registration dates and course availability for each semester can be found on the NCSU Registration and Records webpage. Information regarding Engineering Online can be found on the EOL webpage.

Academic success in the MSE GCP might have a strong bearing on admission to a graduate degree program. However, completion of a graduate certificate program IN NO WAY guarantees entry into a graduate degree program, which must be done through a separate application process.

Plan Requirements

<table>
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<td>MSE 500</td>
<td>Modern Concepts in Materials Science</td>
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Select a minimum of three courses from "MSE Courses" listed below

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<td>MSE/NE 509</td>
<td>Nuclear Materials</td>
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<tr>
<td>MSE 540</td>
<td>Processing of Metallic Materials</td>
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<tr>
<td>MSE 545</td>
<td>Ceramic Processing</td>
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<tr>
<td>MSE 555</td>
<td>Polymer Technology and Engineering</td>
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<tr>
<td>MSE 556</td>
<td>Composite Materials</td>
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<tr>
<td>MSE 560</td>
<td>Microelectronic Materials Science and Technology</td>
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<tr>
<td>MSE 561</td>
<td>Organic Chemistry Of Polymers</td>
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<tr>
<td>MSE 565</td>
<td>Introduction to Nanomaterials</td>
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<tr>
<td>MSE 566</td>
<td>Mechanical Properties of Nanostructured Materials</td>
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<tr>
<td>MSE 576</td>
<td>Technology Entrepreneurship and Commercialization I</td>
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<tr>
<td>MSE 577</td>
<td>Technology Entrepreneurship and Commercialization II</td>
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<tr>
<td>MSE 580</td>
<td>Materials Forensics and Degradation</td>
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<tr>
<td>MSE 589</td>
<td>Solid State Solar and Thermal Energy Harvesting</td>
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<tr>
<td>MSE 702</td>
<td>Defects In Solids</td>
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<tr>
<td>MSE 703</td>
<td>Interaction of Electrons with Materials</td>
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<tr>
<td>MSE 704</td>
<td>Interaction of Photons with Materials</td>
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<tr>
<td>MSE 705</td>
<td>Mechanical Behavior Of Engineering Materials</td>
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<tr>
<td>MSE 706</td>
<td>Phase Transformations and Kinetics</td>
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<td>MSE 708</td>
<td>Thermodynamics Of Materials</td>
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<td>MSE 709</td>
<td>Metastable Materials: Processing, Structure, and Properties</td>
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<td>MSE 710</td>
<td>Elements Of Crystallography and Diffraction</td>
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<tr>
<td>MSE 712</td>
<td>Scanning Electron Microscopy</td>
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<td>MSE 715</td>
<td>Fundamentals Of Transmission Electron Microscopy</td>
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<td>MSE 718</td>
<td>Advanced Transmission Electron Microscopy</td>
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<tr>
<td>MSE 721</td>
<td>Nanoscale Simulations and Modeling</td>
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<tr>
<td>MSE 723</td>
<td>Materials Informatics</td>
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<tr>
<td>MSE 731</td>
<td>Materials Processing by Deformation</td>
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<tr>
<td>MSE 741</td>
<td>Principles of Corrosion</td>
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<tr>
<td>MSE 751</td>
<td>Thin Film and Coating Science and Technology I</td>
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<tr>
<td>MSE 752</td>
<td>Thin Film and Coating Science and Technology II</td>
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<td>MSE/NE 757</td>
<td>Radiation Effects on Materials</td>
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<td>MSE 760</td>
<td>Materials Science in Processing of Semiconductor Devices</td>
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<td>MSE 761</td>
<td>Polymer Blends and Alloys</td>
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<td>MSE 763</td>
<td>Characterization Of Structure Of Fiber Forming Polymers</td>
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<td>MSE 770</td>
<td>Defects, Diffusion and Ion Implantation In Semiconductors</td>
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<td>MSE 771</td>
<td>Materials Science of Nanoelectronics</td>
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<td>MSE 775</td>
<td>Structure of Semicrystalline Polymers</td>
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<td>MSE 791</td>
<td>Advanced Topics in Materials Science and Engineering</td>
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<tr>
<td>MSE 795</td>
<td>Advanced Materials Experiments</td>
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</tbody>
</table>

Total Hours 12
Faculty

Full Professors
Harald Ade
David E. Aspnes
Charles M. Balk
Salah M. A. Bedair
Donald Wayne Brenner
Jerome J. Cuomo
Elizabeth Carol Dickey
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John T. Prater
Justin Schwartz
Fumio Shimura
Victor Zhirnov

Mechanical Engineering

The Mechanical Engineering graduate program prepares students in all aspects of mechanical and thermal systems design and manufacturing. Course offerings and research programs for mechanical engineering students are available in applied mechanics; biomechanics; combustion; design and manufacturing; dynamic systems and control; energy conversion and systems; experimental mechanics; fluid dynamics; heat transfer; mechanics of materials; micro, nano and MEMS; and vibration and acoustics. Sub-areas include adaptive and auto adaptive structures, controls and system identification, CFD, energy conversion and renewable energy, materials processing and tribology, mechatronics, precision engineering, and reactive and multiphase flows.

Admission Requirements
An applicant to the master's program must be a graduate of an accredited undergraduate program with a B.S. degree in either mechanical or aerospace engineering. Graduates of other accredited programs in engineering, physical sciences and mathematics may be considered but may be required to make up undergraduate deficiencies without graduate credit. Provisional admissions, as well as exceptions, are sometimes granted under special circumstances. The most qualified applicants are accepted first. Applicants to the Ph.D. program must have met the M.S. admission requirements and additionally must satisfy the Ph.D. admissions requirements. Applicants to the online, distance education M.S. program in mechanical or aerospace engineering are not required to take the GRE exam.

Master's Degree Requirements
The thesis-option M.S. degree programs in mechanical engineering and aerospace engineering require 21 hours of course credit and nine hours of thesis research. The non-thesis M.S. degree programs in mechanical engineering and aerospace engineering require 27 hours of course credit and a three-credit-hour project. The non-thesis M.S. degree programs in mechanical engineering and aerospace engineering are offered on campus and off campus through distance education.

Ph.D. Degree Requirements
A minimum of 72 hours of credit are required to obtain the Ph.D. degree. A direct path to the Ph.D. from the B.S. is also available with which the student is granted the M.S. degree “enroute” to the Ph.D. The enroute Ph.D. (direct to Ph.D. path) requires a minimum of 3.5 undergraduate GPA.

Student Financial Support
Various types of assistantships and fellowships are available. Awards are made to the most qualified applicants first and generally are not available for all students.

Other Relevant Information
Each new student chooses an area of specialty, selects an advisor and committee, customizes a program of study and begins research in the first semester of residence. The Director of Graduate Programs acts as a temporary advisor initially and should be contacted with questions.

Degrees
- Mechanical Engineering (MS) (p. 382)
- Mechanical Engineering (PhD) (p. 383)
- Mechanical Engineering (Minor) (p. 384)

Faculty
Full Professors
Gregory D. Buckner
Tarek Echekki
Jack Ray Edwards Jr
Srinath Ekkad
Tiegang Fang
Ashok Gopalarathnam
Richard David Gould
Xiaoning Jiang
Richard F. Keltie
Clement Kleinstreuer
Andrey Valerevich Kuznetsov
Hong Luo
Kevin M. Lyons
Gracious Ngaile
Kara Jo Peters
Afsaneh Rabiei
Lawrence M. Silverberg
Juei Feng Tu
Fen Wu
Fuh-Gwo Yuan
Yong Zhu
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Jong Eun Ryu
Pramod K. V. Subbareddy
Jie Yin

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Mechanical Engineering (MS)
Degree Requirements
Non-Thesis Option

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Total Hours 30

Thesis Option

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<th>Code</th>
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</tr>
</tbody>
</table>

Total Hours 30

* "Required Courses" may include up to three non-MAE courses approved in conjunction with the academic committee.

Faculty
Full Professors
Gregory D. Buckner
Tarek Echekki
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Mechanical Engineering (PhD)
Degree Requirement

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Total Hours 72

1 “Required Courses” must consist a minimum of two 700-level courses, and may consist of up to five non-MAE courses approved in conjunction with the academic committee.

Additional Requirements

- Students with a previous MS degree from NCSU:
  - without minor – may transfer up to 18 credit hours
  - with minor – may transfer up to 30 credit hours
- Students with a previous MS from outside NCSU:
• without minor – may transfer up to 18 credit hours
• with minor – may transfer up to 18 credit hours

Faculty

Full Professors
Gregory D. Buckner
Tarek Echekki
Jack Ray Edwards Jr
Srinath Ekkad
Tiegang Fang
Ashok Gopalarathnam
Richard David Gould
Xiaoning Jiang
Richard F. Keltie
Clement Kleinstreuer
Andrey Valerevich Kuznetsov
Hong Luo
Kevin M. Lyons
Gracious Ngaile
Kara Jo Peters
Afsaneh Rabiei
Lawrence M. Silverberg
Juei Feng Tu
Fen Wu
Fuh-Gwo Yuan
Yong Zhu
Mohammed A. Zikry

Associate Professors
Matthew Bryant
Jeffrey W. Eischen
Scott M. Ferguson
Charles Edward Hall Jr.
Hsiao-Ying Shadow Huang
Andre P. Mazzoleni
Venkat Narayanaswamy
Brendan O’Connor

Katherine Saul
Alexei V. Saveliev
Christopher R. Vermillion
Cheryl Xu

Assistant Professors
Landon Grace
Kenneth Granlund
Timothy Joseph Horn
Arun Kumar Kota
Jun Liu
Marie Muller
Mark R. Pankow
Jong Eun Ryu
Pramod K. V. Subbareddy
Jie Yin

Practice/Research/Teaching Professors
Stephen D. Terry

Emeritus Faculty
John A. Bailey
Herbert Martin Eckerlin
Francis J. Hale
Franklin D. Hart
Hassan A. Hassan
Thomas H. Hodgson
Richard R. Johnson
David S. McRae
James C. Mulligan
Robert T. Nagel
Larry H. Royster
Ronald O. Scattergood
Furman Y. Sorrell Jr.
John S. Strenkowski
Carl F. Zorowski

Mechanical Engineering (Minor)
Plan Requirements

• 9 (MS student) or 12 (PhD student) credit hours

Faculty

Full Professors

Gregory D. Buckner
Tarek Echekki
Jack Ray Edwards Jr
Srinath Ekkad
Tiegang Fang
Ashok Gopalarathnam
Richard David Gould
Xiaoning Jiang
Richard F. Keltie
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Hong Luo
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Ronald O. Scattergood
Furman Y. Sorrell Jr.
John S. Strenkowski
Carl F. Zorowski

Nanoengineering
Degrees

- Nanoengineering (MR) (p. 386)
- Nanoengineering (MR): Biomedical Sciences in Nanoengineering Concentration (p. 386)
- Nanoengineering (MR): Materials Science in Nanoengineering Concentration (p. 387)
- Nanoengineering (MR): Nanoelectronics and Nanophotonics Concentration (p. 387)

Full Professors
Charles M. Balk
Elizabeth Carol Dickey
Nadia A. El-Masry
Albena Ivanisevic
Thomas H. LaBean
Jagdish Narayan
Joseph B. Tracy
Daryoosh Vashaee
Yaroslava G. Yingling
Yong Zhu

Assistant Professors
Kaveh Ahadi
Wenpei Gao
Srikanth Patala

Practice/Research/Teaching Professors
Claude Lewis Reynolds Jr.

Nanoengineering (MR)

Degree Requirements

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<td>MSE 500</td>
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<tr>
<td>MSE 565</td>
<td>Introduction to Nanomaterials</td>
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<tr>
<td>MSE 791</td>
<td>Advanced Topics in Materials Science and Engineering</td>
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<tr>
<td>ECE/CHE 568</td>
<td>Conventional and Emerging Nanomanufacturing</td>
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<td></td>
<td>Techniques and Their Applications in Nanosystems</td>
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<tr>
<td>ISE 718</td>
<td>Micro/Nano-Scale Fabrication and Manufacturing</td>
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<td>MAE 536</td>
<td>Micro/Nano Electromechanical Systems</td>
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<tr>
<td></td>
<td>academic committee</td>
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</table>

Total Hours 30

* "Technical Electives" may be ones in the MNAE program not used to satisfy other degree requirements or other technical courses approved by the Director of Graduate Program, Nanoengineering.
Nanoengineering (MR): Materials Science in Nanoengineering Concentration

### Degree Requirements

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<tr>
<td>ECE/CHE 568</td>
<td>Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems</td>
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<td>MAE 536</td>
<td>Micro/Nano Electromechanical Systems</td>
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<td>ECE 530</td>
<td>Physical Electronics</td>
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<tr>
<td>ECE/BME 518</td>
<td>Wearable Biosensors and Microsystems</td>
<td></td>
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<tr>
<td>ECE/MSE 589</td>
<td>Solid State Solar and Thermal Energy Harvesting</td>
<td></td>
</tr>
<tr>
<td>ECE 723</td>
<td>Optical Properties Of Semiconductors</td>
<td></td>
</tr>
<tr>
<td>CHE 560</td>
<td>Chemical Processing Of Electronic Materials</td>
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<tr>
<td>MSE 760</td>
<td>Materials Science in Processing of Semiconductor Devices</td>
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</tr>
<tr>
<td>MSE 771</td>
<td>Materials Science of Nanoelectronics</td>
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</table>

**Technical Electives** | 6 |

*“Technical Electives” are approved in conjunction with the academic committee*

Total Hours | 30

* “Technical Electives” may be ones in the MNAE program not used to satisfy other degree requirements or other technical courses approved by the Director of Graduate Program, Nanoengineering.

---

Nuclear Engineering

The discipline of nuclear engineering is concerned with the development of nuclear processes for energy production and with the applications of radiation for the benefit of society. Representative topics of investigation include analytical, computational and experimental research in the neutronics, materials, thermal-hydraulics and control aspects of fission reactors; radiation detection and measurement of basic physics parameters; nuclear safety and security; applications of radioisotopes and radiation in industry, medicine and science; and plasma science, plasma engineering and design aspects of fusion reactors.

### Admission Requirements

Bachelor's degree graduates in any of the fields of engineering or physical sciences may be qualified for successful advanced study in nuclear engineering. Prior experience or course work in nuclear physics, partial differential equations and basic reactor analysis is helpful but may be gained during the first year of graduate study. GRE scores (general test) are needed for on-campus graduate study.

### Master's Degree Requirements

A total of 30 credit hours (at least nine semester hours of interdisciplinary breadth and 21 Nuclear Engineering) is required for both the M.S. and MNE degrees. An engineering project is required for the MNE degree and a formal thesis is required for the M.S. degree.

### Doctoral Degree Requirements

A total of 72 credit hours which includes a minor (at least 12 hours) is required. Students must pass a departmental qualifying exam in three core areas of nuclear engineering, and they can (if they so choose and
if their advisor approves) prepare for the exam by enrolling during their first year in three corresponding graduate courses comprising radiation fundamentals, reactor engineering, and radiation detection. Students who already earned a masters degree may count some of their credits towards the required PhD hours; consult <grad manual posted online> for details.

Student Financial Support

Teaching assistantships, research assistantships, and fellowships are available for qualified applicants. Opportunities are also available for graduate traineeships with utility companies, reactor and fuel vendors, and national laboratories providing a valuable combination of financial support and learning in the classroom, the research laboratory and on the job.

Other Relevant Information

The department has many excellent facilities including the one-megawatt PULSTAR fission reactor (soon to be uprated to 2MW), ultra cold neutron source, intense low-energy positron source, neutron scattering facility, neutron radiography unit, neutron activation analysis laboratory, nuclear materials laboratory, plasma laboratories, instrumentation and controls equipment, radiation analyzers and tomography systems, Generic PWR simulator and access to extensive computer facilities ranging from workstations to a supercomputer.

Degrees

• Nuclear Engineering (MR) (p. 389)
• Nuclear Engineering (MS) (p. 390)
• Nuclear Engineering (PhD) (p. 390)
• Nuclear Engineering (Minor) (p. 391)

Faculty

Full Professors

Dmitriy Y. Anistratov
Yousry Y. Azmy
Mohamed Abdelhay Bourham
Nam Truc Dinh
Joseph M. Doster
Jacob Eapen
John G. Gilligan
Ayman I. Hawari
Kostadin Nikolov Ivanov
John Kelly Mattingly
Korukonda Linga Murty
Steven Christopher Shannon

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Igor A. Bolotnov
Robert Bruce Hayes
Djamel Kaoumi

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David Kropaczek
Nilesh Kumar
Jeffrey William Lane
Elijah H. Martin

Associate Professors

Maria Nikolova Avramova
William David Pointer
Curtis Lee Smith
Rene Van Geemert
Louise Gail Worrall
Robert Joseph Zerr

Nuclear Engineering (MR)

Degree Requirements

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<td><strong>Interdisciplinary Courses</strong></td>
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<td>&quot;Interdisciplinary Courses&quot; are approved in conjunction with the academic committee to meet 30 total hours</td>
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</table>

Total Hours: 30

* Students are required to take one course above the 700 level.

Faculty

Full Professors
Dmitriy Y. Anistratov
Yousry Y. Azmy
Mohamed Abdelhay Bourham
Nam Truc Dinh
Joseph M. Doster
Jacob Eapen
John G. Gilligan
Ayman I. Hawari
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John Kelly Mattingly
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David Kropaczek
Nilesh Kumar
Jeffrey William Lane
Elijah H. Martin
William David Pointer
Curtis Lee Smith
Rene Van Geemert
Louise Gail Worrall

Associate Professors
Maria Nikolova Avramova
Igor A. Bolotnov
Robert Bruce Hayes
Djamel Kaoumi
Robert Joseph Zerr

**Nuclear Engineering (MS)**

## Degree Requirements

<table>
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<td>NE 693</td>
<td>Master's Supervised Research</td>
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<td>NE 695</td>
<td>Master's Thesis Research</td>
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<td>NE 699</td>
<td>Master's Thesis Preparation</td>
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<td><strong>Interdisciplinary Courses</strong></td>
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<td>&quot;Interdisciplinary Courses&quot; are approved in conjunction with the academic committee to meet 30 total hours</td>
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</tbody>
</table>

Total Hours | 30 |

* Students are required to take one course above the 700 level.

**Faculty**

### Full Professors
- Dmitriy Y. Anistratov
- Yousry Y. Azmy
- Mohamed Abdelhay Bourham
- Nam Truc Dinh
- Joseph M. Doster
- Jacob Eapen
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- Korukonda Linga Murty
- Steven Christopher Shannon

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- Igor A. Bolotnov
- Robert Bruce Hayes
- Djamel Kaoumi

### Assistant Professors
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- Bernard Wehring

### Professors Emeritus
- Robin Pierce Gardner
- Paul J. Turinsky

### Adjunct Faculty
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- Erik Matthews Brubaker
- Jon Dahl
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- David Lindsay Green
- Vincent Joseph Jodoin
- Philip Allan Kraus
- David Kropaczek
- Nilesh Kumar
- Jeffrey William Lane
- Elijah H. Martin
- William David Pointer
- Curtis Lee Smith
- Rene Van Geemert
- Louise Gail Worrall

**Nuclear Engineering (PhD)**
Degree Requirements

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<td>Research Courses</td>
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<td>NE 895 Doctoral Dissertation Research</td>
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<tr>
<td>Additional Courses</td>
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<td>30</td>
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</tbody>
</table>

Total Hours 72

1 Students are required to take two courses above the 750 level.
2 "Additional Courses" may include NE courses, Research courses, and Interdisciplinary courses.

Faculty

Full Professors

Dmitriy Y. Anistratov
Yousry Y. Azmy
Mohamed Abdelhay Bourham
Nam Truc Dinh
Joseph M. Doster
Jacob Eapen
John G. Gilligan
Ayman I. Hawari
Kostadin Nikolov Ivanov
John Kelly Mattingly
Kerukonda Linga Murty
Steven Christopher Shannon

Associate Professors

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Igor A. Bolotnov
Robert Bruce Hayes
Djamel Kaoumi

Assistant Professors

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Benjamin Warren Beeler
Mihai Aurelian Diaconesea

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William David Pointer
Curtis Lee Smith
Rene Van Geemert
Louise Gail Worrall
Robert Joseph Zerr

Nuclear Engineering (Minor)

Jia Hou
Katharina Stapelmann
Xu Wu
Ge Yang
Plan Requirements

Master’s Requirements

<table>
<thead>
<tr>
<th>Code</th>
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<td></td>
<td>Total Hours</td>
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</tbody>
</table>

* To receive a Master’s Minor, students must take at least one course above the 700-level; to receive a PhD Minor, students must take at least one course above the 750-level.

Faculty

Full Professors

Dmitriy Y. Anistratov
Yousry Y. Azmy
Mohamed Abdelhay Bourham
Nam Truc Dinh
Joseph M. Doster
Jacob Eapen
John G. Gilligan
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Robert Joseph Zerr

College of Humanities and Social Sciences
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- Anthropology (p. 393)
- Communication (p. 395)
- Communication, Rhetoric, and Digital Media (p. 397)
- Creative Writing (p. 400)
- English (p. 401)
- Foreign Language and Literature (p. 407)
- History (p. 408)
- International Studies (p. 412)
- Liberal Studies (p. 414)
- Philosophy & Religious Studies (p. 416)
- Psychology (p. 416)
- Public Administration (p. 420)
- Public History (p. 424)
- School of Public and International Affairs (p. 427)
- Social Work (p. 427)
- Sociology (p. 429)
- Technical Communication (p. 433)

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- English (MA) (p. 403)
- Foreign Language and Literature (MA) (http://catalog.ncsu.edu/graduate/humanities-social-sciences/foreign-language-literature/foreign-language-literature-ma/)
- Foreign Language and Literature (MA): French Language and Literature Concentration (p. 408)
- Foreign Language and Literature (MA): Spanish Language and Literature Concentration (p. 408)
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- Liberal Studies (MA) (p. 415)
- Public History (MA) (p. 424)

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- Communication, Rhetoric, and Digital Media (PhD) (p. 399)
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- History (Minor) (p. 411)
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- Liberal Studies (Minor) (p. 415)
- Psychology (Minor) (p. 420)
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- Digital Humanities (Certificate) (p. 406)
- Nonprofit Management (Certificate) (p. 423)
- Nuclear Nonproliferation Science and Policy (Certificate) (p. 435)
- Policy Analysis (Certificate) (p. 423)
- Professional Communication and Managerial Skills (Certificate) (p. 435)
- Public Policy (Certificate) (p. 436)

Anthropology

We offer a 30-hour, two-year long graduate program culminating in the Master of Arts degree with specializations in cultural anthropology, biological anthropology, and archaeology. Our faculty conduct research across the globe and prepare our students to enter top-ranked doctoral programs and to find satisfying careers in non-academic and applied settings. Students have the option to complete a master’s thesis, which we recommend for those considering going on to a PhD program, or a non-thesis project for those considering non-academic careers.

Financial Support

A limited number of Graduate Student Assistantships are available on a competitive basis.

Admissions Requirements

In addition to general Graduate School requirements, applicants are required to provide a completed application, including transcripts, three letters of recommendation, a personal statement, and a writing sample. CV or resume is optional but encouraged. GRE scores are not required. The deadline for completed applications is January 10. The curriculum is set for fall admission only.

Master’s Degree Requirements

The M.A. degree requires a total of 30 credit hours. All students take an introduction to anthropological research course in their first semester (ANT 501) and select a specialty area, such as archaeology, bioarchaeology, or cultural anthropology. Students who write a master’s thesis will take six hours of thesis research credit (ANT 695). Students completing a non-thesis project (also known as Option B) take one
independent study (ANT 598) and one additional course in place of the six hours of ANT 695 credit.

Degrees

- Anthropology (MA) (p. 394)
- Anthropology (Minor) (p. 395)

Faculty

Full Professors
Daniel Troy Case

Associate Professors
Nora M. Haenn
John K. Millhauser

Assistant Professors
Kathryn Mary Grossman
Dru Evan McGill
Julie K. Wesp

Practice/Research/Teaching Professors
Alison C. Greene
Carol Ann Lewald
Seth Murray

Emeritus Faculty
Risa Ellovich
J. M. Wallace III
William Wormsley

Anthropology (MA)

Degree Requirements

Students may choose from the thesis tracks and course specializations below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Arts in Anthropology" without specialization or track specifications

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Courses</td>
<td>Select one specialization below</td>
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<tr>
<td></td>
<td>Select one research track below</td>
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<tr>
<td>Total Hours</td>
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<td>30</td>
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Specializations

Biological Anthropology

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<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>Required Courses</td>
<td>Proseminar: Introduction to Graduate Studies in Anthropology</td>
<td>18</td>
</tr>
<tr>
<td>ANT 501</td>
<td>Human Osteology</td>
<td></td>
</tr>
<tr>
<td>ANT 521</td>
<td>Statistical Methods For Researchers I</td>
<td></td>
</tr>
<tr>
<td>ST 511</td>
<td>Theories of Archaeological Research</td>
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<tr>
<td>AN 583</td>
<td>Select six credit hours of the following:</td>
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<tr>
<td>AN 524</td>
<td>Bioarchaeology</td>
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<tr>
<td>AN 528</td>
<td>Human Paleopathology</td>
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<tr>
<td>AN 585</td>
<td>Skeletal Biology in Anthropology (can be Biological, Cultural, or Archaeology)</td>
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</table>

Elective Courses

Select three credit hours of additional electives

Total Hours

Archaeology

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Courses</td>
<td>Proseminar: Introduction to Graduate Studies in Anthropology</td>
<td>18</td>
</tr>
<tr>
<td>ANT 501</td>
<td></td>
<td></td>
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</tbody>
</table>
ANT 511 Overview of Anthropological Theory
ANT 583 Theories of Archaeological Research
ANT 575 Environmental Archaeology
or ANT 587 Cultural Resource Management

Elective Courses
Select three credit hours of additional electives  
Additional ANT credit hours or advised coursework  
Total Hours 27

1 Counts toward 6 hours of additional biological anthropology electives
2 Can be Biological, Cultural, or Archaeology
3 Total depends on thesis or plan B

Research Tracks

Thesis Track

Required Courses
- ANT 693 Masters Supervised Research
- ANT 695 Masters Research
- ANT 699 Masters Thesis Preparation

Plan B Track

Required Course
- ANT 598 Independent Study in ANT (independent study with advisor for plan B only)

Faculty

Full Professors
- Daniel Troy Case

Associate Professors
- Nora M. Haenn
- John K. Millhauser

Assistant Professors
- Kathryn Mary Grossman
- Dru Evan McGill
- Julie K. Wesp

Practice/Research/Teaching Professors
- Alison C. Greene
- Carol Ann Lewald
- Seth Murray

Emeritus Faculty
- Risa Ellovich
- J. M. Wallace III
- William Wormsley

Anthropology (Minor)

Plan Requirements
- 9 (MS student) or 12 (PhD student) credit hours

Faculty

Full Professors
- Daniel Troy Case

Associate Professors
- Nora M. Haenn
- John K. Millhauser

Assistant Professors
- Kathryn Mary Grossman
- Dru Evan McGill
- Julie K. Wesp

Practice/Research/Teaching Professors
- Alison C. Greene
- Carol Ann Lewald
- Seth Murray

Emeritus Faculty
- Risa Ellovich
- J. M. Wallace III
- William Wormsley

Communication

The Master of Science program in communication is designed to provide graduate-level expertise for solving problems in modern organizations and social systems from a communication perspective. The curriculum addresses issues concerned with interpersonal, relational and technologically mediated communication systems essential to modern, networked organizations and societies. Its graduates will acquire advanced-level expertise in communication theory, research, and applications that will improve processes and enhance outcomes within and across diverse social systems. The degree prepares students for higher-level positions in communication professions and for advanced degree programs (e.g., Ph.D. programs).
Admission Requirements
Applicants should have a minimum 3.0 GPA in the undergraduate major and a minimum of 3.0 over the last 60 hours of undergraduate work.

Master's Degree Requirements
The degree requires 36 credit hours with a minimum of 27 credit hours taken in communication. Students will be required to complete 9 hours of core requirements, and 27 hours of electives, 9 of which can be taken outside of the department with the approval of the graduate advisor. Students can also take up to 6 internship or independent study credit hours. Students on the thesis track can take up to 6 thesis credit hours.

Degrees
• Communications (MS) (p. 396)

Faculty

Full Professors
Deanna P. Dannels
Adriana Araujo de Souza e Silva
Victoria J. Gallagher
Jessica Katz Jameson
Melissa A. Johnson
Joann Keyton
William J. Kinsella
Robert Laurence Schrag
Kenneth S. Zagacki

Associate Professors
Andrew Ray Binder
Elizabeth Ann Craig
James Kiwanuka-Tondo
Kama A. Kosenko
Sarah R. Stein
Stephen B. Wiley

Assistant Professors
Yang Cheng
Nicole Marie Lee

Emeritus Faculty
Daniel A. DeJoy
Edward T. Funkhouser

Communications (MS)

Degree Requirements

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<th>Code</th>
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<td>COM 540</td>
<td>Critical and Interpretive Inquiry in Communication</td>
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<td>COM 541</td>
<td>Quantitative Research Methods in Applied Communication</td>
<td></td>
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<tr>
<td>COM 542</td>
<td>Qualitative Research Methods in Applied Communication</td>
<td></td>
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<tr>
<td>COM 561</td>
<td>Human Communication Theory</td>
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<td><strong>Elective Courses</strong></td>
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<td></td>
<td>Select nine credit hours of COM electives – see &quot;Elective Courses&quot; listed below</td>
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<tr>
<td></td>
<td><strong>Thesis Courses</strong></td>
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<td>Thesis Option</td>
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<tr>
<td>COM 695</td>
<td>MR Thesis Research</td>
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<td>COM 696</td>
<td>Summer Thesis Res</td>
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<td>Non-Thesis Option</td>
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<td>COM 688</td>
<td>Non-Thesis Masters Continuous Registration - Half Time Registration</td>
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<tr>
<td>COM 689</td>
<td>Non-Thesis Master Continuous Registration - Full Time Registration</td>
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Elective Courses

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<td>Select a minimum of three courses below:</td>
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<td>COM 514</td>
<td>History Of Rhetoric</td>
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<td>COM 516</td>
<td>Rhetorical Criticism: Theory and Practice</td>
<td>3</td>
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<tr>
<td>COM 521</td>
<td>Communication and Globalization</td>
<td>3</td>
</tr>
<tr>
<td>COM 522</td>
<td>Critical Approaches to Organizational Communication</td>
<td>3</td>
</tr>
<tr>
<td>COM 523</td>
<td>International and Intercultural Communication</td>
<td>3</td>
</tr>
<tr>
<td>COM 525</td>
<td>Group/Team Communication</td>
<td>3</td>
</tr>
<tr>
<td>COM 526</td>
<td>Media Economics</td>
<td>3</td>
</tr>
<tr>
<td>COM 527</td>
<td>Seminar in Organizational Conflict Management</td>
<td>3</td>
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<tr>
<td>COM 529</td>
<td>Communication Campaigns</td>
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<tr>
<td>COM 530</td>
<td>Interpersonal Communication in Science and Technology Organizations</td>
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<tr>
<td>COM 532</td>
<td>Communication Consulting</td>
<td>3</td>
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<tr>
<td>COM 536</td>
<td>Environmental Communication</td>
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<tr>
<td>COM 537</td>
<td>Gaming and Social Networks</td>
<td>3</td>
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<tr>
<td>COM 538</td>
<td>Risk Communication</td>
<td>3</td>
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</table>
COM 539  Fund Development  3
COM 540  Critical and Interpretive Inquiry in Communication  3
COM 541  Quantitative Research Methods in Applied Communication  3
COM 542  Qualitative Research Methods in Applied Communication  3
COM 543  Visual Content Analysis  3
COM 546  Nonprofit Marketing and Public Relations  3
COM 547  Mobile Media and Communication  3
COM 554  Contemporary Rhetorical Theory  3
COM 562  Communication and Social Change  3
COM 563  Public Relations Theory  3
COM 566  Seminar In Crisis Communication  3
COM/ENG 581  Visual Rhetoric: Theory and Criticism  3
COM 585  Teaching College Communication  3
COM 598  Special Topics In Communication  1-6
COM 598  Special Topics In Communication (Communication in Groups and Teams)  1-6
COM 598  Special Topics In Communication (International Public Relations)  1-6
COM 630  Independent Study in Communication  1-3
COM 650  Communication Internship  1-6
COM 685  Master's Supervised Teaching  1-3
COM 695  MR Thesis Research  1-6

Faculty

Full Professors
Deanna P. Dannels
Adriana Araujo de Souza e Silva
Victoria J. Gallagher
Jessica Katz Jameson
Melissa A. Johnson
Joann Keyton
William J. Kinsella
Robert Laurence Schrag
Kenneth S. Zagacki

Associate Professors
Andrew Ray Binder
Elizabeth Ann Craig
James Kiwanuka-Tondo
Kama A. Kosenko
Sarah R. Stein
Stephen B. Wiley

Assistant Professors
Yang Cheng
Nicole Marie Lee

Emeritus Faculty
Daniel A. DeJoy
Edward T. Funkhouser
William J. Jordan
Rebecca Leonard
Burton Lester Russell
Robert Laurence Schrag
Craig Allen Smith
Sarah R Stein

Communication, Rhetoric, and Digital Media

The Ph.D. Program in Communication, Rhetoric, and Digital Media prepares doctoral students to analyze the social, cultural, rhetorical, philosophical, and political dimensions of information technologies, new communication media, and digital texts, and to actively engage digital media through research, criticism, production, and practice.

Students work with program faculty from the departments of Communication and English and with affiliated faculty from departments across the university and the broader UNC system to study oral, written, visual, computational, and multimodal forms of communication and rhetoric; to examine the transformation of communication in the context of converging digital media and communication networks; and to address the theoretical and practical challenges of innovative, interdisciplinary research.


Faculty guide students in their work by using a broad range of social scientific and humanistic methods in which they specialize. The program offers comprehensive mentoring for professional development, diverse opportunities for teaching experience, and research assistantships associated with grant-funded faculty projects. CRDM faculty and students collaborate with colleagues in science and technology fields across the university and the Research Triangle.

Our graduates have been very successful finding employment in a variety of positions in academia (both at research-intensive universities and at teaching-oriented liberal arts colleges), government and corporate
organizations, where there is a growing demand for the interdisciplinary skill sets developed in CRDM.

See our website (http://crdm.chass.ncsu.edu/) for more details.

**Admission Requirements**

Master’s degree in Communication, English, Rhetoric, or other relevant field with GPA of 3.0 or better. Master’s level work should include one quantitative or qualitative methods course, as well as three courses in an approved disciplinary area. These hours do not count toward the doctoral degree. Disciplinary areas include: composition studies, including writing across the curriculum, interpersonal/group communication, media studies, organizational communication or public relations, rhetorical studies, and technical communication.

Applicants who are otherwise well qualified may make up these courses after admission. Three reference letters, a statement of goals and interests, a resume of work experience, and a writing sample are also required for application to the program. GRE is not required. The application deadline is January 15th.

**Ph.D. Degree Requirements**

A minimum of 56 hours beyond the Master’s degree are required to complete the Ph.D. program: 15 credit hours of core courses, 3 hours of research methods, 6 hours of professional preparation, 12 hours in an elective focus area, and 20 hours of research and dissertation.

**Student Financial Support**

The CRDM program offers a limited number of Teaching Assistantships, with a stipend, health insurance, and tuition (excluding fees). Teaching Assistants will be assigned according to their interests and qualifications, as well as departmental needs, to either the Communication or the English Department with the possibility of teaching in both departments during their course of study. Those who do not have sufficient qualifications to teach in the first semester will participate in a training program. Some Research Assistantships may also be available.

**Degrees**

- Communication, Rhetoric, and Digital Media (PhD) (p. 399)

**Faculty**

**Full Professors**

Christopher M. Anson
Deanna P. Dannels
John D. Morillo
Adriana Araujo de Souza e Silva
Victoria J. Gallagher
Jean Elizabeth Goodwin
Marsha Gabrielle Gordon
Jessica Katz Jameson
Melissa A. Johnson

Hans Dodds Kellner
William J. Kinsella
Jason Swarts
John N. Wall
Kenneth S. Zagacki

**Associate Professors**

Andrew Ray Binder
Grant David Bollmer
Helen Jane Burgess
Elizabeth Ann Craig
Huiling Ding
Casie J. Fedukovich
Paul Camm Fyfe
Ora Gelley
Andrew Robert Johnston
James Kiwanuka-Tondo
Kami A. Kosenko
Stacey L. Pigg
David Maurice Rieder
Timothy Linwood Stinson
Nicholas Thiel Taylor
Douglas M. Walls
Rebecca Ann Walsh
Stephen B. Wiley

**Assistant Professors**

Zachary Beare
Ronisha Witlee Browdy
Franklin D. Cason
Yang Cheng
Fernanda Duarte
Veljko Dubljevic
Noura Howell
Michelle McMullin
Emeritus Faculty
Michael P. Carter
David H. Covington
Robert S. Dicks
William J. Jordan
Susan M. Katz
William J. Kinsella
Carolyn Rae Miller
Devin A. Orgeron
Ann M. Penrose
Robert Laurence Schrag
Sarah R. Stein

Communication, Rhetoric, and Digital Media (PhD)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tr>
<td><strong>Core Courses</strong></td>
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<tr>
<td>CRD 701</td>
<td>History and Theory of Media Technologies</td>
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<tr>
<td>CRD 702</td>
<td>Rhetoric and Digital Media</td>
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<tr>
<td>CRD 703</td>
<td>Communication Networks</td>
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<tr>
<td>CRD 704</td>
<td>Communication, Technologies, and Pedagogy</td>
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<tr>
<td>CRD 790</td>
<td>Scholarly and Professional Paths in Disciplinary and Interdisciplinary Research</td>
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<tr>
<td>COM 541</td>
<td>Quantitative Research Methods in Applied Communication</td>
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<tr>
<td>COM 543</td>
<td>Visual Content Analysis</td>
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<tr>
<td>ENG 508</td>
<td>Usability Studies for Technical Communication</td>
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<tr>
<td>ENG 513</td>
<td>Empirical Research In Composition</td>
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<tr>
<td>COM 581</td>
<td>Visual Rhetoric: Theory and Criticism</td>
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<tr>
<td>ENG 543</td>
<td>Introduction to Digital Humanities</td>
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<td>COM/ENG</td>
<td>Verbal Data Analysis</td>
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<td>COM/ENG</td>
<td>Rhetorical Criticism: Theory and Practice</td>
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<tr>
<td>516</td>
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<tr>
<td>COM 540</td>
<td>Critical and Interpretive Inquiry in Communication</td>
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<td>COM 542</td>
<td>Qualitative Research Methods in Applied Communication</td>
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<tr>
<td>COM 543</td>
<td>Visual Content Analysis</td>
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<tr>
<td>ENG 527</td>
<td>Discourse Analysis</td>
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<tr>
<td>ENG 532</td>
<td>Narrative Analysis</td>
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</tr>
<tr>
<td>ENG 587</td>
<td>Interdisciplinary Studies in English</td>
<td></td>
</tr>
<tr>
<td>ENG 513</td>
<td>Empirical Research In Composition (Methods and Theories in Media studies)</td>
<td></td>
</tr>
</tbody>
</table>

**Elective Courses**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th></th>
</tr>
</thead>
</table>

Select an elective focus approved in conjunction with the academic committee

**Additional Courses**

<table>
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<tbody>
<tr>
<td>CRD 809</td>
<td>Colloquium in Communication, Rhetoric, and Digital Media</td>
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<td>COM 585</td>
<td>Teaching College Communication</td>
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<tr>
<td>ENG 511</td>
<td>Theory and Research In Composition</td>
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</tr>
<tr>
<td>CRD 885</td>
<td>Doctoral Supervised Teaching</td>
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**Dissertation and Exam courses**

Select 20 credit hours of Exams and Dissertation courses of the following:

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<th>Code</th>
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<tbody>
<tr>
<td>CRD 895</td>
<td>Doctoral Dissertation Research</td>
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<td>CRD 893</td>
<td>Doctoral Supervised Research</td>
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</tr>
<tr>
<td>CRD 899</td>
<td>Doctoral Dissertation Preparation</td>
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</tr>
<tr>
<td>ENG/COM</td>
<td>Directed Readings in English Studies</td>
<td>810</td>
</tr>
</tbody>
</table>

**Total Hours**

- ENG 543 Introduction to Digital Humanities is Interdisciplinary Studies in English. Not all topics will fulfill a methods course.
- Minimum 6/20 credits

**Faculty**

**Full Professors**

Deanna P. Dannels
Adriana Araujo de Souza e Silva
Victoria J. Gallagher
Jessica Katz Jameson
Melissa A. Johnson
Joann Keyton
William J. Kinsella
Robert Laurence Schrag
Kenneth S. Zagacki

**Associate Professors**

Andrew Ray Binder
Elizabeth Ann Craig
James Kiwanuka-Tondo
Kama A. Kosenko
Sarah R. Stein
Stephen B. Wiley
Creative Writing

The Department of English offers a two-year studio/academic program in fiction or poetry leading to the Master of Fine Arts degree. The program provides an opportunity for students of superior and demonstrated ability in imaginative writing to develop their skills and critical judgment through the practice of writing and the study of literature. The aim of the program is to prepare talented students for careers in writing. Degree candidates are expected to produce a book-length work of literary value and publishable quality.

Admission Requirements

Overall GPA of 3.0 or higher; applicants should submit GRE scores (general aptitude and analytical writing); one official transcript of all undergraduate and graduate work; three letters of recommendation; and two writing samples, one creative, one critical. Creative sample: for fiction, two short stories, or for a novel, three chapters (or one chapter and a short story) totaling 25-40 pages; for poetry, 12 complete poems. Critical sample: no more than 15 pages of writing demonstrating your ability to succeed in graduate-level literature classes, a required part of the MFA curriculum.

Requirements for the MFA in Creative Writing

Candidates for the MFA degree must complete a total of 36 credits. Eighteen of these are taken in the area of writing specialization. These include workshop courses (12 credits) and thesis (6 credits). The remaining credits are taken in literature (6 credits) and elective areas (12 credits, including 6 credit hours of teaching preparation for those on a composition teaching assistantship). In their final semester, students must pass a comprehensive written examination on writing craft, based on a book list selected jointly by the student and the faculty. The final thesis must be a book-length manuscript in the student's field of interest. In fiction, an approximate 200 pages are expected; in poetry, 60 pages. See program website for specific requirements by concentration.

Student Financial Support

All students admitted to the MFA program are eligible for teaching assistantships. TAs in the MFA train to teach undergraduate composition courses, and a few selected creative writing classes.

Other Relevant Information

Application deadline is February 1. Students are admitted for the fall semester only.

The English department has a long tradition of academic and literary excellence, including its heritage of writers from Guy Owen to Lee Smith. The strength of NCSU in the sciences offers students the opportunity to do creative work that engages with issues of technology and its effect on individuals and institutions that are not typically addressed in fine arts programs.

Through the NC State Literary Readings Series, the department sponsors readings and visits by distinguished poets, fiction and non-fiction writers.

Degrees

- Creative Writing (MFA) (p. 400)

Faculty

Full Professors

Wilton Barnhardt
Dorianne Louise Laux

Associate Professors

Belle McQuaide Boggs

Assistant Professors

Eduardo C. Corral
Cadwell Turnbull

Practice/Research/Teaching Professors

John J. Kessel
Jill Collins McCorkle
Joseph H. Millar

Creative Writing (MFA)

Degree Requirements

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<tr>
<th>Code</th>
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<td>ENG 588</td>
<td>Fiction Writing Workshop</td>
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<tr>
<td>ENG 589</td>
<td>Poetry Writing Workshop</td>
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<td>ENG 509</td>
<td>Old English Literature</td>
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<tr>
<td>ENG 510</td>
<td>Middle English Literature</td>
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<tr>
<td>ENG 529</td>
<td>16th-Century Non-Dramatic English Literature</td>
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</tr>
</tbody>
</table>
English

The M.A. is a 33-hour program offered in four concentrations: literature, rhetoric and composition, linguistics and film studies. Regardless of which path you choose, you'll select from a broad array of courses that will help you meet your personal and professional goals.

Admissions Requirements

Students must submit a personal statement, writing sample, and three letters of recommendations. The application deadline is June 15 for fall semester admission and November 1 for spring. The application deadline to be considered for a teaching assistantship is February 1. Students are admitted for either the fall or spring semesters.

Requirements for MA in English

We offer four areas of concentration that represent distinct dimensions of our discipline. While all options share an emphasis on research and critical thinking, each provides diverse pathways for exploring culture and language. You'll hone your expertise through each concentration's core and elective curriculum (https://english.chass.ncsu.edu/graduate/ma/#degree-requirements). At the end of the 33-hour program, you'll fine-tune and showcase your knowledge through a capstone project.

Student Financial Support

Teaching assistantships (https://english.chass.ncsu.edu/graduate/teaching_assistantships.php) are available for a limited number of promising students. Assistantships are awarded upon admission and are only available for full-time students who begin their graduate work in the fall semester. These students will work with an experienced faculty member during their first year in the program before teaching classes during their second year. Most TAs will teach composition in the First-Year Writing Program while a few others may teach linguistics or film studies.

Degrees

- English (MA) (p. 403)
- Digital Humanities (Certificate) (p. 406)

Faculty

Full Professors
Wilton Barnhardt
Dorianne Louise Laux

Associate Professors
Belle McQuaide Boggs

Assistant Professors
Eduardo C. Corral
Cadwell Turnbull

Practice/Research/Teaching Professors
John J. Kessel

Jill Collins McCorkle
Joseph H. Millar
Dorianne Louise Laux
Leila S. May
Jeffrey Ingle Mielke
Jason Miller
John D. Morillo
Miriam E. Orr
Juliana Makuchi Nfah-Abbenyi
Jeffrey Leo Reaser
Sharon M. Setzer
Laura Ruth Severin
Allen Frederick Stein
Jason Swarts
Erik R. Thomas
Jon F. Thompson
John N. Wall Jr.
Catherine A. Warren
Walter A. Wolfram
Rebecca Ann Walsh

Assistant Professors
Zachary Charles Beare
Ronisha Witlee Browdy
Franklin D. Cason
Eduardo C. Corral
Andrew Robert Johnston
Michelle McMullin
Cadwell Turnbull

Practice/Research/Teaching Professors
Josie Torres Barth
Brian Blackley
Anna Marie Gibson-Knowles
John J. Kessel
James Robert Knowles
Jill Collins McCorkle
Joseph H. Millar

Emeritus Faculty
Barbara Joan Baines
John Balaban
Philip E. Blank Jr.
Michael P. Carter
David H. Covington
Robert S. Dicks
James W. Clark Jr.
Angela Mackie Davis-Gardner
Jack D. Durant
Joseph A. Gomez
Charlotte Gross
Linda T. Holley
Deborah Hooker
Marvin Hunt
Susan M. Katz
John J. Kessel
English (MA)

Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: “Master of Arts in English” without focus area track specifications.

Focus Tracks are as follows:

Film Studies Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG 587</td>
<td>Interdisciplinary Studies in English</td>
<td>6</td>
</tr>
<tr>
<td>ENG 676</td>
<td>Master's Project in English</td>
<td></td>
</tr>
</tbody>
</table>

Core Courses

Select nine credit hours 500-level film courses of the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG 585</td>
<td>Studies in Film</td>
</tr>
<tr>
<td>ENG 591</td>
<td>Studies in National Cinemas</td>
</tr>
</tbody>
</table>

Select six credit hour film courses of the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG 585</td>
<td>Studies in Film</td>
</tr>
<tr>
<td>ENG 591</td>
<td>Studies in National Cinemas</td>
</tr>
<tr>
<td>ENG 592</td>
<td>Special Topics in Film Styles and Genres</td>
</tr>
<tr>
<td>ENG 636</td>
<td>Directed Readings</td>
</tr>
</tbody>
</table>

Elective Courses

Select six credit hours of the following literature electives: 1

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG 509</td>
<td>Old English Literature</td>
</tr>
<tr>
<td>ENG 510</td>
<td>Middle English Literature</td>
</tr>
<tr>
<td>ENG 529</td>
<td>16th-Century Non-Dramatic English Literature</td>
</tr>
</tbody>
</table>

Total Hours 33

1 American, British, or World literature, or literary theory

Linguistics Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG 530</td>
<td>17th-Century English Literature</td>
<td></td>
</tr>
<tr>
<td>ENG 531</td>
<td>American Colonial Literature</td>
<td></td>
</tr>
<tr>
<td>ENG 551</td>
<td>Chaucer</td>
<td></td>
</tr>
<tr>
<td>ENG 558</td>
<td>Studies In Shakespeare</td>
<td></td>
</tr>
<tr>
<td>ENG 561</td>
<td>Milton</td>
<td></td>
</tr>
<tr>
<td>ENG 578</td>
<td>English Drama To 1642</td>
<td></td>
</tr>
<tr>
<td>ENG 582</td>
<td>Studies in Literature</td>
<td></td>
</tr>
<tr>
<td>ENG 550</td>
<td>English Romantic Period</td>
<td></td>
</tr>
<tr>
<td>ENG 560</td>
<td>Victorian Poetry and Critical Prose</td>
<td></td>
</tr>
<tr>
<td>ENG 562</td>
<td>18TH-Century English Literature</td>
<td></td>
</tr>
<tr>
<td>ENG 563</td>
<td>18TH-Century English Novel</td>
<td></td>
</tr>
<tr>
<td>ENG 564</td>
<td>Victorian Novel</td>
<td></td>
</tr>
<tr>
<td>ENG 570</td>
<td>20TH-Century British Prose</td>
<td></td>
</tr>
<tr>
<td>ENG 571</td>
<td>20TH-Century British Poetry</td>
<td></td>
</tr>
<tr>
<td>ENG 572</td>
<td>Modern British Drama</td>
<td></td>
</tr>
<tr>
<td>ENG 579</td>
<td>Restoration and 18th-Century Drama</td>
<td></td>
</tr>
<tr>
<td>ENG 531</td>
<td>American Colonial Literature</td>
<td></td>
</tr>
<tr>
<td>ENG 548</td>
<td>African-American Literature</td>
<td></td>
</tr>
<tr>
<td>ENG 555</td>
<td>American Romantic Period</td>
<td></td>
</tr>
<tr>
<td>ENG 565</td>
<td>American Realism and Naturalism</td>
<td></td>
</tr>
<tr>
<td>ENG 573</td>
<td>Modern American Drama</td>
<td></td>
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<tr>
<td>ENG 575</td>
<td>Southern Writers</td>
<td></td>
</tr>
<tr>
<td>ENG 576</td>
<td>20TH-Century American Poetry</td>
<td></td>
</tr>
<tr>
<td>ENG 577</td>
<td>20TH-Century American Prose</td>
<td></td>
</tr>
<tr>
<td>ENG 580</td>
<td>Literary Postmodemism</td>
<td></td>
</tr>
<tr>
<td>ENG 539</td>
<td>Seminar In World Literature</td>
<td></td>
</tr>
<tr>
<td>ENG 549</td>
<td>Modern African Literature</td>
<td></td>
</tr>
<tr>
<td>ENG 532</td>
<td>Narrative Analysis</td>
<td></td>
</tr>
<tr>
<td>ENG 540</td>
<td>History Of Literary Criticism</td>
<td></td>
</tr>
<tr>
<td>ENG 541</td>
<td>Literary and Cultural Theory</td>
<td></td>
</tr>
<tr>
<td>ENG 586</td>
<td>Studies In Theory</td>
<td></td>
</tr>
<tr>
<td>ENG 676</td>
<td>Master's Project in English</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 33

Distribution Requirements

Select one course in Theory and Research in Composition approved in conjunction with the academic committee

Select one course in the History of Rhetoric approved in conjunction with the academic committee

Concentration Requirements

Select a minimum of six courses in Linguistics approved in conjunction with the academic committee

Select a minimum of three 500-level or above ENG or complimentary fields of study courses approved in conjunction with the academic committee

Research Course

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>ENG 676</td>
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Total Hours 33
**Literature Track**

<table>
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<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>ENG 669</td>
<td>Literature, Methods, and the Profession</td>
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</tr>
<tr>
<td>ENG 676</td>
<td>Master's Project in English</td>
<td></td>
</tr>
</tbody>
</table>

**Distribution Requirements**

12

Select one of the following courses in British Literature before 1660:

- ENG 509 Old English Literature
- ENG 510 Middle English Literature
- ENG 529 16th-Century Non-Dramatic English Literature
- ENG 520 Science Writing for the Media
- ENG 551 Chaucer
- ENG 558 Studies In Shakespeare
- ENG 561 Milton
- ENG 578 English Drama To 1642
- ENG 582 Studies in Literature (when topic applies)

Select one of the following courses in British Literature after 1660:

- ENG 550 English Romantic Period
- ENG 560 Victorian Poetry and Critical Prose
- ENG 562 18TH-Century English Literature
- ENG 563 18TH-Century English Novel
- ENG 564 Victorian Novel
- ENG 570 20TH-Century British Prose
- ENG 571 20TH-Century British Poetry
- ENG 572 Modern British Drama
- ENG 579 Restoration and 18th-Century Drama
- ENG 582 Studies in Literature (when topic applies)

Select one of the following courses in American literature:

- ENG 531 American Colonial Literature
- ENG 548 African-American Literature
- ENG 555 American Romantic Period
- ENG 565 American Realism and Naturalism
- ENG 573 Modern American Drama
- ENG 575 Southern Writers
- ENG 576 20TH-Century American Poetry
- ENG 577 20th-Century American Prose
- ENG 580 Literary Postmodernism
- ENG 582 Studies in Literature (when topic applies)

Select one of the following courses in Rhetoric, Linguistics, Composition, Film Studies, Criticism, or Theory:

- ENG 539 Seminar In World Literature
- ENG 549 Modern African Literature
- ENG 532 Narrative Analysis
- ENG 540 History Of Literary Criticism
- ENG 541 Literary and Cultural Theory
- ENG 580 Literary Postmodernism
- ENG 582 Studies in Literature
- ENG 586 Studies In Theory
- ENG 523 Language Variation Research Seminar
- ENG 524 Introduction to Linguistics
- ENG 525 Variety In Language
- ENG 527 Discourse Analysis

**Elective Courses**

15

Select three literature courses approved in conjunction with the academic committee

Select two elective courses in English or complementary fields of study approved in conjunction with the academic committee

Total Hours 33

**Rhetoric and Composition Track**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG 511</td>
<td>Theory and Research In Composition</td>
<td>6</td>
</tr>
</tbody>
</table>

Select a course of the following:

- ENG 514 History Of Rhetoric
- ENG 516 Rhetorical Criticism: Theory and Practice
- ENG 554 Contemporary Rhetorical Theory
- ENG 515 Rhetoric Of Science and Technology

**Elective Courses**

18

Select two courses from either the disciplinary core or research component

Select a minimum of two literature courses approved in conjunction with the academic committee

Select a minimum of six 500-level and above ENG courses or complementary fields of study approved in conjunction with the academic committee

**Linguistics Course**

3

Select a Linguistics course in any language approved in conjunction with the academic committee

**Research Component**

6

Select one of the following courses:

- ENG 676 Master's Project in English
- ENG 506 Verbal Data Analysis
- ENG 513 Empirical Research In Composition
- ENG/COM 516 Rhetorical Criticism: Theory and Practice
- ENG 527 Discourse Analysis
- ENG 532 Narrative Analysis
- ENG/COM 581 Visual Rhetoric: Theory and Criticism
- ENG 583 Studies In Rhetoric and Writing
ENG 585  Studies In Film
ENG 587  Interdisciplinary Studies in English

Total Hours  33

1  American, British, or World literature, film studies, or literary theory.
2  Rhetoric and Composition, Linguistics, literature, digital humanities
   or other areas in the English Department. Courses in the Department
   of Communication, Foreign Languages, History, Psychology, the
   College of Education, and other fields may be appropriate as well.

Faculty

Full Professors
Christopher M. Anson
William Wilton Barnhardt
Barbara A. Bennett
Robin M. Dodsworth
Antony Howard Harrison
Marsha Gabrielle Gordon
James M. Grimwood
Hans Dodds Kellner
Dorianne Louise Laux
Leila S. May
Jeffrey Ingle Mielke
Jason Miller
John D. Morillo
Miriam E. Orr
Juliana Makuchi Nlah-Abbenyi
Jeffrey Leo Reaser
Sharon M. Setzer
Laura Ruth Severin
Allen Frederick Stein
Jason Swarts
Erik R. Thomas
Jon F. Thompson
John N. Wall Jr.
Catherine A. Warren
Walter A. Wolfram

Assistant Professors
Belle McQuaide Boggs
Agnes Bolonyai
Helen Jane Burgess
Christopher James Crosbie
Huiling Ding
Marc K. Dudley
Casie J. Fedukovich
Paul Camm Fyfe
Ora Gelley
James S. Mulholland
Jennifer Anne Nolan
Stacey L. Pigg
David M. Rieder
Margaret Simon
Timothy Linwood Stinson
Douglas M. Walls
Rebecca Ann Walsh

Assistant Professors
Zachary Charles Beare
Ronisha Witlee Browdy
Franklin D. Cason
Eduardo C. Corral
Andrew Robert Johnston
Michelle McMullin
Cadwell Turnbull

Practice/Research/Teaching Professors
Josie Torres Barth
Brian Blackley
Anna Marie Gibson-Knowles
John J. Kessel
James Robert Knowles
Jill Collins McCorkle
Joseph H. Millar
The Certificate in Digital Humanities is designed for students from any discipline to construct a curriculum in digital humanities training and project work. The certificate is currently coordinated in the English department with participation across CHASS and other colleges.

The Graduate Certificate consists of a student-proposed curriculum of four 3-credit courses which must collectively satisfy the program’s three requirements: contexts, training, and applications. In consultation with the coordinator, students can propose their own tracks through the certificate drawing from a broad array of approved courses at NC State as well as at UNC and Duke, as part of the Triangle Digital Humanities Network. Rather than insisting on a prescriptive definition and preset curriculum for “digital humanities,” this certificate program encourages students to adapt course offerings in digital humanities or digital media to their own evolving research and professional interests in any variety of fields.

To qualify for admission to the Graduate Certificate in Digital Humanities, students must be enrolled in, or have completed, a Master’s or PhD program at an accredited university. Applicants can be either non-degree or degree students. Degree students must have a 3.00 grade point average in their graduate degree program. Non-degree students must have a final grade point average that is at least 3.00. Current degree students in History can apply up to nine (9) towards a doctorate. Students seeking the certificate from other programs must consult with those graduate coordinators to confirm allowed credits toward degree. The certificate will accept up to three hours of transfer credit from courses included in the curriculum. All GCP requirements must be completed within three (3) calendar years beginning on the date the student commences applicable courses.

### Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Required Courses</strong></td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Select 12 credit hours of electives:</td>
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</tr>
<tr>
<td>ENG 506</td>
<td>Verbal Data Analysis</td>
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</tr>
<tr>
<td>ENG 519</td>
<td>Online Information Design and Evaluation</td>
<td></td>
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<tr>
<td>ENG 583</td>
<td>Studies In Rhetoric and Writing</td>
<td></td>
</tr>
<tr>
<td>ENG 584</td>
<td>Studies In Linguistics</td>
<td></td>
</tr>
<tr>
<td>ENG 587</td>
<td>Interdisciplinary Studies in English</td>
<td></td>
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<tr>
<td>CRD 702</td>
<td>Rhetoric and Digital Media</td>
<td></td>
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<tr>
<td>HI 534</td>
<td>Theory and Practice of Digital History</td>
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<tr>
<td>HI 535</td>
<td>Spatial History</td>
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<tr>
<td>HI 599</td>
<td>Independent Study</td>
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<tr>
<td>COM 537</td>
<td>Gaming and Social Networks</td>
<td></td>
</tr>
<tr>
<td>COM 547</td>
<td>Mobile Media and Communication</td>
<td></td>
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<tr>
<td>COM 598</td>
<td>Special Topics In Communication (Internet and Society)</td>
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<td>ADN 419</td>
<td>Creative Technology Studio I</td>
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<td>ADN 423</td>
<td>Digital Modeling</td>
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<td>ADN 502</td>
<td>Advanced Visual Laboratory</td>
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<tr>
<td>ADN 561</td>
<td>Graduate Studio II: Exploring the HyperReal: Materiality, Reality and Speculation</td>
<td></td>
</tr>
<tr>
<td>ECI 511</td>
<td>Introduction to Learning Design and Technology</td>
<td></td>
</tr>
<tr>
<td>ECI 512</td>
<td>Emerging Technologies for Teaching and Learning</td>
<td></td>
</tr>
<tr>
<td>ECI 513</td>
<td>Teaching and Learning with Digital Video</td>
<td></td>
</tr>
<tr>
<td>ECI 514</td>
<td>Developing and Delivering Online Instruction</td>
<td></td>
</tr>
</tbody>
</table>
Foreign Language and Literature

The Master's degree in Foreign Languages and Literature offers concentrations in both French Language and Literature and Spanish Language and Literature.

Admission Requirements

- A baccalaureate degree from an accredited college or university
- Undergraduate GPA of 3.0 or above
- Narrative statement of professional and personal objectives (in English, 300 words).
- Language proficiency as determined by a writing sample and a speaking sample in the target language (French or Spanish). Follow the specific sample guidelines (https://fll.chass.ncsu.edu/graduate/application_information.php#Sample).
- Some applicants may be given provisional admittance. Students admitted provisionally must complete at least 9 hours of 500-level courses in the target language, earning grades of B or higher in order to receive full graduate standing.
- Visit the program’s web site (https://fll.chass.ncsu.edu/graduate/) for complete admissions information.

Degree Requirements

The program requires at least 30 hours of course work and a culminating project. Each student’s program is tailored to enhance his or her career objectives. Students who plan to pursue a Ph.D. or teach in a college community or university receive the requisite training and assistance. K-12 teachers who already have “Initial” or “A” licensure may earn “M” licensure by taking 30 hours in specified disciplines and completing an Action Research Project as their culminating project. K-12 teachers who already hold “A” licensure can add-on English as a Second Language (ESL) licensure by taking 36 hours in specified disciplines. Visit the program web site (https://fll.chass.ncsu.edu/graduate/plans_of_study.php) for complete departmental course requirement information.

Student Financial Support

Graduate assistantships are available to students in both the French and Spanish concentrations and are awarded by open competition and based on the strength of the admissions application.

Other Relevant Information

Students are admitted for the fall semester only. February 1 is the application deadline for students interested in receiving full consideration for a teaching assistantship. (Interest is indicated on the Graduate School Admissions application.) February 15 is the deadline for international students and May 1 for domestic students.

Degrees

- Foreign Language and Literature (MA): French Language and Literature Concentration (p. 408)
- Foreign Language and Literature (MA): Spanish Language and Literature Concentration (p. 408)
- Foreign Language and Literature (MA): Teaching of English to Speakers of Other Languages (TESOL) Concentration (p. 408)

Full Professors

Gregory A. Dawes
Thomas P. Feeny
Michael D. Garval
Hector A. Jaimes
Dudley Michael Marchi
Jorge Mari
James Casimir Michnowicz
Jose Agustin Pasten

Associate Professors

Mark Anthony Darhower
Jeffrey Scott Despain
Shelley E. Garrigan
Larysa Anna Mykyta
Rebecca Ellen Ronquest
Valerie Ann Wust

Assistant Professors

Johanna Montlouis-Gabriel

Practice/Research/Teaching Professors

Laura K. Call
Mary Michaels Estrada
Foreign Language and Literature (MA): French Language and Literature Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Courses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLF 520</td>
<td>Approaches to Literary Theory and Culture (course pending Admin Board approval 2020)</td>
<td>9</td>
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<tr>
<td>FL 507</td>
<td>College Teaching of Foreign Languages</td>
<td></td>
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<tr>
<td>FLF 675</td>
<td>Special Project in French</td>
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<tr>
<td>Elective Courses</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Select at least a minimum of four of the following:</td>
<td></td>
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<tr>
<td>FLF 502</td>
<td>Variety in Language: French</td>
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</tr>
<tr>
<td>FLF 511</td>
<td>Approaches to French Translation</td>
<td></td>
</tr>
<tr>
<td>FLF 521</td>
<td>French Cultures and Contexts</td>
<td></td>
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<tr>
<td>FLF 525</td>
<td>Literature, Cinema and Culture of the Francophone World</td>
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<td>FLF 592</td>
<td>Seminar in French Studies</td>
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<tr>
<td>FLF 595</td>
<td>Special Topics in French</td>
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</tr>
<tr>
<td>Additional elective courses are approved in conjunction with the academic committee to meet the 30 total credit hours</td>
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<td></td>
</tr>
</tbody>
</table>

Total Hours | 30

* Only FLF 520 and FLF 675 are required for the degree; FL 507 is also required of GTAs.

Foreign Language and Literature (MA): Spanish Language and Literature Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Courses</td>
<td>12</td>
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<tr>
<td>FLS 502</td>
<td>Linguistic Structure of Spanish</td>
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<tr>
<td>FLS 520</td>
<td>Survey of Hispanic Literature and Culture</td>
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</tr>
<tr>
<td>FLS 507</td>
<td>College Teaching of Foreign Languages</td>
<td></td>
</tr>
<tr>
<td>FLS 675</td>
<td>Special Project in Spanish</td>
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</tr>
<tr>
<td>Elective Courses</td>
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<td></td>
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<tr>
<td>Select a minimum of three of the following courses:</td>
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<tr>
<td>FLS 503</td>
<td>Spanish Applied Linguistics</td>
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<td>FLS 504</td>
<td>Spanish Language Change and Variation</td>
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<td>FLS 509</td>
<td>Spanish Phonetics and Phonology</td>
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<td>FLS 512</td>
<td>Spanish in the United States</td>
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<tr>
<td>FLS 515</td>
<td>History of Spanish Language</td>
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<tr>
<td>FLS 528</td>
<td>Don Quixote</td>
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<td>FLS 530</td>
<td>The Cultural Production of Spanish Democracy</td>
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<td>FLS 545</td>
<td>Spanish Environmental Cultural Studies</td>
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<td>FLS 553</td>
<td>The Latin American Avant-Garde</td>
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<td>FLS 554</td>
<td>The Sixties in Latin America</td>
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<td>FLS 563</td>
<td>The Latin American Novel</td>
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<td>FLS 592</td>
<td>Seminar in Hispanic Studies</td>
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<td>FLS 595</td>
<td>Special Topics in Spanish</td>
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<td>Additional elective courses are approved in conjunction with the academic committee to meet the 30 total credit hours</td>
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</table>

Total Hours | 30

*Elective Courses* are approved in conjunction with the academic committee

Foreign Language and Literature (MA): Teaching of English to Speakers of Other Languages (TESOL) Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
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<tr>
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<tr>
<td>FL 524</td>
<td>Linguistics for ESL Professionals</td>
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<tr>
<td>FL 527</td>
<td>Methods and Materials in Teaching English as a Second Language</td>
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<tr>
<td>FL 535</td>
<td>Teaching Academic Writing to Multilingual Learners</td>
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<td>FL 536</td>
<td>Perspectives on English as a New Language</td>
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<td>FL 595</td>
<td>Special Topics in Foreign Languages and Literatures</td>
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<tr>
<td>Issues and Trends in Foreign Language</td>
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<tr>
<td>&amp; Education: Theory &amp; Practice and Second Language Acquisition Research: Interlanguage Development</td>
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<tr>
<td>FL 507 &amp; FL 508</td>
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<tr>
<td>&amp; Second Language Acquisition Research: Interlanguage Development</td>
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</table>

Total Hours | 30

History

Admission Requirements

Admission to the M.A. in History and Public History programs require: a bachelor’s degree from an accredited college or university; transcripts; personal statement, listing career goals, historical interests, and potential advisor; letters of recommendation; and a writing sample of...
approximately ten pages. Admission to the Ph.D. in Public History requires a bachelor’s degree from an accredited college or university; transcripts; scores from the Graduate Record Exam (GRE); personal statement, listing career goals, historical interests, and potential advisor; letters of recommendation; and a writing sample of approximately ten pages.

**Master’s Degree Requirements**

Master of Arts Degree in History: This program requires a total of 30 credit hours, including 6 hours in core courses, 12 credit hours in a major field, 6 credit hours in a minor field, and 6 credit hours in thesis work. Each student’s program is tailored to enhance his or her career objectives. Social studies teachers, for example, may earn advanced competency on completion of the M.A. in history with additional course work in education. Similarly, students who plan to pursue a Ph.D. degree receive the requisite training and assistance. Master of Arts Degree in Public History: This program requires 36 credit hours of course work. Students may take a non-thesis or thesis option. Half the hours fall in historical studies, the rest in applied history classes, including innovative courses in museum studies and heritage studies. Students perform internships in their own special areas of interest.

**Doctoral Degree Requirements**

The Ph.D. program in Public History requires 72 credit hours. Students complete 21 credit hours in a public history field, including an internship; 21 credit hours in a history field; 6 credit hours in an outside field; and 24 credit hours of dissertation work.

**Student Financial Support**

Graduate teaching assistantships are available to students in all programs and are awarded by open competition.

**Other Relevant Information**

The application deadline for fall semester is January 15; students are admitted for the fall semester only.

**Degrees**

- History (MA) (p. 409)
- History (Minor) (p. 411)

**Faculty**

**Full Professors**

William Adler
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Murray S. Downs
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John M. Riddle
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Gerald Surh

**History (MA)**

**Degree Requirements**

<table>
<thead>
<tr>
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<th>Title</th>
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<tr>
<td>HI 597</td>
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<td>HI 598</td>
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<td>Secondary Field Courses</td>
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</table>

Select a minimum of four courses of 500-level or above courses approved in conjunction with the academic committee.
Select a minimum of three courses other than those used to fulfill the “Primary Field Courses” approved in conjunction with the academic committee.

**Thesis Research Course**

<table>
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**Total Hours**: 30

### Primary, Secondary, and Thesis Prep Courses

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<td>HI 502</td>
<td>Early Christianity to the Time of Eusebius</td>
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<td>HI 503</td>
<td>Ancient Greek Civilization</td>
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<tr>
<td>HI 504</td>
<td>Rome to 337 A.D.</td>
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<td>HI 505</td>
<td>History and Archaeology of the Roman Empire</td>
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<td>HI 506</td>
<td>From Roman Empire to Middle Ages</td>
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<td>HI 507</td>
<td>Islamic History to 1798</td>
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<td>HI 508</td>
<td>Islam in the Modern World</td>
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<td>HI 509</td>
<td>The High Middle Ages</td>
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<td>HI 511</td>
<td>Trials of Faith: Religious Reformation in Early-Modern Europe</td>
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<td>HI 512</td>
<td>The Sexes and Society in Early-Modern Europe</td>
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<td>HI 514</td>
<td>From Kings to Revolution: The History of Early-Modern France</td>
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<td>HI 515</td>
<td>The French Revolution</td>
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<td>HI 518</td>
<td>Fascist Italy and Nazi Germany</td>
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<td>HI 519</td>
<td>Modern European Imperialism</td>
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<td>HI 521</td>
<td>European Intellectual History: The Eighteenth Century</td>
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<td>HI 522</td>
<td>European Intellectual History: The 19th Century</td>
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<td>HI 523</td>
<td>Women in European Enlightenment</td>
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<td>HI 525</td>
<td>Tudor and Stuart England</td>
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<td>HI 530</td>
<td>Modern France</td>
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<td>HI 533</td>
<td>Theory and Practice of Oral History</td>
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<td>HI 534</td>
<td>Theory and Practice of Digital History</td>
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<td>Spatial History</td>
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<td>Colonial and Revolutionary U.S.</td>
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<td>US Constitutional History Since 1870</td>
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<td>Early American Borderlands</td>
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<td>Topics in Civil War and Reconstruction</td>
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<td>Women in America: From Contact to the Civil War</td>
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<td>American Women in the Twentieth Century</td>
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<td>The Vietnam War</td>
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<td>Recent America</td>
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<td>United States-Latin American Relations Since 1823</td>
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<td>History Of U. S. Foreign Relations, 1900-Present</td>
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<td>Slavery in the Americas</td>
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<td>Revolutionary China</td>
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<td>The Rise of Modern Japan, 1850-Present</td>
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<td>Japan's Empire in Asia, 1868-1945</td>
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<td>History of the Republic of South Africa</td>
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<td>Islam and Christianity in Sub-Saharan Africa since the 19th Century</td>
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<td>Africa (sub-Saharan) in the Twentieth Century</td>
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<td>Science in European Culture</td>
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<td>Science and Empire</td>
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<td>Interpretation in Historic Sites and Parks</td>
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<td>Public History in International Context</td>
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<tr>
<td>HI 899</td>
<td>Doctoral Dissertation Preparation</td>
<td>1-3</td>
</tr>
</tbody>
</table>
Faculty

Full Professors
William Adler
David R. Ambaras
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David P. Gilmartin
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Mi Gyung Kim
Keith Phillip Luria
Anne W. Mitchell
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Blair Lynne Murphy Kelley
William Charles Kimler
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John M. Riddle
Richard Wayne Slatta

Stephanie Laine Spencer
Gerald Surh

History (Minor)

Plan Requirements
• 9 (MS student) or 12 (PhD student) credit hours

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History (Minor)

Plan Requirements
• 9 (MS student) or 12 (PhD student) credit hours
International Studies

The Master of International Studies (MIS) is a 36 credit, non-thesis professional degree program that prepares students for careers in government service, non-profit administration, international business, and international student services and study abroad. Located in the School of Public and International Affairs, the MIS degree draws upon faculty and courses from colleges and departments across the university. Approximately half of the course work for the degree is devoted to developing international knowledge and competencies. The remaining coursework is comprised of regional, topical, professional or technical specializations designed by students in consultation with their faculty advisors. The program has an excellent internship program that contributes to job placement upon graduation.

Admission Requirements

Applicants must provide GRE scores and a current resume in addition to other application materials required by the Graduate School.

Degree Requirements

The requirements for the MIS degree are as follows:

1. 36 credit hours of course work;
2. Core Curriculum (15 hours). One course from each of the following five groups:
   - Group A - International Relations
   - Group B - Comparative Politics/Societies
   - Group C - International Law and Organization
   - Group D - International Economy/Development
   - Group E - Research Methods
3. Individualized specialization (12-15 hours). The specialization may be in a geographical region (e.g., Europe, Latin America), an international topic (e.g., security, global governance, sustainable development), a professional field (e.g., public administration, non-profit management), or a technical specialty (e.g., Geographic Information System-GIS);
4. Capstone seminar (3 hours) and oral presentation of work to faculty and peers;
5. International experience or study abroad; and
6. Competency in a foreign language as determined by the Department of Foreign Languages and Literatures (FLL).
International Studies (MR)

Degree Requirements

Students may choose from a specialization to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of International Studies" without specialization specifications.

<table>
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<tr>
<th>Code</th>
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<td>PS 571</td>
<td>Research Methods and Analysis (or equivalent/ or 2 GIS courses)</td>
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<td>MIS 601</td>
<td>Colloquium in International Studies</td>
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Select one of the following:
- PS 530 Seminar In International Relations
- PS 533 Global Problems and Policy
- HI 554 History Of U. S. Foreign Relations, 1900-Present

Select one of the following:
- PS 540 Seminar In Comparative Politics
- PS 541 Political Islam
- PS 542 European Politics
- PS 543 Seminar in Latin American & Caribbean Politics
- PS 545 Comparative Systems of Law and Justice
- PS 546 The Politics of East Asia
- PS 547 Russian Politics

Select one of the following:
- PS 531 International Law
- PS 532 Seminar in Global Governance
- PS 536 Global Environmental Law and Policy

Select one of the following:
- ECG 540 Economic Development
- ECG 548 International Economics
- PS 539 International Political Economy

Total Hours: 36
International Studies (Minor)

Plan Requirements

- 9 (MS student) or 12 (PhD student) credit hours

Faculty

Full Professors
Frederick Willis Cubbage
Dennis M. Daley
Melissa A. Johnson
Akram F. Khater
Anne W. Mitchell
Robert P. Patterson
Mitchell Adam Renkow
Michael D. Schulman
Erin O. Sills
Andrew J. Taylor

Associate Professors
William A. Boettcher III
Clifford E Griffin
Heidi H. Hobbs
James Kiwanuka-Tondo
Lada V. Kochtcheeva
Mark T. Nance
Traciel V. Reid
Michael John Struett
Stephen B. Wiley

Assistant Professors
Moses Khisa
Chia yueh Liao
Robert John Reardon

Practice/Research/Teaching Professors
Tracy Ann Appling
Dmitri Mitin

Emeritus Faculty
Leonard S Bull
Stanley Buol
James M. Wallace III
Robert C. Kochersberger
Robert S. Moog
Robert Lonnie Moxley
Jason C. Shih
Marvin Stanley Soroos
Randy J. Thomson
Sarah Timberlake Warren
Mary Ann Witt

Liberal Studies

The Master of Arts in Liberal Studies (MALS) program is an interdisciplinary graduate program administered by the College of Humanities and Social Sciences. This is a broad, interdisciplinary program of part-time or full-time graduate study that integrates and expands the student’s knowledge and awareness and that is geared to the student’s personal interests. Each student, in consultation with an academic advisor, designs an individual program of study around an interdisciplinary theme or topic that is of intrinsic interest to the student or that relates to the student’s professional or vocational interests. Students take graduate courses across a range of NC State departments as well as MALS seminars designed specifically for the program.

Admissions Requirements

Students entering the Master’s program in liberal studies must have an undergraduate degree. In addition to the material required by the Graduate School, students applying are asked to submit a four to five page statement describing their objectives in doing a degree in liberal studies and a resume. GRE scores are not required. All applicants are interviewed.

Master’s Degree Requirements

Thirty hours of course work made up of:
1. three MALS seminars or two MALS seminars and a research methods course,
2. 18 hours representing the student’s interdisciplinary theme or concentration, and
3. a three-hour culminating project.

Examples of concentrations that are well supported by graduate courses in the NC State curriculum are: science, technology and society, the American experience and leadership.

Degrees

- Liberal Studies (MA) (p. 415)
- Liberal Studies (Minor) (p. 415)

Faculty

Full Professors

Michael D. Garval
Robert P. Patterson
Jorge Mari

Associate Professors

Shelley E. Garrigan
Karey A. Harwood

Assistant Professors

Veljko Dubljevic

Emeritus Faculty

Charles D. Korte
Robert C. Kochersberger

Practice/Research/Teaching Professors

Jonathan Kramer
Seth Murray

Liberal Studies (MA)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Required Courses</td>
<td>9</td>
</tr>
<tr>
<td>MLS 501</td>
<td>Seminar In Liberal Studies</td>
<td></td>
</tr>
<tr>
<td>MLS 501</td>
<td>Seminar In Liberal Studies</td>
<td></td>
</tr>
</tbody>
</table>

Select one of the following:

- Research Methods course across all departments approved in conjunction with the academic committee

Concentration Courses

Additional Courses

- “Additional Courses” are approved in conjunction with the academic committee to meet 30 total hours

Culminating Project Course

- MLS 676 Independent Project

Total Hours

- 31

Select an interdisciplinary concentration approved in conjunction with the academic committee

1 Must be from at least 3 different academic disciplines, no more than 2 courses from one department, at least 2 courses in CHASS. Examples of concentrations that are well supported by graduate courses in the NC State curriculum are: science, technology and society, the American experience and leadership.

Faculty

Full Professors

Michael D. Garval
Robert P. Patterson
Jorge Mari

Associate Professors

Shelley E. Garrigan
Karey A. Harwood

Assistant Professors

Veljko Dubljevic

Emeritus Faculty

Charles D. Korte
Robert C. Kochersberger

Practice/Research/Teaching Professors

Jonathan Kramer
Seth Murray

Liberal Studies (Minor)

Plan Requirements

- 9 (MS student) or 12 (PhD student) credit hours

Faculty

Full Professors

Michael D. Garval
Robert P. Patterson
Jorge Mari
Associate Professors
Shelley E. Garrigan
Karey A. Harwood

Assistant Professors
Veljko Dubljevic

Emeritus Faculty
Charles D. Korte
Robert C. Kochersberger

Practice/Research/Teaching Professors
Jonathan Kramer
Seth Murray

Philosophy & Religious Studies

Degrees
- Cognitive Science (Minor) (p. 416)

Faculty
Assistant Professors
Veljko Dubljevic
Kevin Andrew Richardson

Cognitive Science (Minor)

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>PHI/PSY 525</td>
<td>Introduction To Cognitive Science</td>
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<tr>
<td><strong>Required Courses</strong></td>
<td></td>
<td></td>
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<tr>
<td>CSC 520</td>
<td>Artificial Intelligence I (must be outside student's degree-granting program)</td>
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</tr>
<tr>
<td>CSC 522</td>
<td>Automated Learning and Data Analysis</td>
<td></td>
</tr>
<tr>
<td>CSC 707</td>
<td>Automata, Languages and Computability Theory</td>
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<tr>
<td>CSC 720</td>
<td>Artificial Intelligence II</td>
<td></td>
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<tr>
<td>ENG 524</td>
<td>Introduction to Linguistics</td>
<td></td>
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<tr>
<td>ENG 584</td>
<td>Studies In Linguistics</td>
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<tr>
<td>PHI 540</td>
<td>The Scientific Method</td>
<td></td>
</tr>
<tr>
<td>PSY 500</td>
<td>Visual Perception</td>
<td></td>
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<tr>
<td>PSY 502</td>
<td>Physiological Psychology</td>
<td></td>
</tr>
<tr>
<td>PSY 508</td>
<td>Cognitive Processes</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 9

Psychology

The Department of Psychology offers five courses of study (concentrations) leading to the Ph.D.: applied social and community psychology, human factors and applied cognition, industrial-organizational psychology, lifespan developmental psychology, and school psychology. An additional master’s degree program is available for school psychology.

Admission Requirements
With the exception of the school psychology master’s degree program, admitted students enter doctoral training programs. Applicants must be graduates of accredited institutions. Although a degree in psychology is not required, applicants must demonstrate that their academic backgrounds have prepared them for doctoral training in their specialty area. A strong academic record, competitive scores on the GRE (General Test) and three satisfactory letters of recommendation are required for admission. Research experience is important. Match of applicants' research interests with current faculty research is an important consideration. See https://psychology.chass.ncsu.edu/graduate/apply.php for additional information.

Master’s Degree Requirements

The department offers the master’s degree in school psychology; students in the other concentrations are admitted only to the doctoral program. Students completing the school psychology master’s program are eligible for licensure as public school psychologists in North Carolina. The program requires a total of 60 credit hours, including two years of course work, a summer practicum program, and a full-time internship in the third year.

For students entering doctoral programs, the master’s degree is awarded only in special circumstances, typically when a student in good standing chooses not to continue in the doctoral program.

Doctoral Degree Requirements

The graduate program for each doctoral student is determined in conjunction with the student's graduate advisory committee and tailored to the needs, interests, and accomplishments of the individual. Requirements vary across concentrations, but all doctoral plans of work include at least 72 credit hours. See https://psychology.chass.ncsu.edu/graduate/ for information about requirements for different concentrations.

Student Financial Support

Many graduate students receive financial support in the form of teaching or research assistantships. All admitted applicants are considered for assistantships.
Degrees

- Psychology (MS): School Psychology Concentration (p. 417)
- Psychology (PhD) (p. 418)
- Psychology (Minor) (p. 420)

Faculty

Full Professors
Lynne Elizabeth Baker-Ward
John Charles Begeny
Jeffrey P. Braden
Lori Lea Foster
Douglas John Gillan
Amy G. Halberstadt
Mary E. Haskett
Thomas M. Hess
Christopher Brooke Mayhorn
Anne Collins McLaughlin
Adam W. Meade
Natalie Simona Murr
Rupert W. Nacoste
Shevaun D. Neupert
Katharine E. Stewart
Eric N. Wiebe

Assistant Professors
Seong Hee Cho
Y. He
Kate Norwalk
Vanessa V. Volpe

Practice/Research/Teaching Professors
Dana Kotter-Gruehn
Lindsey C. McGowen
Joseph M. Simons-Rudolph

Emeritus Faculty
Joseph W. Cunningham
Donald William Drewes
William P. Erchul
Denis O. Gray
Thomas M. Hess
James W. Kalat
James E. Luginbuhl
David W. Martin
Samuel B. Pond III
Frank J. Smith
Michael S. Wogalter

Adjunct Faculty
David B. Kaber

Psychology (MS): School Psychology Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td></td>
<td>Two years of coursework approved in conjunction with the academic committee</td>
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</tr>
<tr>
<td></td>
<td>Third-Year full-time internship</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Hours</td>
<td>60</td>
</tr>
</tbody>
</table>
Faculty

Full Professors
Lynne Elizabeth Baker-Ward
John Charles Begeny
Jeffery P. Braden
Lori Lea Foster
Douglas John Gillan
Amy G. Halberstadt
Mary E. Haskett
Thomas M. Hess
Christopher Brooke Mayhorn
Anne Collins McLaughlin
Adam W. Meade
Natalie Simona Murr
Rupert W. Nacoste
Shevaun D. Neupert
Katharine E. Stewart
Eric N. Wiebe

Assistant Professors
Jason Christopher Allaire
Craig C. Brookins
Jennifer L. Burnette
Stephen Bartholomew Craig
Sarah Louise Desmarais
Jing Feng
Daniel Gruehn
Elan Hope
Samuel B. Pond III
Kelly Lynn Sara Mulvey
Scott Andrew Stage
Laura Marie Widman
Mark A. Wilson
Mary B. Wyer

Assistant Professors
Seong Hee Cho
Y. He
Kate Norwalk
Vanessa V. Volpe

Practice/Research/Teaching Professors
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Samuel B. Pond III
Frank J. Smith
Michael S. Wogalter

Adjunct Faculty
David B. Kaber

Psychology (PhD)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Core Courses</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Select three of the following courses:</td>
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<tr>
<td></td>
<td>PSY 502 Physiological Psychology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSY 508 Cognitive Processes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSY 511 Advanced Social Psychology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSY 584 Advanced Developmental Psychology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ethics and Quantitative Methods Courses</td>
<td>8</td>
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<tr>
<td></td>
<td>PSY 820 Special Topics In Psychology</td>
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<tr>
<td></td>
<td>PSY 880 Directed Study In Psychology (Quantitative Methods I)</td>
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<tr>
<td></td>
<td>PSY 880 Directed Study In Psychology (Quantitative Methods II)</td>
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</table>
Additional Statistics or Research Methods Course

Select one of the following courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>PSY 880</td>
<td>Directed Study In Psychology (Multi-Level Modeling in Psychology)</td>
</tr>
<tr>
<td>PSY 752</td>
<td>Action Research In Psychology</td>
</tr>
<tr>
<td>PSY 760</td>
<td>Psychometrics</td>
</tr>
<tr>
<td>PSY 785</td>
<td>Methodological Issues In Developmental Psychology</td>
</tr>
</tbody>
</table>

Department Requirements

"Department Requirements" are approved in conjunction with the academic committee

Program Area Courses

"Program Area Courses" are approved in conjunction with the academic committee

Research Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSY 893</td>
<td>Doctoral Supervised Research</td>
</tr>
<tr>
<td>PSY 895</td>
<td>Doctoral Dissertation Research</td>
</tr>
</tbody>
</table>

Total Hours 72

Faculty

Full Professors

Lynne Elizabeth Baker-Ward
John Charles Begeny
Jeffery P. Braden
Lori Lea Foster
Douglas John Gillan
Amy G. Halberstadt
Mary E. Hasket
Thomas M. Hess
Christopher Brooke Mayhorn
Anne Collins McLaughlin
Adam W. Meade
Natalie Simona Murr
Rupert W. Nacoste
Shevaun D. Neupert
Katharine E. Stewart
Eric N. Wiebe

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Scott Andrew Stage
Laura Marie Widman
Mark A. Wilson
Mary B. Wyer

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Lindsey C. McGowen
Joseph M. Simons-Rudolph

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William P. Erchul
Denis O. Gray
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James E. Luginbuhl
David W. Martin
Samuel B. Pond III
Frank J. Smith
Michael S. Wogalter

Associate Professors

Seong Hee Cho
Y. He
Kate Norwalk
Vanessa V. Volpe

Adjunct Faculty

David B. Kaber
Psychology (Minor)

Plan Requirements

- 9 (MS student) or 12 (PhD student) credit hours

Faculty

Full Professors
Lynne Elizabeth Baker-Ward
John Charles Begeny
Jeffery P. Braden
Lori Lea Foster
Douglas John Gillan
Amy G. Halberstadt
Mary E. Haskett
Thomas M. Hess
Christopher Brooke Mayhorn
Anne Collins McLaughlin
Adam W. Meade
Natalie Simona Murr
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Shevaun D. Neupert
Katharine E. Stewart
Eric N. Wiebe

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Y. He
Kate Norwalk
Vanessa V. Volpe

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Lindsey C. McGowen
Joseph M. Simons-Rudolph

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William P. Erchul
Denis O. Gray
Thomas M. Hess
James W. Kalat
James E. Luginbuhl
David W. Martin
Samuel B. Pond III
Frank J. Smith
Michael S. Wogalter

Adjunct Faculty
David B. Kaber

Public Administration

Public Administration students at NC State are prepared for a career in public service. They will develop the leadership tools and knowledge they need to serve, manage and lead public or nonprofit organizations or to conduct cutting-edge academic research.

Admission Requirements

A list of required application documents can be found on the Public Administration page (https://spia.ncsu.edu/graduate/public_administration.php). The deadline to apply to the MPA program is May 15 (March 1 for International applicants) for Fall admission and November 1 (March 1 for International applicants) for Spring admission. The deadline to apply to the Ph.D. program is March 15 (March 1 for International applicants) for Fall admission. Completed applications
Master’s Degree Requirements

The MPA degree requires the completion of 40 graduate credit hours:

- 24 credit hours of core coursework
- 18 credit hours of elective coursework
- Students lacking the equivalent of one year of full-time public service experience must complete a 3 credit hour internship as part of their elective coursework.

Prerequisites for the program are an undergraduate course in microeconomics and an intermediate statistics (equivalent to ST 311) course. Students who do not have one or both of these prerequisite courses must successfully complete equivalent coursework prior to graduation. The MPA is an Option B Master’s degree with a one-person committee and no final oral examination. Details on the degree requirements can be found on the Master of Public Administration page (https://spia.ncsu.edu/graduate/mpa.php).

The mission of the MPA program is to develop principled and skilled public service professionals who fulfill leadership roles within governmental and nonprofit organizations. We focus on practical and problem-solving skills and emphasize public service values -- including efficiency, effectiveness, equity and accountability.

To accomplish this mission, the MPA program offers elective coursework in public management, nonprofit management, urban management, financial management, organizational leadership, public policy and justice administration.

Doctoral Degree Requirements

The Ph.D. degree requires the completion of 72 graduate credit hours:

- 60 credit hours of coursework (18 hours of relevant graduate credit from a prior Master’s degree may be used; total degree hours must include at least 36 hours at the doctoral level)
- 12 credit hours of dissertation research

Details on the degree requirements can be found on the Ph.D. in Public Administration page (https://spia.ncsu.edu/graduate/phd.php).

Each student will select or develop one or two fields of specialization.

Student Financial Support

A limited number of fellowships and graduate assistantships are offered by the Department of Public Administration. Contact the Department for more information. Other forms of student aid are described in the financial aid section of the Graduate Catalog.

Other Relevant Information

The Department of Public Administration also offers Graduate Certificates in Public Policy and Nonprofit Management, either of which can be taken alone or in conjunction with a graduate degree.

Degrees

- Public Administration (MR) (p. 421)
- Public Administration (PhD) (p. 422)
- Public Administration (Minor) (p. 422)
- Nonprofit Management (Certificate) (p. 423)
- Policy Analysis (Certificate) (p. 423)
Faculty

Full Professors
Thomas A. Birkland
Richard M. Clerkin
Jerrell D. Coggburn
Dennis M. Daley
George D. Garson
Jennifer Kuzma
Branda L. Nowell

Associate Professors
Rajade M. Berry-James
James R. Brunet
Jason Alix Coupet
Jeffrey Childress Diebold
Christopher Galik
Bruce D. McDonald III
Amanda Janis Stewart

Emeritus Faculty
Michael L. Vasu

Public Administration (PhD)

Degree Requirements
The Ph.D. in Public Administration requires the completion of 72 graduate credit hours, including 60 credit hours of coursework and 12 credit hours of dissertation research. Students having obtained a master's degree in a relevant discipline prior to enrollment in the PhD program may be approved for up to an 18-credit hour reduction, reducing the total to 54 graduate credit hours.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Core Courses</td>
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<tr>
<td>PA 715</td>
<td>Quantitative Policy Analysis</td>
<td>24</td>
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<tr>
<td>PA 761</td>
<td>Foundation of Public Administration</td>
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<tr>
<td>PA 762</td>
<td>Public Organization Theory</td>
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</tr>
<tr>
<td>PA 763</td>
<td>Public Policy Process</td>
<td></td>
</tr>
<tr>
<td>PA 765</td>
<td>Quantitative Research in Public Administration</td>
<td></td>
</tr>
<tr>
<td>PA 766</td>
<td>Advanced Quantitative Research in Public Administration</td>
<td></td>
</tr>
<tr>
<td>PA 798</td>
<td>Special Topics in Public Administration and Policy (Public Administration Research Methods and Traditions)</td>
<td></td>
</tr>
<tr>
<td>PA 803</td>
<td>Advanced Research Design</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Management, Methods, &amp; Specialization Courses</td>
<td>6</td>
</tr>
</tbody>
</table>

Select a minimum of six credit hours of management, methods and/or content specialization courses approved in conjunction with the academic committee.

Elective Courses
Select a minimum of one methods elective approved in conjunction with the academic committee.
Select an additional elective approved in conjunction with the academic committee.

Additional Courses
18

Previous Masters Credit

“Additional Courses” are approved in conjunction with the academic committee to meet 72 total hours.

Dissertation Research Course
12

PA 895 Doctoral Dissertation Research

Total Hours
72

Faculty

Full Professors
Thomas A. Birkland
Richard M. Clerkin
Jerrell D. Coggburn
Dennis M. Daley
George D. Garson
Jennifer Kuzma
Branda L. Nowell

Associate Professors
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James R. Brunet
Jason Alix Coupet
Jeffrey Childress Diebold
Christopher Galik
Bruce D. McDonald III
Amanda Janis Stewart

Emeritus Faculty
Michael L. Vasu

Public Administration (Minor)

Plan Requirements
- 9 (MS student) or 12 (PhD student) credit hours
Faculty
Full Professors
Thomas A. Birkland
Richard M. Clerkin
Jerrell D. Coggburn
Dennis M. Daley
George D. Garson
Jennifer Kuzma
Branda L. Nowell

Associate Professors
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James R. Brunet
Jason Alix Coupet
Jeffrey Childress Diebold
Christopher Galik
Bruce D. McDonald III
Amanda Janis Stewart

Emeritus Faculty
Michael L. Vasu

Nonprofit Management (Certificate)
A Graduate Certificate in Nonprofit Management is available to students, including NC State degree students, who have a Bachelor’s degree from an accredited university. The Certificate requires 15 credit hours of course work and substantive nonprofit experience. The courses are designed to provide the basic management knowledge and skills needed in nonprofit organizations. For applications and a description of program requirements go to https://spia.ncsu.edu/graduate/nonprofit_cert.php.

Plan Requirements

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>PA 531</td>
<td>Human Resource Management in Public and Nonprofit Organizations</td>
<td>12</td>
</tr>
<tr>
<td>PA 536</td>
<td>Management of Nonprofit Organizations</td>
<td></td>
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<tr>
<td>PA 538</td>
<td>Nonprofit Budgeting and Financial Management</td>
<td></td>
</tr>
<tr>
<td>PA 539</td>
<td>Fund Development</td>
<td></td>
</tr>
</tbody>
</table>

Select up to two of the following:

| PA 514 | Management Systems |
| PA 516 | Effective Communications for Public Administrators |

Total Hours: 18

Faculty
Full Professors
Thomas A. Birkland
Richard M. Clerkin
Jerrell D. Coggburn
Dennis M. Daley
George D. Garson
Jennifer Kuzma
Branda L. Nowell

Associate Professors
Rajade M. Berry-James
James R. Brunet
Jason Alix Coupet
Jeffrey Childress Diebold
Christopher Galik
Bruce D. McDonald III
Amanda Janis Stewart

Emeritus Faculty
Michael L. Vasu

Policy Analysis (Certificate)

Plan Requirements

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA 507</td>
<td>The Public Policy Process</td>
<td>15</td>
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<tr>
<td>PA 509</td>
<td>Applied Political Economy</td>
<td></td>
</tr>
<tr>
<td>PA 511</td>
<td>Public Policy Analysis</td>
<td></td>
</tr>
</tbody>
</table>

Select two electives

Total Hours: 15

1. Policy courses from any program - approved by coordinator
Faculty

Full Professors
Thomas A. Birkland
Richard M. Clerkin
Jerrell D. Coggburn
Dennis M. Daley
George D. Garson
Jennifer Kuzma
Branda L. Nowell

Associate Professors
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James R. Brunet
Jason Alix Coupet
Jeffrey Childress Diebold
Christopher Galik
Bruce D. McDonald III
Amanda Janis Stewart

Emeritus Faculty
Michael L. Vasu

Public History

Admission Requirements
Admission to the M.A. in History and Public History programs require: a bachelor’s degree from an accredited college or university; transcripts; personal statement, listing career goals, historical interests, and potential advisor; letters of recommendation; and a writing sample of approximately ten pages. Admission to the Ph.D. in Public History requires a bachelor’s degree from an accredited college or university; transcripts; personal statement, listing career goals, historical interests, and potential advisor; letters of recommendation; and a writing sample of approximately ten pages.

Master’s Degree Requirements
Master of Arts Degree in History: This program requires a total of 30 credit hours, including 6 hours in core courses, 12 credit hours in a major field, 6 credit hours in a minor field, and 6 credit hours in thesis work. Each student’s program is tailored to enhance his or her career objectives. Social studies teachers, for example, may earn advanced competency on completion of the M.A. in history with additional course work in education. Similarly, students who plan to pursue a Ph.D. degree receive the requisite training and assistance. Master of Arts Degree in Public History: This program requires 36 credit hours of course work. Students may take a non-thesis or thesis option. Half the hours fall in historical studies, the rest in applied history classes, including innovative courses in museum studies and heritage studies. Students perform internships in their own special areas of interest.

Doctoral Degree Requirements
The Ph.D. program in Public History requires 72 credit hours. Students complete 21 credit hours in a public history field, including an internship; 21 credit hours in a history field; 6 credit hours in an outside field; and 24 credit hours of dissertation work.

Student Financial Support
Graduate teaching assistantships are available to students in all programs and are awarded by open competition.

Other Relevant Information
The application deadline for fall semester is January 15; students are admitted for the fall semester only.

Degrees
- Public History (MA) (p. 424)
- Public History (PhD) (p. 426)
- Public History (Minor) (p. 426)

Faculty

Full Professors
Craig T. Friend
Tammrah Gordon
David Aaron Zonderman

Associate Professors
Katherine Mellien Charron
Blair Lynne Murphy Kelley
Susanna M. Lee

Assistant Professors
Frederico Freitas
Verena Kasper-Marienberg
Judy Kertesz
Alicia McGill
Tate Sewell Paulette

Public History (MA)

Degree Requirements
Degrees earned will be distributed as: "Master of Arts in Public History" without focus area track or thesis option specifications.
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 596</td>
<td>Introduction To Public History</td>
<td></td>
</tr>
<tr>
<td>HI 642</td>
<td>Internship In Public History</td>
<td></td>
</tr>
<tr>
<td>HI 597</td>
<td>Historiography and Historical Method</td>
<td></td>
</tr>
<tr>
<td>HI 598</td>
<td>Historical Writing</td>
<td></td>
</tr>
<tr>
<td>HI 792</td>
<td>Colloquium in History</td>
<td></td>
</tr>
</tbody>
</table>

Additional HI course approved in conjunction with the academic committee.

**Core Courses and Colloquium Courses**

"Core Courses and Colloquium Courses" are approved in conjunction with the academic committee.

**Focus Area Track Courses**

See "Thesis Options & Focus Area Tracks" listed below

**Elective Courses**

"Elective Courses" will be determined in conjunction with the academic committee.

**Thesis Option**

See "Thesis Options & Focus Area Tracks" listed below

**Total Hours:** 36

### Thesis Options & Focus Area Tracks

#### Non-Thesis

Select a Focus Track Area and corresponding courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 591</td>
<td>Museum Studies</td>
<td>3</td>
</tr>
<tr>
<td>HI 593</td>
<td>Material Culture</td>
<td>3</td>
</tr>
<tr>
<td>HI 588</td>
<td>Family and Community History</td>
<td>3</td>
</tr>
<tr>
<td>or HI 589</td>
<td>Interpretation in Historic Sites and Parks</td>
<td></td>
</tr>
<tr>
<td>or HI 787</td>
<td>African American Public History</td>
<td></td>
</tr>
<tr>
<td>or HI 788</td>
<td>Native American Public History</td>
<td></td>
</tr>
</tbody>
</table>

**Cultural Heritage**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 594</td>
<td>Cultural Heritage</td>
<td>3</td>
</tr>
<tr>
<td>HI 595</td>
<td>Special Topics in History</td>
<td>1-6</td>
</tr>
<tr>
<td>HI 588</td>
<td>Family and Community History</td>
<td>3</td>
</tr>
<tr>
<td>or HI 589</td>
<td>Interpretation in Historic Sites and Parks</td>
<td></td>
</tr>
<tr>
<td>or HI 787</td>
<td>African American Public History</td>
<td></td>
</tr>
<tr>
<td>or HI 788</td>
<td>Native American Public History</td>
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</tbody>
</table>

**Public Memory**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 563</td>
<td>Topics in History and Memory</td>
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Select two of the following courses:

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<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>HI 533</td>
<td>Theory and Practice of Oral History</td>
<td>3</td>
</tr>
<tr>
<td>HI 534</td>
<td>Theory and Practice of Digital History</td>
<td>3</td>
</tr>
<tr>
<td>HI 787</td>
<td>African American Public History</td>
<td>3</td>
</tr>
<tr>
<td>HI 788</td>
<td>Native American Public History</td>
<td>3</td>
</tr>
</tbody>
</table>

**Archives and Records Management**

Select any three courses; this track must be completed as part of the credit transfer agreement with UNC SILS.

Select courses from the following list to fill the 36 total hours:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 594</td>
<td>Cultural Heritage</td>
<td>3</td>
</tr>
</tbody>
</table>

### Thesis

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>HI 791</td>
<td>Colloquium in Public History</td>
<td>3</td>
</tr>
<tr>
<td>HI 693</td>
<td>Master's Supervised Research</td>
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**Required Courses**

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<td>HI 533</td>
<td>Theory and Practice of Oral History</td>
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<tr>
<td>HI 534</td>
<td>Theory and Practice of Digital History</td>
<td>3</td>
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<tr>
<td>HI 535</td>
<td>Spatial History</td>
<td>3</td>
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<tr>
<td>HI 563</td>
<td>Topics in History and Memory</td>
<td>3</td>
</tr>
<tr>
<td>HI 587</td>
<td>Cultural Resource Management</td>
<td>3</td>
</tr>
<tr>
<td>HI 588</td>
<td>Family and Community History</td>
<td>3</td>
</tr>
<tr>
<td>HI 589</td>
<td>Interpretation in Historic Sites and Parks</td>
<td>3</td>
</tr>
<tr>
<td>HI 591</td>
<td>Museum Studies</td>
<td>3</td>
</tr>
<tr>
<td>HI 593</td>
<td>Material Culture</td>
<td>3</td>
</tr>
<tr>
<td>HI 594</td>
<td>Cultural Heritage</td>
<td>3</td>
</tr>
<tr>
<td>HI 595</td>
<td>Special Topics in History</td>
<td>1-6</td>
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<tr>
<td>HI 787</td>
<td>African American Public History</td>
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</tr>
<tr>
<td>HI 788</td>
<td>Native American Public History</td>
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**Non-History Electives**

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<th>Code</th>
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<td>Tourism, Culture and Anthropology</td>
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<td>ANT 533</td>
<td>Anthropology of Ecotourism and Heritage</td>
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<tr>
<td>ARC 451</td>
<td>Digital Drawing and Modeling</td>
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<tr>
<td>ARC 544</td>
<td>American City Planning History</td>
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<td>ARC 545</td>
<td>Methods of Interpretation in Architectural History</td>
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<td>ARC 548</td>
<td>Vernacular Architecture</td>
<td>3</td>
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<tr>
<td>COM 537</td>
<td>Gaming and Social Networks</td>
<td>3</td>
</tr>
<tr>
<td>COM 546</td>
<td>Nonprofit Marketing and Public Relations</td>
<td>3</td>
</tr>
<tr>
<td>COM 581</td>
<td>Visual Rhetoric: Theory and Criticism</td>
<td>3</td>
</tr>
<tr>
<td>NR 548</td>
<td>Historical Environments</td>
<td>3</td>
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<tr>
<td>PA 531</td>
<td>Human Resource Management in Public and Nonprofit Managers</td>
<td>3</td>
</tr>
<tr>
<td>PA 535</td>
<td>Problem Solving for Public and Nonprofit Managers</td>
<td>3</td>
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<tr>
<td>PA 536</td>
<td>Management of Nonprofit Organizations</td>
<td>3</td>
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<tr>
<td>PA 538</td>
<td>Nonprofit Budgeting and Financial Management</td>
<td>3</td>
</tr>
<tr>
<td>PA 539</td>
<td>Fund Development</td>
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<tr>
<td>PA 540</td>
<td>Grant Writing for Public Administrators</td>
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**Thesis**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>HI 591</td>
<td>Museum Studies</td>
<td>3</td>
</tr>
<tr>
<td>HI 593</td>
<td>Material Culture</td>
<td>3</td>
</tr>
<tr>
<td>HI 588</td>
<td>Family and Community History</td>
<td>3</td>
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<tr>
<td>or HI 589</td>
<td>Interpretation in Historic Sites and Parks</td>
<td></td>
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</tr>
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</table>

**Cultural Heritage**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 594</td>
<td>Cultural Heritage</td>
<td>3</td>
</tr>
</tbody>
</table>

Select any three courses; this track must be completed as part of the credit transfer agreement with UNC SILS.
HI 595 Special Topics in History 1-6
HI 588 Family and Community History 3
or HI 589 Interpretation in Historic Sites and Parks
or HI 787 African American Public History
or HI 788 Native American Public History

Public Memory
HI 563 Topics in History and Memory 3
Select two of the following courses:
HI 533 Theory and Practice of Oral History 3
HI 534 Theory and Practice of Digital History 3
HI 787 African American Public History 3
HI 788 Native American Public History 3

Archives and Records Management
Select any three courses; this track must be completed as part of the credit transfer agreement with UNC SILS

Faculty
Full Professors
Craig T. Friend
Tammrah Gordon
David Aaron Zonderman

Associate Professors
Katherine Mellen Charron
Blair Lynne Murphy Kelley
Susanna M. Lee

Assistant Professors
Frederico Freitas
Verena Kasper-Marienberg
Judy Kertesz
Alicia McGill
Tate Sewell Paulette

Public History (PhD)
Degree Requirements
Students may choose from course tracks to complete coursework within a focus area.

Degrees earned will be distributed as: "Doctor of Philosophy in Public History" without track specifications.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Required Courses</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Public History Field</strong></td>
<td></td>
</tr>
<tr>
<td>HI 596</td>
<td>Introduction To Public History</td>
<td></td>
</tr>
<tr>
<td>HI 642</td>
<td>Internship In Public History</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>History Field</strong></td>
<td></td>
</tr>
<tr>
<td>HI 597</td>
<td>Historiography and Historical Method</td>
<td></td>
</tr>
<tr>
<td>HI 792</td>
<td>Colloquium in History</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Interdisciplinary Field</strong></td>
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<td></td>
<td>Select a minimum of four additional 500- to 700-level HI courses approved in conjunction with the academic committee</td>
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</tr>
<tr>
<td></td>
<td><strong>Dissertation Research Courses</strong></td>
<td>24</td>
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<tr>
<td>HI 889</td>
<td>Doctoral Dissertation Seminar</td>
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</tr>
<tr>
<td>HI 895</td>
<td>Doctoral Dissertation Research</td>
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</tr>
<tr>
<td></td>
<td><strong>Total Hours</strong></td>
<td>24</td>
</tr>
</tbody>
</table>

1 Students can select a focus area track for to meet this requirement.
Focus Area tracks include: African American History, Digital History, Heritage Studies, Museum Studies and Public Memory.
2 Must be taken in two consecutive semesters
3 Minimum 22 credit hours

Faculty
Full Professors
Craig T. Friend
Tammrah Gordon
David Aaron Zonderman

Associate Professors
Katherine Mellen Charron
Blair Lynne Murphy Kelley
Susanna M. Lee

Assistant Professors
Frederico Freitas
Verena Kasper-Marienberg
Judy Kertesz
Alicia McGill
Tate Sewell Paulette

Public History (Minor)
Plan Requirements
- 9 (MS student) or 12 (PhD student) credit hours
The mission of the MSW program is to prepare students for practice that is sensitive to the social, economic, cultural, demographic and political contexts that shape our state and beyond. Within a framework emphasizing professional ethics, social justice, diversity, strengths and community engagement, the Department seeks to equip students for leadership roles and effective practice.

**Admission Requirements**

*(scroll down to see additional requirements for Advanced Standing applicants)*

- Bachelor's degree (any major) from an accredited liberal arts college or university.
- GPA of 3.0 or higher for the last 60 hours of academic work. Students with a GPA less than 3.0 but greater than 2.5 for the last 60 hours of academic course work must have official Graduate Record Exam (GRE) or Miller Analogies Test (MAT) scores forwarded to the Graduate School.
- Liberal arts coursework in the social sciences, humanities, biology, and statistics.
- Four courses in the social sciences (e.g. anthropology, economics, ethnic studies, political science, psychology, social work, sociology), with a grade of C or better.
- Three courses in the humanities (e.g. comparative religions, history, linguistics, literature, modern or classic languages, philosophy and ethics, visual and performing arts), with a grade of C or better.
- A biology and a statistics course, with a grade of C or better.
- A variety of life and work experience in human services, paid or volunteer. Note: In accordance with the CSWE standards, students cannot receive academic credit based on life and work experience.

**Additional Requirements for Advanced Standing**

In addition to the above admissions requirements, the following applies to Advanced Standing applicants:

- Applicants with a BSW degree from an accredited program and a GPA of at least 3.5 (on a 4.0 scale) for the last 60 credit hours of academic work are eligible to apply for Advanced Standing status. Students with a GPA less than 3.5 but greater than 2.5 for the last 60 hours of academic course work must have official Graduate Record Exam (GRE) or Miller Analogies Test (MAT) scores forwarded to the Graduate School.
- BSW students who graduate prior to the first semester of Advanced Standing coursework will be considered for admission.
- Applicants must have grades of "B" or better in all social work courses.
- One of three references must be from Field/Task Supervisor or Field Director/Liaison.

**Master’s Degree Requirements**

The MSW Program provides two options: The Traditional 60-credit program, and the 39-credit Advanced Standing Program, which is designed for BSW graduates only.

We do not offer a part-time curriculum at this time.

**Other Relevant Information**

The MSW program is accredited by The Council on Social Work Education (CSWE).

**Degrees**

- Social Work (MR) (p. 428)
Assistant Professors
Gloria Thomas Anderson
Qiana Cryer-Coupet
Alan Reid Ellis

Social Work (MR)

Degree Requirements

Degrees earned will be distributed as: "Master of Social Work" curriculum specifications.

Traditional Curriculum

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>SW 501</td>
<td>Social Work Policy, Services and Programs</td>
<td>3</td>
</tr>
<tr>
<td>SW 505</td>
<td>Human Behavior and the Social Environment:</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Social Justice</td>
<td></td>
</tr>
<tr>
<td>SW 506</td>
<td>Human Behavior and the Social Environment:</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Individuals, Families, and Groups</td>
<td></td>
</tr>
<tr>
<td>SW 520</td>
<td>SW Generalist Practice I</td>
<td>3</td>
</tr>
<tr>
<td>SW 561</td>
<td>Social Work Field Internship I</td>
<td>5</td>
</tr>
<tr>
<td>SW 510</td>
<td>Research Methods for Social Work</td>
<td>3</td>
</tr>
<tr>
<td>SW 521</td>
<td>SW General Practice II</td>
<td>3</td>
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<tr>
<td>SW 562</td>
<td>Social Work Field Internship II</td>
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<tr>
<td>SW 519</td>
<td>Evaluation of a Social Work Intervention</td>
<td>2</td>
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<tr>
<td>SW 561</td>
<td>Social Work Administration and Supervision</td>
<td>3</td>
</tr>
<tr>
<td>SW 581</td>
<td>Advanced Social Work Practice with Individuals</td>
<td>3</td>
</tr>
<tr>
<td>SW 563</td>
<td>Advanced Social Work Field Internship I</td>
<td>5</td>
</tr>
<tr>
<td>SW 564</td>
<td>Advanced Social Work Field Internship II</td>
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<tr>
<td>SW 560</td>
<td>Advanced Policy Practice with Organizations and</td>
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<tr>
<td></td>
<td>Communities</td>
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<tr>
<td>SW 583</td>
<td>Advanced Social Work Practice with Family Systems</td>
<td>3</td>
</tr>
<tr>
<td>SW 590</td>
<td>Social Work Capstone</td>
<td>2</td>
</tr>
<tr>
<td>SW 551</td>
<td>Social Work Practice with Children and Adolescents</td>
<td>3</td>
</tr>
</tbody>
</table>

Select at least six credit hours of the following: 6

| SW 512 | Social Work in Schools                            |       |
| SW 515 | Child Welfare                                     |       |
| SW 516 | Addiction Recovery and Social Work Practice       |       |
| SW 517 | Direct Practice with Older Adults                 |       |
| SW 518 | Child Welfare Seminar                             |       |
| SW 525 | Hunger and Homelessness                           |       |
| SW 523 | Social Work with Soldiers, Veterans, and Their    |       |
|        | Families                                           |       |
| SW 557 | SW Program Development and Grant Writing          |       |
| SW 582 | Advanced Social Work Practices with Groups        |       |

Total Hours 63

Advanced Standing Curriculum

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<tbody>
<tr>
<td>SW 505</td>
<td>Human Behavior and the Social Environment:</td>
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<tr>
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<td>Social Justice</td>
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<td>SW 500</td>
<td>Advanced Standing Seminar</td>
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<tr>
<td>SW 561</td>
<td>Social Work Administration and Supervision</td>
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<td>SW 581</td>
<td>Advanced Social Work Practice with Individuals</td>
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</tr>
<tr>
<td>SW 519</td>
<td>Evaluation of a Social Work Intervention</td>
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</tr>
<tr>
<td>SW 653</td>
<td>Advanced Social Work Field Internship I</td>
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<tr>
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<td>Advanced Social Work Practice with Family Systems</td>
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<tr>
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<tr>
<td></td>
<td>Communities</td>
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<tr>
<td>SW 590</td>
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<td>SW 654</td>
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<tr>
<td>SW 551</td>
<td>Social Work Practice with Children and Adolescents</td>
<td>3</td>
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</tbody>
</table>

Select at least six credit hours of the following: 6

| SW 512 | Social Work in Schools                            |       |
| SW 515 | Child Welfare                                     |       |
| SW 516 | Addiction Recovery and Social Work Practice       |       |
| SW 517 | Direct Practice with Older Adults                 |       |
| SW 518 | Child Welfare Seminar                             |       |
| SW 525 | Hunger and Homelessness                           |       |
| SW 523 | Social Work with Soldiers, Veterans, and Their    |       |
|        | Families                                           |       |
| SW 557 | SW Program Development and Grant Writing          |       |
| SW 582 | Advanced Social Work Practices with Groups        |       |

Total Hours 42

Faculty

Full Professors
Karen Bullock

Associate Professors
Natalie R. Ames
Jodi K. Hall
Kim L. Stansbury
Jocelyn DeVance Warren
Intae Yoon

Assistant Professors
Gloria Thomas Anderson
Qiana Cryer-Coupet
Alan Reid Ellis

Sociology

Degrees

- Sociology (MR) (p. 429)
- Sociology (MS) (p. 430)
- Sociology (PhD) (p. 431)
- Sociology, Humanities & Social Sciences (Minor) (p. 432)

Faculty

Full Professors
Sarah K. Bowen,
Martha L. Crowley
Stacy DeCoster
Steven J. McDonald
Toby L. Parcel
Michael L. Schwalbe
Thomas Eugene Shriver

Associate Professors
Michaela Anne DeSoucey
Kimberly Lynn Ebert
Stefano B. Longo
Anna Manzoni
William R. Smith
Melvin E. Thomas

Assistant Professors
Celeste Curington
Andrew Paul Davis
Laura DeMarco
April Dawn Fernandes
Jessica Pfaffendorf

Practice/Research/Teaching Professors
Megan Glancy
Deann Judge
Margaret Stiffler

Jim Yocom

Emeritus Faculty
Virginia M Aldige
Maxine Atkinson
Ronald F. Czaja
William B. Clifford II
L. Richard Dellafave
Ted Greenstein
Stephen C. Lilley
Patricia Lou McCall
Robert Lonnie Moxley
Maxine S. Thompson
Randy J. Thomson
Charles Ray Tittle
Eric M. Woodrum
Margaret A Zahn
James J. Zuiches

Sociology (MR)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
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<td>Seminar</td>
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<tr>
<td>SOC 642</td>
<td>Practicum In Sociology</td>
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<td>SOC 701</td>
<td>Classical Sociological Theory</td>
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<td>SOC 711</td>
<td>Research Methods In Sociology I</td>
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<tr>
<td>SOC 713</td>
<td>Applied Research</td>
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</tbody>
</table>

Elective Courses

Select a minimum of three 500- or 700-level courses approved in conjunction with the academic committee
Additional elective courses will be determined in conjunction with the academic committee

Total Hours

31

Faculty

Full Professors
Sarah K. Bowen,
Martha L. Crowley
Stacy DeCoster
Steven J. McDonald
### Sociology (MS)

#### Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>SOC 601</td>
<td>Seminar</td>
<td>16</td>
</tr>
<tr>
<td>SOC 642</td>
<td>Practicum In Sociology</td>
<td></td>
</tr>
<tr>
<td>SOC 701</td>
<td>Classical Sociological Theory</td>
<td></td>
</tr>
<tr>
<td>SOC 711</td>
<td>Research Methods In Sociology I</td>
<td></td>
</tr>
<tr>
<td>SOC 713</td>
<td>Applied Research</td>
<td></td>
</tr>
</tbody>
</table>

**Core Courses**

**Elective Courses**

Select a minimum of three 500- or 700-level courses approved in conjunction with the academic committee.

Additional elective courses will be determined in conjunction with the academic committee.

**Total Hours**

---

#### Faculty

**Full Professors**

Sarah K. Bowen,

Martha L. Crowley

Stacy DeCoster

Steven J. McDonald

Toby L. Parcel

Michael L. Schwalbe

Thomas Eugene Shriver

**Associate Professors**

Michaela Anne DeSoucey

Kimberly Lynn Ebert

Stefano B. Longo

Anna Manzoni

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Melvin E. Thomas

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April Dawn Fernandes

Jessica Pfaffendorf

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Jim Yocom

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Stephen C. Lilley

Patricia Lou McCall

Robert Lonnie Moxley

Maxine S. Thompson

Randy J. Thomson

Charles Ray Tittle

Eric M. Woodrum

Margaret A Zahn

James J. Zuiches
**Sociology (PhD)**

**Degree Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOC 601</td>
<td>Seminar</td>
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<tr>
<td>SOC 701</td>
<td>Classical Sociological Theory</td>
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<tr>
<td>SOC 707</td>
<td>Quantitative Sociological Analysis</td>
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<tr>
<td>SOC 711</td>
<td>Research Methods In Sociology I</td>
<td></td>
</tr>
<tr>
<td>SOC 713</td>
<td>Applied Research</td>
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</tbody>
</table>

**Core Requirements**

- SOC 601 Seminar
- SOC 701 Classical Sociological Theory
- SOC 707 Quantitative Sociological Analysis
- SOC 711 Research Methods In Sociology I
- SOC 713 Applied Research

**Total Hours**

- 13

**Method / Analysis Courses**

- SOC 708 Advanced Sociological Analysis (Social Network Analysis)
- SOC 708 Advanced Sociological Analysis (Multilevel/Longitudinal Analysis)
- SOC 708 Advanced Sociological Analysis (Sequence Analysis)
- SOC 708 Advanced Sociological Analysis (Computational Text Analysis)

**Select two of the following courses:**

- SOC 708 Advanced Sociological Analysis (Social Network Analysis)
- SOC 708 Advanced Sociological Analysis (Multilevel/Longitudinal Analysis)
- SOC 708 Advanced Sociological Analysis (Sequence Analysis)
- SOC 708 Advanced Sociological Analysis (Computational Text Analysis)

**Substantive Courses**

- SOC 715 Qualitative Sociological Methods and Analysis
- SOC 791 Special Topics In Sociology

**Select eight courses from “Substantive Courses” listed below - based on speciality area.**

**Research Courses**

- SOC 893 Doctoral Supervised Research
- SOC 895 Doctoral Dissertation Research

**Total Hours**

- 72

**Specialty Courses**

Select eight courses from the following options - based on speciality area.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>SOC 721</td>
<td>Deviant Behavior</td>
<td>3</td>
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<tr>
<td>SOC 722</td>
<td>Social Control</td>
<td>3</td>
</tr>
<tr>
<td>SOC 725</td>
<td>Gender and Crime</td>
<td>3</td>
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<tr>
<td>SOC 791</td>
<td>Special Topics In Sociology (Advanced Qualitative Sociological Methods and Analysis)</td>
<td>1-6</td>
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<tr>
<td>SOC 736</td>
<td>Social Stratification</td>
<td>3</td>
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<tr>
<td>SOC 737</td>
<td>Sociology Of Gender</td>
<td>3</td>
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<tr>
<td>SOC 738</td>
<td>Race and Ethnic Inequality</td>
<td>3</td>
</tr>
<tr>
<td>SOC 739</td>
<td>Social Psychology Of Inequality</td>
<td>3</td>
</tr>
<tr>
<td>SOC 752</td>
<td>Work and Industry</td>
<td>3</td>
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<tr>
<td>SOC 754</td>
<td>Economic Sociology</td>
<td>3</td>
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<tr>
<td>SOC 755</td>
<td>Global Institutions and Markets</td>
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**Work and The Global Economy Specialty Courses**

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<td>SOC 761</td>
<td>Contemporary Debates in Food &amp; Environment</td>
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<td>SOC 762</td>
<td>Sociology of Food Systems</td>
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<td>SOC 763</td>
<td>Environmental Sociology</td>
<td>3</td>
</tr>
<tr>
<td>SOC 791</td>
<td>Special Topics In Sociology (Food Systems)</td>
<td>1-6</td>
</tr>
</tbody>
</table>

**Faculty**

**Full Professors**

Sarah K. Bowen,
Martha L. Crowley
Stacy DeCoster
Steven J. McDonald
Toby L. Parcel
Michael L. Schwalbe
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Robert Lonnie Moxley
Maxine S. Thompson
Randy J. Thomson
Charles Ray Tittle
Eric M. Woodrum
Margaret A Zahn
James J. Zuiches

Sociology, Humanities & Social Sciences (Minor)

Plan Requirements
• 9 (MS student) or 12 (PhD student) credit hours

Faculty
Full Professors
Sarah K. Bowen,
Martha L. Crowley
Stacy DeCoster
Steven J. McDonald
Toby L. Parcel
Michael L. Schwalbe
Thomas Eugene Shriver

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Randy J. Thomson
Charles Ray Tittle
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James J. Zuiches

Sociology, Humanities & Social Sciences (Minor)

Plan Requirements
• 9 (MS student) or 12 (PhD student) credit hours

Faculty
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L. Richard Dellafave
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Stephen C. Lilley
Patricia Lou McCall

Robert Lonnie Moxley
Maxine S. Thompson
Randy J. Thomson
Charles Ray Tittle
Eric M. Woodrum
Margaret A Zahn
James J. Zuiches
Technical Communication

The Master of Science in technical communication is designed to prepare professional communicators for advanced positions in industry and research organizations; with appropriate electives, students can prepare for careers in web design and development, software documentation, environmental communication, medical writing, industrial training in writing and editing, publications management and related areas.

Admission Requirements

Applicants should submit a resume and a writing sample. The application deadline is June 15. Those who wish to be considered for teaching assistantships should complete the application by February 1. Students are admitted for either the fall or spring semesters.

Requirements for MS in Technical Communication

The program requires 33 semester hours: 15 hours in the fields of technical writing, publication management, rhetoric and a projects course; the remaining hours are taken in applications, theory and methods and cross-disciplinary courses. Students must also satisfy a requirement for one semester of professional work experience.

Student Financial Support

Teaching assistantships (https://english.chass.ncsu.edu/graduate/teaching_assistantships.php) are available for a limited number of promising students. These students work with an experienced teacher in their first year to assist in 300-level professional writing courses. They devote half time in subsequent semesters to teaching technical communication.

Degrees

• Technical Communication (MS) (p. 433)

Full Professors

Jason Swarts

Associate Professors

Huiling Ding
Stacey L. Pigg
Douglas M. Walls

Assistant Professors

Michelle McMullin

Emeritus Faculty

David H. Covington
Robert S. Dicks
Susan M. Katz
Carolyn Rae Miller
Nancy Penrose

Technical Communication (MS)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
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<tbody>
<tr>
<td>ENG 512</td>
<td>Theory and Research In Professional Writing</td>
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<tr>
<td>ENG 515</td>
<td>Rhetoric Of Science and Technology</td>
<td></td>
</tr>
<tr>
<td>ENG 517</td>
<td>Advanced Technical Writing, Editing and Document Design</td>
<td></td>
</tr>
<tr>
<td>ENG 518</td>
<td>Publication Management for Technical Communicators</td>
<td></td>
</tr>
<tr>
<td>ENG 675</td>
<td>Projects in Technical Communication</td>
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</table>

Methods or Theory Electives (9-12)

Select nine or twelve credit hours of the following:

- ENG 506 Verbal Data Analysis
- ENG 508 Usability Studies for Technical Communication
- ENG 519 Online Information Design and Evaluation
- ENG 520 Science Writing for the Media
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>ENG 583</td>
<td>Studies In Rhetoric and Writing (Seminar on Communication in Health and Environmental Sciences)</td>
</tr>
<tr>
<td>ECI 716</td>
<td>Design and Evaluation Of Instructional Materials</td>
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**Applications Electives** 6-9

Select six or nine credit hours of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
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<tr>
<td>ENG 524</td>
<td>Introduction to Linguistics</td>
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<tr>
<td>ENG 525</td>
<td>Variety In Language</td>
</tr>
<tr>
<td>ENG 527</td>
<td>Discourse Analysis</td>
</tr>
<tr>
<td>ENG 513</td>
<td>Empirical Research In Composition</td>
</tr>
<tr>
<td>ENG 514</td>
<td>History Of Rhetoric</td>
</tr>
<tr>
<td>ENG 516</td>
<td>Rhetorical Criticism: Theory and Practice</td>
</tr>
<tr>
<td>ENG 541</td>
<td>Literary and Cultural Theory</td>
</tr>
<tr>
<td>PA 515</td>
<td>Research Methods and Analysis</td>
</tr>
<tr>
<td>BUS 462</td>
<td>Marketing Research</td>
</tr>
<tr>
<td>BUS 465</td>
<td>Traditional and Digital Brand Promotion</td>
</tr>
<tr>
<td>COM 402</td>
<td>Advanced Group Communication</td>
</tr>
<tr>
<td>COM 411</td>
<td>Rhetorical Criticism</td>
</tr>
<tr>
<td>COM 421</td>
<td>Communication Law</td>
</tr>
<tr>
<td>COM 441</td>
<td>Ethical Issues in Communication</td>
</tr>
<tr>
<td>COM 442</td>
<td>Communication and Conflict Management</td>
</tr>
<tr>
<td>COM 456</td>
<td>Organizational Communication</td>
</tr>
<tr>
<td>COM 476</td>
<td>Public Relations Campaigns</td>
</tr>
<tr>
<td>COM 487</td>
<td>Internet and Society</td>
</tr>
<tr>
<td>COM 522</td>
<td>Critical Approaches to Organizational Communication</td>
</tr>
<tr>
<td>COM 523</td>
<td>International and Intercultural Communication</td>
</tr>
<tr>
<td>COM 527</td>
<td>Seminar in Organizational Conflict Management</td>
</tr>
<tr>
<td>COM 528</td>
<td>Communication Culture and Technology</td>
</tr>
<tr>
<td>COM 541</td>
<td>Quantitative Research Methods in Applied Communication</td>
</tr>
<tr>
<td>COM 542</td>
<td>Qualitative Research Methods in Applied Communication</td>
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<tr>
<td>COM 556</td>
<td>Seminar In Organizational Communication</td>
</tr>
<tr>
<td>COM 561</td>
<td>Human Communication Theory</td>
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<tr>
<td>COM 566</td>
<td>Seminar In Crisis Communication</td>
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<tr>
<td>CSC 442</td>
<td>Introduction to Data Science</td>
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<td>CSC 454</td>
<td>Human-Computer Interaction</td>
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<td>CSC 461</td>
<td>Computer Graphics</td>
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<td>CSC 467</td>
<td>Multimedia Technology</td>
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<td>CSC 501</td>
<td>Operating Systems Principles</td>
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<tr>
<td>CSC 510</td>
<td>Software Engineering</td>
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<td>CSC 554</td>
<td>Human-Computer Interaction</td>
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<tr>
<td>EAC 559</td>
<td>The Adult Learner</td>
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<tr>
<td>EAC 540</td>
<td>Foundations of Higher Education and Student Affairs</td>
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<tr>
<td>EAC 580</td>
<td>Designing Instructional Systems in Training and Development</td>
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<tr>
<td>EAC 581</td>
<td>Advanced Instructional Design in Training and Development</td>
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<tr>
<td>EAC 582</td>
<td>Organization and Operation Of Training and Development Programs</td>
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<tr>
<td>EAC 583</td>
<td>Needs Assessment and Task Analysis in Training and Development</td>
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<td>EAC 584</td>
<td>Evaluating Training Transfer and Effectiveness</td>
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<td>EAC 585</td>
<td>Integrating Technology into Training Program</td>
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<tr>
<td>EAC 586</td>
<td>Methods and Techniques Of Training and Development</td>
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<tr>
<td>EAC 595</td>
<td>Special Topics (Web-based Training)</td>
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<td>ECG 512</td>
<td>Law and Economics</td>
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<td>ECG 515</td>
<td>Environmental and Resource Policy</td>
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<tr>
<td>ECG 537</td>
<td>Health Economics</td>
</tr>
<tr>
<td>ECG 715</td>
<td>Environmental and Resource Economics</td>
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<td>ECE 792</td>
<td>Special Topics In Electrical Engineering (Information Theory)</td>
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<td>ECI 716</td>
<td>Design and Evaluation Of Instructional Materials</td>
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<td>ENG 508</td>
<td>Usability Studies for Technical Communication</td>
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<tr>
<td>ENG 513</td>
<td>Empirical Research In Composition</td>
</tr>
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<td>ENG 516</td>
<td>Rhetorical Studies for Technical Communication</td>
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<td>ENG 519</td>
<td>Online Information Design and Evaluation</td>
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<td>ENG 520</td>
<td>Science Writing for the Media</td>
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<tr>
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<td>Introduction to Linguistics</td>
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<tr>
<td>ENG 525</td>
<td>Variety In Language</td>
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<td>ENG 527</td>
<td>Discourse Analysis</td>
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<tr>
<td>ENG 583</td>
<td>Studies In Rhetoric and Writing (Gender and Medicine)</td>
</tr>
<tr>
<td>ENG 588</td>
<td>Studies In Rhetoric and Writing (Seminar on Communication in Health and Environmental Science)</td>
</tr>
<tr>
<td>ET 460</td>
<td>Practice of Environmental Technology</td>
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<td>GC 420</td>
<td>Visual Thinking</td>
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<td>GD 400</td>
<td>Advanced Graphic Design Studio</td>
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<td>GD 417/517</td>
<td>Information and Publishing Design Systems</td>
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<tr>
<td>HI 581</td>
<td>History of the Life Sciences</td>
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<tr>
<td>HI 582</td>
<td>Darwinism in Science and Society</td>
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<td>NR 571</td>
<td>Current Issues in Natural Resource Policy</td>
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<td>PA 511</td>
<td>Public Policy Analysis</td>
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<td>PA 512</td>
<td>The Budgetary Process</td>
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<td>PA 513</td>
<td>Public Organization Behavior</td>
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<tr>
<td>PA 514</td>
<td>Management Systems</td>
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<tr>
<td>PA 525</td>
<td>Organizational Development and Change Management</td>
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<td>PA 540</td>
<td>Grant Writing for Public Administrators</td>
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<td>PA 550</td>
<td>Environmental Policy</td>
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<td>PS 502</td>
<td>The Legislative Process</td>
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<td>PSY 410</td>
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<td>PSY 420</td>
<td>Cognitive Processes</td>
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<td>PSY 425</td>
<td>Introduction to Cognitive Science</td>
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<td>PSY 500</td>
<td>Visual Perception</td>
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<td>PSY 511</td>
<td>Advanced Social Psychology</td>
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<td>PSY 525</td>
<td>Introduction To Cognitive Science</td>
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<td>PSY 704</td>
<td>Learning and Motivation</td>
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<td>PSY 740</td>
<td>Engineering Psychology of Human-computer Interaction</td>
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<td>PSY 743</td>
<td>Ergonomic Performance Assessment</td>
</tr>
<tr>
<td>PSY 745</td>
<td>Human Performance Modeling</td>
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</tbody>
</table>
Graduate Certificates - College of Humanities and Social Sciences

Certificates

- Digital Humanities (Certificate) (p. 406)
- Nonprofit Management (Certificate) (p. 423)
- Nuclear Nonproliferation Science and Policy (Certificate) (p. 435)
- Policy Analysis (Certificate) (p. 423)
- Professional Communication and Managerial Skills (Certificate) (p. 435)
- Public Policy (Certificate) (p. 436)

Nuclear Nonproliferation Science and Policy (Certificate)

The objective of the program is to educate students about nuclear nonproliferation, safeguards, and security from both the global and the technical perspectives. Students will be exposed to state-of-the-art techniques and will develop an understanding of the technical and policy challenges to maintain and support a robust nuclear nonproliferation regime. This process will be supported by assignments designed to reinforce understanding of the individual subject areas covered, class projects which cover key areas such as proliferation case studies and physical security simulations, as well as interactions with subject matter experts in nuclear nonproliferation technology and policy.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>NE 501</td>
<td>Reactor Analysis and Design</td>
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</tr>
<tr>
<td>NE 504</td>
<td>Radiation Safety and Shielding</td>
<td>3</td>
</tr>
<tr>
<td>NE 505</td>
<td>Reactor Systems</td>
<td>3</td>
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<tr>
<td>NE 512</td>
<td>Nuclear Fuel Cycles</td>
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</tr>
<tr>
<td>NE 520</td>
<td>Radiation and Reactor Fundamentals</td>
<td>3</td>
</tr>
<tr>
<td>NE 541</td>
<td>Nuclear Nonproliferation Technology and Policy</td>
<td>3</td>
</tr>
</tbody>
</table>

Professional Communication and Managerial Skills (Certificate)

This online certificate program is designed to provide graduate students and professionals with a common platform of courses that will enhance their communication skills and professional development. In particular, professional science master’s program students in the program will gain the management and communication training that will allow them to transfer success in the laboratory to success in the marketplace.

Admission Requirements

Students not attending NC State must apply through the regular application process (https://applygrad.ncsu.edu/apply/). Proof of completion of a bachelor’s degree is necessary. A minimum undergraduate GPA of 3.0 is required for admission to the certificate program. However, GRE scores are not required.

Students currently in a degree program at NC State may add the certificate program to their degree program by completing the application for currently enrolled graduate students. For applications and description of program requirements, see the program web site (https://communication.chass.ncsu.edu/academics/pcms/).

Student Financial Support


Other Relevant Information

The interdisciplinary certificate requires a total of 12 credit hours, with 6 hours taken in the Poole College of Management and 6 hours taken in the College of Humanities and Social Sciences. Two required classes are BUS 590 (Management Foundations) and BUS 554 (Strategic Project Management). Two of the three following classes should also be taken: COM 521 (Communication and Globalization), COM 527 (Seminar in Organizational Conflict Management), or COM 530 (Interpersonal Communication in Science/Technology Organizations). To earn the certificate students must achieve a minimum 3.0 GPA in the program.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<td>BUS 501</td>
<td>Strategic Management Foundations</td>
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</tr>
<tr>
<td>BUS 554</td>
<td>Project Management</td>
<td>3</td>
</tr>
<tr>
<td>COM 521</td>
<td>Communication and Globalization</td>
<td>3</td>
</tr>
<tr>
<td>COM 527</td>
<td>Seminar in Organizational Conflict Management</td>
<td>3</td>
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</tbody>
</table>
Public Policy (Certificate)

Plan Requirements

<table>
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<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
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<td>The Public Policy Process</td>
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<tr>
<td>PA 509</td>
<td>Applied Political Economy</td>
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<tr>
<td>PA 511</td>
<td>Public Policy Analysis</td>
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</table>

Elective Courses

"Elective Courses" will be determined in conjunction with the academic committee

Total Hours 12

College of Natural Resources

Programs

- Environmental Assessment (p. 436)
- Forest Biomaterials (p. 437)
- Forestry and Environmental Resources (p. 441)
- Geospatial Analytics (p. 448)
- Geospatial Information Science & Technology (p. 450)
- Natural Resources (p. 452)
- Parks, Recreation, and Tourism Management (p. 457)

Degree Programs

Master’s (MR)

- Environment Assessment (MR) (p. 437)
- Forest Biomaterials (MR) (p. 438)
- Forestry (MR) (p. 442)
- Geospatial Information Science and Technology (MR) (p. 451)

Master of Science (MS)

- Forest Biomaterials (MS) (p. 439)
- Forestry (MS) (p. 444)
- Natural Resources (MS) (p. 455)
- Parks, Recreation and Tourism Management (MS) (p. 459)

Doctor of Philosophy (PhD)

- Forest Biomaterials (PhD) (p. 440)
- Forestry and Environmental Resources (PhD) (p. 445)
- Geospatial Analytics (PhD) (p. 449)
- Parks, Recreation and Tourism Management (PhD) (p. 460)

Minors

- Forestry (Minor) (p. 447)
- Human Dimensions of Natural Resources (Minor) (p. 461)

Certificates

- Environmental Assessment (Certificate) (p. 462)
- Geographic Information Systems (Certificate) (p. 462)
- Renewable Energy Assessment and Development (Certificate) (p. 463)
- Sport and Entertainment Venue Management (Certificate) (p. 461)

Environmental Assessment

The Master of Environmental Assessment (EA) is an interdisciplinary program focused on understanding the adverse impacts that pollutants and naturally occurring substances pose on human health and the environment. Through the program, students combine multiple fields of study to tackle complex environmental problems. The EA program can be completed entirely online. This allows professionals the flexibility to complete their degree while still working.

Admission Requirements

Admissions to the Master of Environmental Assessment program requires an undergraduate GPA of 3.0 or better in a natural resources, environmental science and management, engineering, or related field, a professional resume, a personal statement describing the applicants professional ambitions and how the EA program will assist in accomplishing those goals. Students with less than a 3.0 undergraduate GPA may be considered for provisional admission to the EA program or referred to the EA certificate program to enhance their skills before reapplying. Graduate Record Exam (GRE) results are NOT required for admittance to the program.

Master’s Degree Requirements

The EA program requires students to complete 30 credit hours of graduate coursework, including a 6 credit hour Project Course. Eighteen hours will be in required courses with the six hours selected from the list of elective courses or equivalent.

Students in the Master of Environmental Assessment program are generally self-supported, however students may also apply for financial aid.

Self-supported students may take up to 9 credit hours of course work per semester. However, students who are employed full time may find it advantageous to enroll in one or two courses per semester.

Other Relevant Information

The EA program also offers a Graduate Certificate in Environmental Assessment (12 credit hours). Certificate students may transfer up to 12 credits into the EA degree. Students enrolled in other NC State graduate programs may enroll in the Certificate program.

Degrees

- Environment Assessment (MR) (p. 437)

Full Professors

Stith Thompson Gower
Stacy Arnold Charles Nelson
Elizabeth Guthrie Nichols
Admission Requirements

Requirements listed here are in addition to graduate school requirements stated elsewhere. To be admitted, a student should have earned a B.S. degree with a major in wood and paper science or another suitable science or engineering degree. Students with a 3.0 GPA and with appropriate course backgrounds will be considered for admission. The GRE test scores are required except for the Master of Forest Biomaterials offered through Distance Education.

Master of Science Degree Requirements

The M.S. degree requires a minimum of 30 credit hours. In addition, there are WPS core course requirements, which vary depending on the field of study. Six hours of research (WPS 695) must be taken. Two hours of Seminar (WPS 591) must be passed. A qualifying exam must be passed.

Master of Forest Biomaterials Degree Requirements

The Master of Forest Biomaterials is a non-thesis, professional degree for students not interested in a thesis-based research program. The Master of Forest Biomaterials degree is offered both on campus and through Distance Education. For the on-campus program a minimum of 36 course credits is required. The regulations regarding credits are the same as for the M.S. degree except that no credit for WPS 695 is required or given and up to six credits of 400-level courses in the major field may be included. A technical report, which demonstrates the student’s ability to gather, analyze and report information is required.

In addition to Graduate School requirements, the Distance Education program requires that the student be employed professionally in a wood or paper science or allied field, have one year of professional experience, and take required WPS core courses, which vary depending on the field of study. A minimum of 30 course credits is required of students who have relevant professional experience, including one hour of Seminar (WPS 591) and five hours of an independent project (WPS 625). For distance students without relevant professional experience, 36 hours is required.

Doctoral Degree Requirements

In addition to Graduate School requirements, Ph.D. candidates must present two departmental seminars (WPS 791) before their final oral examination. Candidates must also write and defend a research proposal on their intended research (first proposition) and a research proposal on an area outside of their dissertation/thesis research (termed a second proposition) and pass qualifying exams.

Student Financial Support

A number of research assistantships and fellowships are available.

Other Relevant Information

Graduate students should select a committee chair and other advisory committee members and submit a plan of graduate work by the end of their first semester of residence. They are also required to take the qualifying examination as part of a Research Methods course. These examinations are to ensure that the student has the basic abilities to think independently as a scientist within the context of the forest biomaterials literature. The department believes M.S. and Ph.D. students should
select a research topic and begin their dissertation or thesis research as early as possible.

As the field of forest biomaterials is a derived science, students are urged to develop a strong secondary area of excellence in one or more of the supporting disciplines such as organic chemistry, polymer chemistry, chemical engineering, mathematics, statistics, biology, engineering mechanics, mechanical engineering, physics, and economics or business administration.

Degrees

- Forest Biomaterials (MR) (p. 438)
- Forest Biomaterials (MS) (p. 439)
- Forest Biomaterials (PhD) (p. 440)

Faculty

Full Professors

Dimitris S. Argyropoulos
Marko Hakovirta
Martin A. Hubbe
Hasan Jameel
Stephen S. Kelley
Melissa Pasquinelli
David C. Tilotta
Richard A. Venditti

Associate Professors

Lucian A. Lucia
Philip H. Mitchell
Lokendra Pal
Sunkyu Park
Joel Justin Pawlak
Perry N. Peralta
Ilona Maria Peszlen
Daniel Erique Saloni

Assistant Professors

Ronalds Wilfredo Gonzalez
Paul Frederik Laleicke
Nathalie Marie Lavoine
Yuan Yao

Practice/Research/Teaching Professors

Medwick V. Byrd

Emeritus Faculty

Hou-Min Chang
Ellis B. Cowling
Earl L. Deal
Eric L. Ellwood
Edward T. Funkhouser
Irving S. Goldstein
John A. Heitmann Jr.
Larry G. Jahn
Magret Joyce
Adrianna G. Kirkman
Michael J. Kocurek
Ronald G. Pearson
Richard J. Thomas
Elisabeth A. Wheeler

Adjunct Faculty

Sujit Banerjee
Jesse Daystar
Richard Phillips

Forest Biomaterials (MR)

Degree Requirements

<table>
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<th>Hours</th>
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<td>Forest Products Colloids &amp; Surfaces</td>
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<td>FB 565</td>
<td>Forest Biomaterials Physics</td>
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</tr>
<tr>
<td>FB 723</td>
<td>Forest Biomaterials Chemistry</td>
<td></td>
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<tr>
<td>FB 760</td>
<td>Engineering Unit Operations for Biomass</td>
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<tr>
<td></td>
<td>Conversion</td>
<td></td>
</tr>
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<td>FB 501</td>
<td>Masters Research Methods in Forest</td>
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<tr>
<td></td>
<td>Biomaterials</td>
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<td>FB 510</td>
<td>Strategic Business Processes for the Forest</td>
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</tr>
<tr>
<td></td>
<td>Products Industry</td>
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</tr>
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<td>FB 522</td>
<td>Chemical Principles for the Papermaking</td>
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<tr>
<td></td>
<td>Process Engineer</td>
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</tr>
<tr>
<td>FB 527</td>
<td>Wet-End and Colloidal Chemistry</td>
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</tr>
<tr>
<td>FB 576</td>
<td>Environmental Life Cycle Analysis</td>
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</tr>
</tbody>
</table>
**Additional Courses**

*Additional Courses* will be approved in conjunction with the academic committee to meet 36 total hours

| Total Hours | 36 |

**Faculty**

**Full Professors**
- Dimitris S. Argyropoulos
- Marko Hakovirta
- Martin A. Hubbe
- Hasan Jameel
- Stephen S. Kelley
- Melissa Pasquinelli
- David C. Tilotta
- Richard A. Venditti

**Associate Professors**
- Lucian A. Lucia
- Philip H. Mitchell
- Lokendra Pal
- Sunkyu Park
- Joel Justin Pawlak
- Perry N. Peralta
- Ilona Maria Peszlen
- Daniel Erique Saloni

**Assistant Professors**
- Ronalds Wilfredo Gonzalez
- Paul Frederik Laleicke
- Nathalie Marie Lavoine
- Yuan Yao

**Adjunct Faculty**
- Sujit Banerjee
- Jesse Daystar
- Richard Phillips

**Forest Biomaterials (MS)**

**Degree Requirements**

<table>
<thead>
<tr>
<th>Code</th>
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<tr>
<td>Select three of the following courses:</td>
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<tr>
<td>FB 516</td>
<td>Forest Products Colloids &amp; Surfaces</td>
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</tr>
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<td>FB 565</td>
<td>Forest Biomaterials Physics</td>
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</tr>
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<td>FB 723</td>
<td>Forest Biomaterials Chemistry</td>
<td></td>
</tr>
<tr>
<td>FB 760</td>
<td>Engineering Unit Operations for Biomass Conversion</td>
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<tr>
<td><strong>Elective Courses</strong></td>
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<tr>
<td>FB 510</td>
<td>Strategic Business Processes for the Forest Products Industry</td>
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<td>FB 522</td>
<td>Chemical Principles for the Papermaking Process Engineer</td>
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<td>FB 527</td>
<td>Wet-End and Colloidal Chemistry</td>
<td></td>
</tr>
<tr>
<td>FB 576</td>
<td>Environmental Life Cycle Analysis</td>
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<tr>
<td>FB 580</td>
<td>The Sustainable Bioeconomy</td>
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<tr>
<td><strong>Additional Course</strong></td>
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<tr>
<td>&quot;Additional Course&quot; approved in conjunction with the academic committee to meet 30 total hours</td>
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| Total Hours | 30 |
Faculty

Full Professors
Dimitris S. Argyropoulos
Marko Hakovirta
Martin A. Hubbe
Hasan Jameel
Stephen S. Kelley
Melissa Pasquinelli
David C. Tilotta
Richard A. Venditti

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Magret Joyce
Adrianna G. Kirkman
Michael J. Kocurek
Ronald G. Pearson
Richard J. Thomas
Elisabeth A. Wheeler

Adjunct Faculty
Sujit Banerjee
Jesse Daystar
Richard Phillips

Forest Biomaterials (PhD)

Degree Requirements

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<td>FB 516</td>
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<td>FB 565</td>
<td>Forest Biomaterials Physics</td>
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<td>FB 723</td>
<td>Forest Biomaterials Chemistry</td>
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<td>FB 760</td>
<td>Engineering Unit Operations for Biomass Conversion</td>
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<tr>
<td><strong>Elective Courses</strong></td>
<td></td>
<td>15</td>
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<tr>
<td>FB 510</td>
<td>Strategic Business Processes for the Forest Products Industry</td>
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<td>FB 522</td>
<td>Chemical Principles for the Papermaking Process Engineer</td>
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<td>Environmental Life Cycle Analysis</td>
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<td>&quot;Additional Courses&quot; are approved in conjunction with the academic committee to meet 72 total hours</td>
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Total Hours 82
Forestry and Environmental Resources

The department offers training in all of the major sub-disciplines of forest, natural resources, and environmental-related science and management. Considerable flexibility is allowed in developing graduate programs tailored to the student's objectives.

Admission Requirements

All parts of the application, including the GRE general test, are considered in making decisions. Admission is competitive and depends on the willingness of at least one member of the faculty to serve as major professor. An undergraduate degree in forestry is not required.

Master's Degree Requirements

The Master of Forestry is now accredited by the Society of American Foresters. It requires 40 credits, with a 1 credit project. The Master of Science course work requirements range from 30 to 36 credits. Students without an appropriate background will require additional preparatory work. For the M.S. degree, a minor is required.

Doctoral Degree Requirements

As a rule, students must complete a master's degree before entering the Ph.D. program. However, exceptionally well-prepared students may petition to have their degree objective changed to Ph.D. before completing the master's degree. In addition to the dissertation, Ph.D. programs require 36 to 54 credits of course work beyond the master's degree. A minor is required.

Student Financial Support

Stipend levels allow students to graduate without incurring significant debt. Those who begin without an assistantship are considered for funding as projects become available. Additional funding is available through a limited number of teaching assistantships.

Other Relevant Information

MS and PhD graduate students must meet the following requirements:

1. take a one-credit research methodology course, FOR 603 or 803, early in his/her program;
2. take a seminar course (typically FOR 601/801), and
3. begin the final oral exam with a seminar to the department based on work accomplished during the graduate program.
Degrees

- Forestry (MR) (p. 442)
- Forestry (MS) (p. 444)
- Forestry and Environmental Resources (PhD) (p. 445)
- Forestry (Minor) (p. 447)

Full Professors

Robert Carroll Abt
Robert E. Bardon
Frederick Willis Cubbage
Christopher S. DePerno
Douglas J. Frederick
Stith Gower
George R. Hess
Gary Ray Hodge
Fikret Isik
John S. King
Bailian Li
Steven Edward McKeand
Ross Meentemeyer
Mark Megalos
Christopher E. Moorman
Stacy Arnold Charles Nelson
Elizabeth Guthrie Nichols
Marcus Peterson
Joseph Peter Roise
Robert Scheller
Erin Odonnell Sills
Mary Watzin
Ross W. Whetten

Associate Professors

Gary B. Blank
Rachel Cook
Beth Cooper
Jason Delborne
Ryan E. Emanuel
Ryan Emanuel

Dennis W. Hazel
Madhusudan Katti
Marcelo Ardon Sayao
Theodore Henry Shear
Mirela Tulbure

Assistant Professor

Ayse Ercuman
Jodi Forrester
Josh Gray
Jordan Kern
Zakiya Holmes Leggett
Katie Martin
Jamain Pacitici
Kitt Payn
Leah Rathbun
Louie Rivers
Jack Wang

Practice/Research/Teaching Professors

Juan Jose Acosta
Jennifer Richmond Bryant
Jennifer Costanza
Stephanie Jeffries
Robert Miller Jetton
Roland Kays
Megan Lupek
Kevin M Potter

Forestry (MR)

Degree Requirements

<table>
<thead>
<tr>
<th>Course</th>
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<tr>
<td>FOR 501</td>
<td>Dendrology</td>
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<td>FOR 502</td>
<td>Forest Measurements</td>
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<td>SSC 461</td>
<td>Soil Physical Properties and Plant Growth</td>
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<td>FOR 574</td>
<td>Forest Mensuration and Modeling</td>
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### Spring Semester

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<td>FOR 504</td>
<td>The Practice of Silviculture</td>
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<tr>
<td>FOR 506</td>
<td>Silviculture Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>FOR 534</td>
<td>Forest Operations and Analysis</td>
<td>3</td>
</tr>
<tr>
<td>GIS 510</td>
<td>Fundamentals of Geospatial Information</td>
<td>3</td>
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| Hours    | 10 |

### Summer

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<td>FOR 630</td>
<td>Independent Study in Forestry</td>
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### Second Year

#### Fall Semester

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<td>NR 560</td>
<td>Renewable Natural Resource Management and Policy</td>
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<tr>
<td>PB 421</td>
<td>Plant Physiology</td>
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<tr>
<td>FOR 519</td>
<td>Forest Economics</td>
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| Hours    | 9  |

### Spring Semester

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<th>Course</th>
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<td>NR 500</td>
<td>Natural Resource Management</td>
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<tr>
<td>FOR 565</td>
<td>Plant Community Ecology</td>
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<tr>
<td>FOR 531</td>
<td>Wildland Fire Science</td>
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</table>

| Hours    | 11 |

| Total Hours | 41 |

* Courses contain outdoor laboratories or assignments.

### Full Professors

- Robert Carroll Abt
- Robert E. Bardon
- Frederick Willis Cubbage
- Christopher S. DePerno
- Douglas J. Frederick
- Stith Gower
- George R. Hess
- Gary Ray Hodge
- Fikret Isik
- John S. King
- Bailian Li
- Steven Edward McKeand
- Ross Meentemeyer
- Mark Megalos
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- Stacy Arnold Charles Nelson
- Elizabeth Guthrie Nichols
- Marcus Peterson
- Joseph Peter Roise
- Robert Scheller
- Erin Odonnell Sills
- Mary Watzin
- Ross W. Whetten

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- Gary B. Blank
- Rachel Cook
- Beth Cooper
- Jason Delborne
- Ryan E. Emanuel
- Ryan Emanuel
- Dennis W. Hazel
- Madhusudan Katti
- Marcelo Ardon Sayao
- Theodore Henry Shear
- Mirela Tulbure

### Assistant Professor

- Ayse Ercuman
- Jodi Forrester
- Josh Gray
- Jordan Kern
- Zakiya Holmes Leggett
- Katie Martin
- Jamain Pacitici
- Kitt Payn
- Leah Rathbun
- Louie Rivers
- Jack Wang

### Practice/Research/Teaching Professors

- Juan Jose Acosta
- Jennifer Richmond Bryant
- Jennifer Costanza
Forestry (MS)

Degree Requirement

The department offers training in all of the major sub-disciplines of forest, natural resources, and environmental-related science and management. Considerable flexibility is allowed in developing graduate programs tailored to the student’s objectives.

<table>
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<tr>
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Forestry Courses

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<td>FOR 501</td>
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<td>FOR 502</td>
<td>Forest Measurements</td>
<td>1</td>
</tr>
<tr>
<td>FOR 503</td>
<td>Tree Physiology</td>
<td>1</td>
</tr>
<tr>
<td>FOR 504</td>
<td>The Practice of Silviculture</td>
<td>3</td>
</tr>
<tr>
<td>FOR 505</td>
<td>Forest Management</td>
<td>4</td>
</tr>
<tr>
<td>FOR 506</td>
<td>Silviculture Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>FOR 508</td>
<td>Hardwood Management</td>
<td>3</td>
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<td>FOR 509</td>
<td>Forest Resource Policy</td>
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<td>FOR 513</td>
<td>Silviculture for Intensively Managed Plantations</td>
<td>3</td>
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<td>FOR 514</td>
<td>Woodland Stewardship</td>
<td>3</td>
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<td>FOR 519</td>
<td>Forest Economics</td>
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<td>Watershed and Wetlands Hydrology</td>
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<tr>
<td>FOR 522</td>
<td>Consulting Forestry</td>
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<td>FOR 531</td>
<td>Wildland Fire Science</td>
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Ross Meentemeyer
Mark Megalos
Christopher E. Moorman
Stacy Arnold Charles Nelson
Elizabeth Guthrie Nichols
Marcus Peterson
The department offers training in all of the major sub-disciplines of forest, natural resources, and environmental-related science and management. Considerable flexibility is allowed in developing graduate programs tailored to the student's objectives.

### Degree Requirements

The additional courses that will be applied to reach 36-72 credit hours will be determined in conjunction with the academic committee.

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1. 72 total hours beyond a Bachelor's degree. Students with a Master's degree from another university can count 18 credit hours from their Master's. Students with a Master's degree from NC State can count 18-36 credits from their masters, following the Graduate School rules and regulations.

### Forestry Courses

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- Robert E. Bardon
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- Elizabeth Guthrie Nichols
- Marcus Peterson
- Joseph Peter Roise
- Robert Scheller
- Erin Odonnell Sills
- Mary Watzin
- Ross W. Whetten

### Associate Professors

- Gary B. Blank
- Rachel Cook
- Beth Cooper
- Jason Delborne
- Ryan E. Emanuel
- Ryan Emanuel
- Dennis W. Hazel
- Madhusudan Katti
- Marcelo Ardon Sayao
- Theodore Henry Shear
- Mirela Tulbure

### Assistant Professor

- Ayse Ercuman
- Jodi Forrester
- Josh Gray
- Jordan Kern
- Zakiya Holmes Leggett
- Katie Martin
- Jamain Pacitici
- Kitt Payn
- Leah Rathbun
Louie Rivers
Jack Wang

Practice/Research/Teaching Professors
Juan Jose Acosta
Jennifer Richmond Bryant
Jennifer Costanza
Stephanie Jeffries
Robert Miller Jetton
Roland Kays
Megan Lupek
Kevin M Potter

Forestry (Minor)

Plan Requirements

• 9 (MS student) or 12 (PhD student) credit hours

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Ross Meentemeyer
Mark Megalos
The Center for Geospatial Analytics innovative Ph.D. program brings together departments from across NC State University to train a new generation of interdisciplinary data scientists skilled in developing novel understanding of spatial phenomena and in applying new knowledge to grand challenges.

This one-of-a-kind degree focuses on integrative thinking and experiential learning:

- Multidisciplinary advising unites expertise from across complementary academic departments
- Cross-cutting curriculum spans core classes in solution-driven analytics and discipline-specific electives
- Geospatial externship enriches practical understanding through a one-week internship with an external partner

If your research goals intersect geospatial problem-solving from any number of fields, you will find your fit here. Our Faculty Fellows (https://cnr.ncsu.edu/geospatial/people/fellows/) advise students interested in a range of disciplines—from design, to cognitive science, natural resources and the environment, computer science, engineering and more—and approach their work in a range of geospatial research areas. Students with strong backgrounds in quantitative methods in geography, geomatics/informatics, remote sensing and earth sciences are strongly encouraged to apply.

**Admission Requirements**

**Minimum requirements include:**

- Undergraduate GPA ≥ 3.0
- Graduate GPA ≥ 3.0 (if entering with a Master’s degree)
- GRE Scores (within last 5 years). There is no minimum, but students accepted for Fall 2019 admission earned the following average scores: Quantitative: 159 (73rd percentile), Verbal: 158 (80th percentile), Writing: 4 (60th percentile)
- IBT TOEFL Score ≥ 80 overall (18 in each section) (International Applicants; the Office of International Services offers additional helpful information)

**Required supporting documents**

- Official NC State Graduate School application.
- Unofficial transcripts from all colleges/universities attended (official transcripts will be required if admitted to the program).
• A personal statement, not to exceed 2 pages. We encourage you to consider the following:
  • Your academic and career goals
  • Special interests and prior research in the area of geospatial analytics
  • What makes you well-suited to our program
  • Describe any computational, quantitative, and/or geospatial training
  • You are encouraged to suggest prospective advisor(s) and describe shared research interests
• 3 letters of recommendation. Submit the names and contact information for your recommenders through the online application, and they will receive an email with instructions for submitting their letters online.
• Curriculum vitae/resume.

Degree Requirements
The Ph.D. program consists of:

• 72 credit hours beyond the Bachelor’s degree. The core required courses comprise 18 credit hours. The remaining 54 credit hours are devoted to an individually tailored selection of electives and research.
• an off-campus professional experience. By the beginning of their third year in the program, students participate in an experiential learning activity within government (local, state, federal), industry, private and academic research institutions, or other organizations in the geospatial arena.
• a comprehensive exam. The written exam is required by the end of the 4th semester, followed by an oral exam consisting of the dissertation proposal defense, typically before the start of the 5th semester.
• a written dissertation and final dissertation oral defense required to complete the degree.

Degrees
• Geospatial Analytics (PhD) (p. 449)

Full Professors
Sankarasubramanian Arumugam
Emily Zechman Berglund
DelWayne R. Bohenstiehl
Ryan E. Emanuel
David Brian Hill
Yu-Fai Leung
Ross Kendall Meentemeyer
Helena Mitasova
Stacy Arnold Charles Nelson
Brian J. Reich
Robert Michael Scheller
Sandra E. Yuter

Associate Professors
Paul Kevin Byrne
Bethany Brooke Cutts
James Aaron Hipp
Christopher Lee Osburn
William Michael Rand
Mirela Gabriela Tulbure
Ranga Raju Vatsavai
Benjamin Allen Watson
Karl William Wegmann

Assistant Professors
Joshua Michael Gray
Anders Schmidt Huseth
Gustavo Machado
Katherine Lee Martin
Natalie Genevieve Nelson Sagues
Daniel R. Obenour
Jamian Krishna Pacifici
Jelena Vukomanovic

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Daniela Jones
Eric Shane Money
Jennifer Richmond-Bryant
Laura Gray Tateosian
Vaishnavi Thakar

Adjunct Faculty
Adam Terando

Geospatial Analytics (PhD)

Degree Requirements

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Geospatial Information Science & Technology

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<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>GIS 712</td>
<td>Environmental Earth Observation and Remote Sensing</td>
</tr>
<tr>
<td>GIS 713</td>
<td>Geospatial Data Mining</td>
</tr>
<tr>
<td>GIS 714</td>
<td>Geospatial Computation and Simulation</td>
</tr>
<tr>
<td>GIS 715</td>
<td>Geovisualization</td>
</tr>
</tbody>
</table>

**Research / Elective Courses** 54

“Research / Elective Courses” are approved in conjunction with the academic committee to meet 72 total hours

**Total Hours** 72

**Full Professors**

Sankarasubramanian Arumugam
Emily Zechman Berglund
DelWayne R. Bohnenstiehl
Ryan E. Emanuel
David Brian Hill
Yu-Fai Leung
Ross Kendall Meentemeyer
Helena Mitasova
Stacy Arnold Charles Nelson
Brian J. Reich
Robert Michael Scheller
Sandra E. Yuter

**Associate Professors**

Paul Kevin Byrne
Bethany Brooke Cutts
James Aaron Hipp
Christopher Lee Osburn
William Michael Rand
Mirela Gabriela Tulbure
Ranga Raju Vatsavai
Benjamin Allen Watson
Karl William Wegmann

**Assistant Professors**

Joshua Michael Gray
Anders Schmidt Huseth
Gustavo Machado
Katherine Lee Martin

Natalie Genevieve Nelson Sagues
Daniel R. Obenour
Jamian Krishna Pacifici
Jelena Vukomanovic

**Practice/Research/Teaching Professors**

Perver Korca Baran
Daniela Jones
Eric Shane Money
Jennifer Richmond-Bryant
Laura Gray Tateosian
Vaishnavi Thakar

**Adjunct Faculty**

Adam Terando

Geospatial Information Science & Technology

The Master of Geospatial Information Science and Technology (MGIST) equips students with the necessary knowledge and tools to become high-end geospatial professionals using a unique curriculum that leverages NC State’s strengths in computational and data sciences, information technology, and interdisciplinary training in combination with professional skills development in areas of project management, technical writing, and communications. The MGIST can be completed entirely online, allowing flexibility for both students just entering the work force and working professionals.

Through a combination of geospatial theory, hands-on applications, and client-based service-learning experiences, students graduate from the program with a solid foundation to provide a wide range of geospatial expertise for local, state, national, and international organizations.

**Admissions Requirements**

Admission to the program requires an undergraduate GPA of 3.0 or better, a professional resume, a personal statement describing the applicant’s professional ambitions and experience, and 3 letters of reference. Students with less than a 3.0 undergraduate GPA may be considered for provisional admission into the MGIST or referred to the GIS Certificate program to enhance skills and prepare for reapplication to the MGIST.

**Master’s Degree Requirements**

The MGIST degree requires 33 course credit hours including a 3-credit-hour Capstone course and development of a professional portfolio highlighting geospatial analytic skills and competencies. A cumulative GPA of 3.0 or better is required in order to graduate. Specific course requirements are listed on the MGIST web site.
Student Financial Support

Students in this program are eligible for financial aid and may compete for program assistantships and internships.

Other Relevant Information

The GIS program also offers a Graduate Certificate in GIS (https://online-distance.ncsu.edu/program/graduate-certificate-in-geographic-information-science/) (12 credit hours). Certificate students may transfer up to 12 credits of B or better grades upon application and acceptance into the MGIST program.

Degrees

• Geospatial Information Science and Technology (MR) (p. 451)

Faculty

Full Professors

Sankarasubramanian Arumugam
DeWayne R. Bohnenstiehl
David A. Crouse
George D. Garson
Christopher Graham Healey
Ronnie William Heiniger
George R. Hess
Hamid Krim
Thomas J Kwak
Duane K. Larick
Yu-Fai Leung
Jay Frederick Levine
Ross Kendall Meentemeyer
Helena Mitasova
Stacy A. C. Nelson
Margery Frances Overton
William John Rasdorf
Gary T. Roberson
Sandra E. Yuter

Associate Professors

William R. Smith
Ranga Raju Vatsavai
Karl William Wegmann
Jeffrey G. White

Assistant Professors

Jelena Vukomanovic

Practice/Research/Teaching Professors

Perver Korca Baran
Eric Shane Money
Stacy Kathleen Supak
Laura Gray Tateosian
Vaishnavi Thakar

Geospatial Information Science and Technology (MR)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Core Courses</th>
<th>Title</th>
<th>Hours</th>
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<td>GIS 501</td>
<td>Geospatial Professionalism</td>
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<tr>
<td>GIS 510</td>
<td>Fundamentals of Geospatial Information Science and Technology</td>
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<tr>
<td>GIS 530</td>
<td>Spatial Data Foundations</td>
<td></td>
<td></td>
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<td>GIS 540</td>
<td>Geospatial Programming Fundamentals</td>
<td></td>
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<td>GIS 550</td>
<td>Geospatial Data Structures and Web Services</td>
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<td>GIS 582</td>
<td>Geospatial Modeling</td>
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<td>GIS 590</td>
<td>Geospatial Information Science Master's Project</td>
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<td>GIS 660</td>
<td>MGIST Professional Portfolio</td>
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<tr>
<td></td>
<td>Elective Courses</td>
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Choose 12 credit hours of electives from the "Elective Courses" listed below, at least 6 of which must be GIS prefix courses

Total Hours

33

Elective Courses

<table>
<thead>
<tr>
<th>Code</th>
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<tr>
<td>GIS 512</td>
<td>Introduction to Environmental Remote Sensing</td>
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<td>GIS 515</td>
<td>Cartographic Design</td>
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<td>GIS 517</td>
<td>GIS Applications in Landscape Architecture and Environmental Planning</td>
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</tr>
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<td>GIS 520</td>
<td>Spatial Problem Solving</td>
<td></td>
</tr>
<tr>
<td>GIS 521</td>
<td>Surface Water Hydrology with GIS</td>
<td></td>
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<tr>
<td>GIS 535</td>
<td>Web and Mobile GIS Protocols</td>
<td></td>
</tr>
<tr>
<td>GIS 595</td>
<td>Special Topics in Geospatial Information Science</td>
<td></td>
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<tr>
<td>GIS 584</td>
<td>Mapping and Analysis Using UAS</td>
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</tr>
<tr>
<td>GIS 609</td>
<td>Geospatial Forum</td>
<td></td>
</tr>
<tr>
<td>GIS 610</td>
<td>Special Topics in Geospatial Information Science</td>
<td></td>
</tr>
<tr>
<td>GIS 630</td>
<td>Independent Study</td>
<td></td>
</tr>
<tr>
<td>SSC 540</td>
<td>Geographic Information Systems (GIS) in Soil Science and Agriculture</td>
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</tbody>
</table>
Natural Resources

The natural resources program is an interdepartmental program designed to prepare students for positions in both private and public natural resource organizations. A selection of technical options couple core courses in natural resources issues and management with a series of related courses in a variety of related technical disciplines. The purpose of the natural resources core curriculum is to educate professionals at a Master's level who are well-versed in policy and regulation and who have skills in quantitative assessments. Currently approved technical options include: assessment and analysis, ecological restoration, economics and management, policy and administration, international resources, hydrology, and geographic information systems in the Department of Forestry and Environmental Resources; outdoor recreation management in the Department of Parks, Recreation and Tourism Management; and landscape architecture in the Department of Landscape Architecture.

Each option is available as either the M.S. in NR or as the non-thesis Master of NR.

Admissions Requirements

Students should have an undergraduate degree in natural resources or a related field. Experience in natural resources management and administration will be considered in lieu of an appropriate undergraduate degree. Admission is contingent upon meeting departmental requirements and acceptance by an advisor.

Master’s Requirements

The M.S. degree requires a research thesis based on completion of a research project. The Master of NR degree requires a practical project which develops and demonstrates problem-solving skills. Students enrolled in the Department of Forestry and Environmental Resources must take FOR 603 in the first or second semester. The minimum number
of credit hours varies by technical option, but is generally 36 credit hours including research or project credits and core courses.

**Degrees**

- Natural Resources (MR) (p. 453)
- Natural Resources (MS) (p. 455)

**Faculty**

**Full Professors**

Robert Carroll Abt
Aziz Amoozegar
Carla E. Barbieri
Jason N. Bocarro
Kofi Malik Boone
Frederick Willis Cubbage
Myron Fran Floyd
Andrew Alan Fox
Douglas J. Frederick
John L. Havlin
George R. Hess
Fikret Isik
John S. King
Yu-Fai Leung
Ross Kendall Meentemeyer
Mark Arthur Megalos
Stacy Arnold Charles Nelson
Elizabeth Guthrie Nichols
Markus Nils Peterson
Joseph Peter Roise
Robert Michael Scheller
Bethany Brooke Cutts

**Assistant Professors**

Rachel Louise Cook
Jodi Anne Forrester
Joshua Michael Gray
Jordan Kern
Lincoln Ray Larson
Zakiya Holmes Leggett
Katherine Lee Martin
Rajan Parajuli
Louie Rivers
Kathryn Tate Stevenson
Jelena Vukomanovic

**Practice/Research/Teaching Professors**

Jennifer Richmond Bryant
Laura Gray Tateosian

**Natural Resources (MR)**

**Degree Requirements**

Students may choose from the degree options below to complete coursework within a focus area.

Degrees earned will be distributed as: “Master of Natural Resources” without option specifications.

**Traditional Option**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>NR 500</td>
<td>Natural Resource Management</td>
<td>10</td>
</tr>
<tr>
<td>NR 571</td>
<td>Current Issues in Natural Resource Policy</td>
<td></td>
</tr>
</tbody>
</table>
NR 601 Graduate Seminar

Select a graduate-level Statistics courses in conjunction with the academic committee

Additional Courses

"Additional Courses" are approved in conjunction with the academic committee to meet 36 total hours

Total Hours 36

1 Equivalent seminar course may be accepted determined in conjunction with the academic committee.

Technical Options

Assessment and Analysis

This option allows students to develop a project incorporating field course components with decision making tools and the opportunity to develop depth in a specific subject matter focus. Focused on planning and conservation processes and efforts, the option aims to hone the abilities of people who will function as part of NEPA process teams, NGOs aiming to preserve and protect land and its biodiversity, or professionals performing Phase I, protected species investigations, and related assessment roles.

Ecological Restoration

This option prepares students to assist in the recovery of ecosystems that have been degraded, damaged, or destroyed. This requires extensive knowledge of the abiotic environments that sustain the biota of ecosystems, community structure, sustainable cultural practices, and performance monitoring, among other skills. Emphasis is on the actual craft of restoring natural ecosystems, and the social and philosophical elements that mandate restoration.

Economics and Management

Economics and Management option graduate students study the trade-offs associated with how society interacts with natural resources in order to assess and improve natural resource policy and management. Students focus on trade-offs at many different spatial and temporal scales. Examples include non-market valuation of ecosystem services, optimal management of forest stands with changing climate, carbon and market consequences of using biomass energy, sustainable development and long-term projections of ecological and economic sustainability.

GIS

This option provides students with a thorough background in the spatial sciences including spatial modeling, remote sensing, geographic information systems, and spatial databases. Students completing this option will be prepared for positions in a variety of federal agencies such as the USDA Forest Service, EPA, NOAA, or Corps of Engineers; with state agencies; with regional or local planning organizations; and with private consulting firms.

Hydrology

This option promotes understanding the hydrologic processes of watersheds and wetlands and prepares students for conducting hydrologic studies and directing watershed management programs. Courses also focus on water resources policy and regulation. Students are prepared for positions with private consulting firms as well as with many other public and private organizations that deal with the hydrologic impacts of land use and climate change.

International Resources

This option is designed to enhance students’ understanding of international forestry and natural resource management and to prepare them for careers abroad or with internationally oriented institutions and companies in the US. Courses in this option are taught in several different departments and provide a broad background with rigorous technical emphases.

Landscape Architecture

This option is a non-thesis professional degree program. Students who complete all courses required for the technical option will receive a Master of Landscape Architecture and the Natural Resources Landscape Architecture with the Technical Option, curriculum code (NRD). No previous LAR degree is required. Students who are interested in becoming physical planners in municipalities, federal government, park and recreation planning as well as housing development and transportation planning will require a first professional degree in landscape architecture and are primary candidates for this second degree in the natural resources.

Outdoor Recreation

This technical option develops the knowledge and skills needed for planning and managing natural resource-based outdoor recreation opportunities and resources. Students are prepared for positions with federal, state, regional, county and municipal parks, recreation and land management agencies as well as with private firms and non-profit organizations.

Policy and Administration

This option develops knowledge and skills about policy processes and sciences, public and private organizations, natural resource law and policy, public governance and involvement, and their applications to natural resource management and conservation.

Faculty

Full Professors

Robert Carroll Abt
Aziz Amoozegar
Carla E. Barbieri
Jason N. Bocarro
Kofi Malik Boone
Frederick Willis Cubbage
Myron Fran Floyd
Andrew Alan Fox
Douglas J. Frederick
John L. Havlin
George R. Hess
NC State University

Fikret Isik
John S. King
Yu-Fai Leung
Ross Kendall Meentemeyer
Mark Arthur Megalos
Stacy Arnold Charles Nelson
Elizabeth Guthrie Nichols
Markus Nils Peterson
Joseph Peter Roise
Robert Michael Scheller
Erin Lynn Seekamp
Erin Odonnell Sills
Michael John Vepraskas

Associate Professors
Marcelo Luise Ardon Sayao
Gary B. Blank
Gene Leroy Brothers
Bethany Brooke Cutts
Jason Aaron Delborne
Michael B. Edwards
Ryan E. Emanuel
Christopher Galik
Madhusudan Vithal Katti
Fernando H. Magallanes
Duarte B. Morais
Theodore Henry Shear
Mirela Gabriela Tulbure
Candace Goode Vick

Assistant Professors
Rachel Louise Cook
Jodi Anne Forrester
Joshua Michael Gray
Jordan Kern
Lincoln Ray Larson

Zakiya Holmes Leggett
Katherine Lee Martin
Rajan Parajuli
Louie Rivers
Kathryn Tate Stevenson
Jelena Vukomanovic

Practice/Research/Teaching Professors
Jennifer Richmond Bryant
Laura Gray Tateosian

Natural Resources (MS)
Degree Requirements
Students may choose from the degree options below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Science in Natural Resources" without option specifications.

Core Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>NR 500</td>
<td>Natural Resource Management</td>
<td>10</td>
</tr>
<tr>
<td>NR 571</td>
<td>Current Issues in Natural Resource Policy</td>
<td></td>
</tr>
<tr>
<td>NR 601</td>
<td>Graduate Seminar</td>
<td></td>
</tr>
</tbody>
</table>

Select a graduate-level Statistics courses in conjunction with the academic committee

Additional Courses

"Additional Courses" are approved in conjunction with the academic committee to meet 30 total hours (may select a Technical Option listed below)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>NR 695</td>
<td>Master's Thesis Research</td>
</tr>
</tbody>
</table>

Total Hours 30

1 Equivalent seminar course may be accepted determined in conjunction with the academic committee.

Technical Options

Assessment and Analysis
This option allows students to develop a project incorporating field course components with decision making tools and the opportunity to develop depth in a specific subject matter focus. Focused on planning and conservation processes and efforts, the option aims to hone the abilities of people who will function as part of NEPA process teams, NGOs aiming to preserve and protect land and its biodiversity, or professionals performing Phase I, protected species investigations, and related assessment roles.

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GIS
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Hydrology
This option promotes understanding the hydrologic processes of watersheds and wetlands and prepares students for conducting hydrologic studies and directing watershed management programs. Courses also focus on water resources policy and regulation. Students are prepared for positions with private consulting firms as well as with many other public and private organizations that deal with the hydrologic impacts of land use and climate change.

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This option is designed to enhance students’ understanding of international forestry and natural resource management and to prepare them for careers abroad or with internationally oriented institutions and companies in the US. Courses in this option are taught in several different departments and provide a broad background with rigorous technical emphases.

Landscape Architecture
This option is a non-thesis professional degree program. Students who complete all courses required for the technical option will receive a Master of Landscape Architecture and the Natural Resources Landscape Architecture with the Technical Option, curriculum code (NRD). No previous LAR degree is required. Students who are interested in becoming physical planners in municipalities, federal government, park and recreation planning as well as housing development and transportation planning will require a first professional degree in landscape architecture and are primary candidates for this second degree in the natural resources.

Outdoor Recreation
This technical option develops the knowledge and skills needed for planning and managing natural resource-based outdoor recreation opportunities and resources. Students are prepared for positions with federal, state, regional, county and municipal parks, recreation and land management agencies as well as with private firms and non-profit organizations.

Policy and Administration
This option develops knowledge and skills about policy processes and sciences, public and private organizations, natural resource law and policy, public governance and involvement, and their applications to natural resource management and conservation.

Faculty
Full Professors
Robert Carroll Abt
Aziz Amoozegar
Carla E. Barbieri
Jason N. Bocarro
Kofi Malik Boone
Frederick Willis Cubbage
Myron Fran Floyd
Andrew Alan Fox
Douglas J. Frederick
John L. Havlin
George R. Hess
Fikret Isik
John S. King
Yu-Fai Leung
Ross Kendall Meentemeyer
Mark Arthur Megalos
Stacy Arnold Charles Nelson
Elizabeth Guthrie Nichols
Markus Nils Peterson
Joseph Peter Roise
Robert Michael Scheller
Erin Lynn Seekamp
Erin Odonnell Sills
Michael John Vepraskas

Associate Professors
Marcelo Luise Ardon Sayao
Gary B. Blank
Gene Leroy Brothers
The Doctoral degree allows students to match their particular research interests and career aspirations with departmental research activities and faculty expertise. The primary areas of interest for students include health and well-being, human dimensions of the natural and built environment, sustainable and equitable tourism, and geospatial methods and modelling with a substantive area of study in another discipline.

The Master's degree provides students the opportunity to develop and enhance their critical understanding of both the conceptual foundations of parks, recreation and tourism management and the procedures of systematic inquiry and critical problem solving as applied to planning and management issues. The department offers educational opportunities and resources for the preparation of professionals concerned with planning, organizing, managing and directing parks, recreation, sport, and tourism programs, areas, and facilities. Several Master's Degree options (https://cnr.ncsu.edu/prtm/graduate-programs/) are available: MS in Parks, Recreation and Tourism Management, MS in Natural Resources-Outdoor Recreation Technical Option, Master of Natural Resources (MNR)-Outdoor Recreation Technical Option (non-thesis), and Online Professional Master of Parks, Recreation, Tourism and Sport Management (MPRTSM) (non-thesis). The Department also administers the Graduate Certificate in Sport and Entertainment Venue Management.

The general emphasis areas at the Master's level include: parks and recreation management, tourism development and management, geographic information systems, recreational sport management, and natural resource recreation management. The MS-NR and MNR (Outdoor Recreation Technical Option) develops the knowledge and skills needed for planning and managing natural resource-based outdoor recreation opportunities and resources.

The online MPRTSM degree provides students with a solid professional and business education designed to advance their career development in parks, recreation, tourism, and sport industries. The online degree program operates on a cohort model and admits students in fall and spring semester.

Doctoral Degree Requirements

Although each doctoral course of study will be unique to the individual student, the usual course of study will include a minimum of 54 hours beyond the Master's. These credit hours are distributed among the core courses, statistics and research methods, a minor or substantive area consisting of 15 hours of course work approved by the student's faculty advisor, and the dissertation. Students are expected to have completed a Master's degree, preferably one with a thesis. Students without research experience will have to demonstrate an ability to produce scholarly work in PRTM.

Master's Degree Requirements

Each Master's Degree has specific requirements (https://cnr.ncsu.edu/prtm/graduate-programs/). The minimum credit hours range from 30 for MS in PRTM Degree, to 34 for MNR-Outdoor Recreation Technical Option Degree. Doctoral and M.S. application deadline is January 15 for both U.S. and international students. Online Degree-MPRTSM application deadline is May 15.

Student Financial Support

Graduate assistantships are available to students in PhD and MS degree program on a competitive basis.

Degrees

- Parks, Recreation, Tourism and Sports Management (MR) (p. 458)
- Parks, Recreation and Tourism Management (MS) (p. 459)
- Parks, Recreation and Tourism Management (PhD) (p. 460)
- Human Dimensions of Natural Resources (Minor) (p. 461)
- Sport and Entertainment Venue Management (Certificate) (p. 461)
Faculty

Full Professors
Carla E. Barbieri
Jason N. Bocarro
Myron F. Floyd
Michael A. Kanters
Yu-Fai Leung
Erin Lynn Seekamp

Associate Professors
Gene Leroy Brothers
Kyle Stephen Bunds
Jonathan M. Casper
Bethany Brooke Cutts
Michael B. Edwards
James Aaron Hipp
Lincoln Ray Larson
Duarte B. Morais

Assistant Professors
Whitney Grace Knollenberg
Kangjae “Jerry” Lee
Kathryn Tate Stevenson
Jelena Vukomanovic

Practice/Research/Teaching Professors
Perver Korca Baran
Kimberly Ann Bush
Stacy Kathleen Supak
Laura Gray Tateosian

Emeritus Faculty
Aram Attarian
Hugh A. Devine Jr
Larry Douglas Gustke
Karla Ann Henderson
Roger Louis Moore

Chrys D. Siderelis
Candace Goode Vick

Parks, Recreation, Tourism, and Sports Management (MR)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
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<tbody>
<tr>
<td>PRT 500</td>
<td>Conceptual Foundations of Recreation</td>
<td>22</td>
</tr>
<tr>
<td>PRT 503</td>
<td>Advanced Fiscal Management for Parks, Recreation, Tourism and Sport Organizations</td>
<td></td>
</tr>
<tr>
<td>PRT 504</td>
<td>Data Management and Applications in Parks, Recreation, Tourism and Sport Management</td>
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</tr>
<tr>
<td>PRT 505</td>
<td>GIS and Spatial Analysis in PRTS</td>
<td></td>
</tr>
<tr>
<td>PRT 506</td>
<td>Organizational Behavior and Leadership in Parks, Recreation, Tourism and Sport</td>
<td></td>
</tr>
<tr>
<td>PRT 507</td>
<td>Strategic Marketing Management in Parks, Recreation, Tourism and Sport Organizations</td>
<td></td>
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<tr>
<td>PRT 508</td>
<td>Risk Management for Parks, Recreation, Tourism and Sport Organizations</td>
<td></td>
</tr>
<tr>
<td>PRT 650</td>
<td>Professional Electronic Portfolio for Parks, Recreation and Tourism Management</td>
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</table>

Elective Courses 9

“Elective Courses” are approved in conjunction with the academic committee to meet 31 total hours

Total Hours 31

Faculty

Full Professors
Carla E. Barbieri
Jason N. Bocarro
Myron F. Floyd
Michael A. Kanters
Yu-Fai Leung
Erin Lynn Seekamp

Associate Professors
Gene Leroy Brothers
Kyle Stephen Bunds
Jonathan M. Casper
Bethany Brooke Cutts
Michael B. Edwards
James Aaron Hipp
Lincoln Ray Larson
## Parks, Recreation and Tourism Management (MS)

### Degree Requirements

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<tr>
<td>PRT 500</td>
<td>Conceptual Foundations of Recreation</td>
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</tr>
<tr>
<td>ST 507</td>
<td>Statistics For the Behavioral Sciences I</td>
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</tr>
<tr>
<td>PRT 701</td>
<td>Research Methods in Parks, Recreation, &amp; Tourism Management</td>
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</tr>
<tr>
<td>PRT 695</td>
<td>Master's Thesis Research</td>
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</tr>
<tr>
<td>Elective Courses</td>
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<td>15</td>
</tr>
<tr>
<td></td>
<td>&quot;Elective Courses&quot; are approved in conjunction with the academic committee to meet 30 total hours (see &quot;Suggested Electives&quot; listed below)</td>
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<tr>
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### Suggested Electives

<table>
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<tr>
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<tbody>
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<td></td>
<td>Select a minimum of five elective courses:</td>
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<tr>
<td>ANT 531</td>
<td>Tourism, Culture and Anthropology</td>
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</tbody>
</table>

## Faculty

### Full Professors

- Carla E. Barbieri
- Jason N. Bocarro
### Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td><strong>Required Courses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRT 700</td>
<td>Advanced Theories of Leisure</td>
<td></td>
</tr>
<tr>
<td>PRT 701</td>
<td>Research Methods in Parks, Recreation, &amp; Tourism Management</td>
<td></td>
</tr>
<tr>
<td>PRT 801</td>
<td>Doctoral Seminar in Parks, Recreation and Tourism Research</td>
<td></td>
</tr>
<tr>
<td><strong>Research Methods / Statistics Electives</strong></td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Select a Statistics Course in conjunction with the academic committee</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Additional “Research Methods / Statistics Electives” are determined in conjunction with the academic committee</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Teaching Course</strong></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>PRT 885</td>
<td>Doctoral Supervised Teaching</td>
<td></td>
</tr>
<tr>
<td><strong>Substantive Area or Minor Courses</strong></td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>“Substantive Area or Minor Courses” are determined in conjunction with the academic committee</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Additional Courses</strong></td>
<td></td>
<td>28</td>
</tr>
<tr>
<td>“Additional Courses” are approved in conjunction with the academic committee to meet 72 total hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dissertation Courses</strong></td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>PRT 893</td>
<td>Doctoral Supervised Research</td>
<td></td>
</tr>
<tr>
<td>PRT 895</td>
<td>Doctoral Dissertation Research</td>
<td></td>
</tr>
<tr>
<td><strong>Total Hours</strong></td>
<td></td>
<td>72</td>
</tr>
</tbody>
</table>

1. Statistics course must be selected from ST 512 Statistical Methods For Researchers II or higher.
Duarte B. Morais

Assistant Professors
Whitney Grace Knollenberg
Kangjae "Jerry" Lee
Kathryn Tate Stevenson
Jelena Vukomanovic

Practice/Research/Teaching Professors
Perver Korca Baran
Kimberly Ann Bush
Stacy Kathleen Supak
Laura Gray Tateosian

Emeritus Faculty
Aram Attarian
Hugh A. Devine Jr
Larry Douglas Gustke
Karla Ann Henderson
Roger Louis Moore
Chrys D. Siderelis
Candace Goode Vick

Human Dimensions of Natural Resources (Minor)

Plan Requirements

Faculty
Full Professors
Carla E. Barbieri
Jason N. Bocarro
Myron F. Floyd
Michael A. Kanters
Yu-Fai Leung
Erin Lynn Seekamp

Associate Professors
Gene Leroy Brothers
Kyle Stephen Bunds

Jonathan M. Casper
Bethany Brooke Cutts
Michael B. Edwards
James Aaron Hipp
Lincoln Ray Larson
Duarte B. Morais

Assistant Professors
Whitney Grace Knollenberg
Kangjae "Jerry" Lee
Kathryn Tate Stevenson
Jelena Vukomanovic

Practice/Research/Teaching Professors
Perver Korca Baran
Kimberly Ann Bush
Stacy Kathleen Supak
Laura Gray Tateosian

Emeritus Faculty
Aram Attarian
Hugh A. Devine Jr
Larry Douglas Gustke
Karla Ann Henderson
Roger Louis Moore
Chrys D. Siderelis
Candace Goode Vick

Sport and Entertainment Venue Management (Certificate)

Whether you are interested in managing stadiums, amphitheaters, performing arts centers or sport arenas, this immersive facilities management program is right for you.

This one-year online graduate certificate program was designed in collaboration with industry experts to either advance your career or facilitate entry into this exciting field.

The 12-credit-hour graduate certificate program can be completed entirely online. Students are admitted as a cohort and complete all required courses as a group. Using an 8-week accelerated course format, students take one course at a time and finish the program in two semesters.
Graduate Certificate - College of Natural Resources

Certificates

- Environmental Assessment (Certificate) (p. 462)
- Geographic Information Systems (Certificate) (p. 462)
- Renewable Energy Assessment and Development (Certificate) (p. 463)
- Sport and Entertainment Venue Management (Certificate) (p. 461)

Environmental Assessment (Certificate)

The graduate certificate program in Environmental Assessment provides students and professionals the opportunity to develop recognized academic credentials and advanced expertise in Environmental Assessment. The certificate program provides excellent opportunities for practicing environmental professionals to stay abreast of new technologies and current government regulations.

The curriculum consists of 12 credit hours selected from the required course listing for the MEA degree. Students may transfer up to 12 credit hours from the Certificate into the Masters of Environmental Assessment (MEA). Students may earn the Certificate as a stand-alone credential or as part of a graduate degree and may apply for entry into the MEA degree while in the Certificate program.

Admission Requirements

Baccalaureate degree. Application information and requirements for award of a certificate are listed on the Environmental Assessment Certificate website (https://online-distance.ncsu.edu/program/graduate-certificate-in-environmental-assessment/). Students can start this certificate in Fall or Spring semesters.

Certificate Requirements

Award of a certificate requires a GPA of 3.0 or better for the certificate courses (required and elective) and a grade of B- or better in all of the certificate courses.

Other Relevant Information

The Certificate is entirely online.

Geographic Information Systems (Certificate)

Building on NC State's strengths in technology, computational methods, and geographic information systems (GIS), this program provides professional, graduate-level academic preparation in the advanced application of GIS technologies to a wide spectrum of disciplines, including economics, public health, emergency planning and response, land use planning, environmental resources, etc. The certificate, which is also available to current NC State students enrolled in non-GIS graduate programs, forms the basis for the Master of Geospatial Information Science and Technology (https://online-distance.ncsu.edu/program/master-of-geospatial-information-science-and-technology/).

Admissions Requirements

Admission to the certificate program requires a baccalaureate degree from an accredited college or university with at least a 3.0 GPA. Students with less than a 3.0 undergraduate GPA may still be considered for admission based on the remaining criteria, including other graduate coursework. These determinations will be made on a case-by-case basis. All applicants must submit:

- Transcript showing Bachelor's degree conferred
- A clear and concise personal statement/statement of interest
- A resume/CV

Current NC State students in other degree programs may also be eligible to earn the certificate. These students should contact the Center for Geospatial Analytics for more information on how to apply.

Other relevant information

Up to 12 credit hours of B or better grades from the Certificate can transfer into the MGIST (https://online-distance.ncsu.edu/program/master-of-geospatial-information-science-and-technology/) program if/when a student applies and is accepted into that program.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRT 503</td>
<td>Advanced Fiscal Management for Parks, Recreation, Tourism and Sport Organizations</td>
<td>3</td>
</tr>
<tr>
<td>PRT 507</td>
<td>Strategic Marketing Management in Parks, Recreation, Tourism and Sport Organizations</td>
<td>3</td>
</tr>
<tr>
<td>PRT 511</td>
<td>Sport and Entertainment Venue Management - Facilities</td>
<td>3</td>
</tr>
<tr>
<td>PRT 512</td>
<td>Sport and Entertainment Venue Management - Operations and Services</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Hours 12

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA 505</td>
<td>Environmental Assessment Law &amp; Policy</td>
<td>3</td>
</tr>
<tr>
<td>or PA 536</td>
<td>Management of Nonprofit Organizations</td>
<td></td>
</tr>
</tbody>
</table>

Select three of the following:

- EA 501 Environmental Stressors
- EA 502 Environmental Risk Assessment
- EA 503 Environmental Exposure Assessment
- EA 504 Environmental Monitoring and Analysis
- GIS 510 Fundamentals of Geospatial Information Science and Technology

Total Hours 12
Elective Courses

Choose 6 credit hours of electives from the "Elective Courses" listed below, at least 3 of which must be GIS prefix courses.

Total Hours 12

Elective Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIS 501</td>
<td>Geospatial Professionalism</td>
<td></td>
</tr>
<tr>
<td>GIS 512</td>
<td>Introduction to Environmental Remote Sensing</td>
<td></td>
</tr>
<tr>
<td>GIS 515</td>
<td>Cartographic Design</td>
<td></td>
</tr>
<tr>
<td>GIS 517</td>
<td>GIS Applications in Landscape Architecture and Environmental Planning</td>
<td></td>
</tr>
<tr>
<td>GIS 521</td>
<td>Surface Water Hydrology with GIS</td>
<td></td>
</tr>
<tr>
<td>GIS 530</td>
<td>Spatial Data Foundations</td>
<td></td>
</tr>
<tr>
<td>GIS 535</td>
<td>Web and Mobile GIS Protocols</td>
<td></td>
</tr>
<tr>
<td>GIS 595</td>
<td>Special Topics in Geospatial Information Science</td>
<td></td>
</tr>
<tr>
<td>GIS/MEA 582</td>
<td>Geospatial Modeling</td>
<td></td>
</tr>
<tr>
<td>GIS 584</td>
<td>Mapping and Analysis Using UAS</td>
<td></td>
</tr>
<tr>
<td>GIS 609</td>
<td>Geospatial Forum</td>
<td></td>
</tr>
<tr>
<td>GIS 610</td>
<td>Special Topics in Geospatial Information Science</td>
<td></td>
</tr>
<tr>
<td>SSC 540</td>
<td>Geographic Information Systems (GIS) in Soil Science and Agriculture</td>
<td></td>
</tr>
<tr>
<td>SSC 545</td>
<td>Remote Sensing Applications in Soil Science and Agriculture</td>
<td></td>
</tr>
<tr>
<td>BAE 535</td>
<td>Precision Agriculture Technology</td>
<td></td>
</tr>
<tr>
<td>BAE 536</td>
<td>GIS Applications in Precision Agriculture</td>
<td></td>
</tr>
<tr>
<td>LAR 517</td>
<td>GIS Applications in Landscape Architecture and Environmental Planning</td>
<td></td>
</tr>
<tr>
<td>MEA 511</td>
<td>Introduction to Meteorological Remote Sensing</td>
<td></td>
</tr>
<tr>
<td>HI 535</td>
<td>Spatial History</td>
<td></td>
</tr>
<tr>
<td>ST 501</td>
<td>Fundamentals of Statistical Inference I</td>
<td></td>
</tr>
<tr>
<td>ST 502</td>
<td>Fundamentals of Statistical Inference II</td>
<td></td>
</tr>
<tr>
<td>ST 511</td>
<td>Statistical Methods For Researchers I</td>
<td></td>
</tr>
<tr>
<td>ST 513</td>
<td>Statistics for Management I</td>
<td></td>
</tr>
<tr>
<td>ST 514</td>
<td>Statistics For Management and Social Sciences II</td>
<td></td>
</tr>
<tr>
<td>ST 533</td>
<td>Applied Spatial Statistics</td>
<td></td>
</tr>
<tr>
<td>ST 555</td>
<td>Statistical Programming I</td>
<td></td>
</tr>
<tr>
<td>ST 556</td>
<td>Statistical Programming II</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 0

* Other courses not listed can be approved as an elective upon consultation with an advisor.

Faculty

Full Professors

Ross Meentemeyer
Helena Mitasova
Stacy Nelson
Gary Roberson

Associate Professors

Jeffrey White

Practice/Research/Teaching Professors

Perver Baran
Eric Money
Stacy Supak
Laura Tateosian
Vaishnavi Thakar

Emeritus Faculty

Heather Cheshire
Hugh Devine
Siamak Khorram

Renewable Energy Assessment and Development (Certificate)

The Graduate Certificate in Renewable Energy Assessment and Development at NC State University provides students with graduate level academic credentials in renewable energy assessment and development. The program is designed for students who wish to enhance their knowledge of renewable energy assessment practices and obtain a background for certification. The Certificate can be completed entirely online. The certificate is available to current NC State students enrolled in graduate degrees. The entire program requires 12 credits hours. Students in the Renewable Energy Assessment and Development Certificate program may wish to continue on to a Graduate degree. Students may transfer up to 6 credit hours from the Renewable Energy Assessment and Development Certificate into the Master of Environmental Assessment upon application and acceptance into the program.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA 520</td>
<td>Renewable Energy Policy and Economics</td>
<td>3</td>
</tr>
<tr>
<td>EA 521</td>
<td>Fundamentals of Renewable Energy Site Assessment</td>
<td>3</td>
</tr>
<tr>
<td>or ECE 552</td>
<td>Renewable Electric Energy Systems</td>
<td></td>
</tr>
<tr>
<td>EA 522</td>
<td>Photovoltaic Design and Assessment</td>
<td>3</td>
</tr>
<tr>
<td>EA 523</td>
<td>Assessment of Renewable Energy Storage Systems</td>
<td>3</td>
</tr>
<tr>
<td>or ECE 552</td>
<td>Renewable Electric Energy Systems</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 12

College of Sciences
Programs

- Applied Mathematics (p. 464)
- Biology (p. 102)
- Biomathematics (p. 476)
- Catalog Home (p. 12)
- Chemistry (p. 481)
- Climate Change and Society (p. 487)
- Marine, Earth and Atmospheric Sciences (p. 487)
- Mathematics (p. 496)
- Microbiology (p. 144)
- Physics (p. 506)
- Statistics (p. 511)
- Toxicology (p. 523)

Degree Programs

Master’s (MR)

- Biology (MR) (p. 104)
- Microbiology (MR) (p. 145)

Master of Science (MS)

- Applied Mathematics (MS) (p. 466)
- Biology (MS) (p. 106)
- Biomathematics (MS) (p. 478)
- Chemistry (MS) (p. 483)
- Marine, Earth, and Atmospheric Sciences (MS) (p. 489)
- Mathematics (MS) (p. 498)
- Microbiology (MS) (p. 147)
- Physics (MS) (p. 508)
- Toxicology (MS) (p. 525)

Doctor of Philosophy (PhD)

- Applied Mathematics (PhD) (p. 469)
- Applied Mathematics (PhD): Computational Mathematics Concentration (p. 470)
- Biology (PhD) (p. 109)
- Biomathematics (PhD) (p. 479)
- Chemistry (PhD) (p. 484)
- Marine, Earth, and Atmospheric Sciences (PhD) (p. 491)
- Mathematics (PhD) (p. 500)
- Mathematics (PhD): Interdisciplinary Mathematics Concentration (p. 501)
- Microbiology (PhD) (p. 148)
- Physics (PhD) (p. 509)
- Statistics (PhD) (p. 520)
- Toxicology (PhD) (p. 526)

Minors

- Applied Mathematics (Minor) (p. 474)
- Biomathematics (Minor) (p. 480)
- Chemistry (Minor) (p. 485)
- Marine, Earth, & Atmospheric Sciences (Minor) (p. 493)

- Mathematics (Minor) (p. 503)
- Microbiology (Minor) (p. 150)
- Statistics (Minor) (p. 521)
- Toxicology (Minor) (p. 527)
- Zoology (Minor) (http://catalog.ncsu.edu/undergraduate/sciences/biological-sciences/zoology-minor/)

Certificates

- Applied Statistics and Data Management (Certificate) (p. 523)
- Biology for Educators (Certificate) (p. 528)
- Climate Adaptation (Certificate) (p. 495)
- Mathematics (Certificate) (p. 506)
- Statistics Education (Certificate) (p. 523)

Applied Mathematics

The Department of Mathematics offers programs leading to the degrees of Master of Science and Doctor of Philosophy in Mathematics and in Applied Mathematics. Students may opt for the Concentration in Computational Mathematics, which is attached to the program in applied mathematics. The Concentration in Interdisciplinary Mathematics (MAI) is available to Ph.D. students in either Mathematics or Applied Mathematics. It is not available to Masters Students. Joint research endeavors with industrial and governmental partners are facilitated and encouraged. The Department of Mathematics also offers a Certificate.

Admissions Requirements

Applicants for admission should have an undergraduate or Master’s degree in mathematics or applied mathematics. This should include courses in advanced calculus, analysis, modern algebra and linear algebra. Applicants with degrees in other subjects may be admitted but may be required to take certain undergraduate courses in mathematics without receiving graduate credit. GRE general scores are required. The GRE Subject Test in Mathematics is not required but a good score can be a positive factor in admission.

Master of Science Requirements

The M.S. degree requires a minimum of 30 credit hours with courses chosen to satisfy certain requirements to cover material from three different areas in the department, and some level of depth of material.

Ph.D. Requirements

The Ph.D. requires a minimum of 72 credit hours. A student will typically take 50-60 semester hours of course credits for the Ph.D. The written preliminary examination consists of examinations in three areas of mathematics chosen by the student from 12 possibilities. The research dissertation should represent a substantial contribution to an area of mathematics or its applications.

Student Financial Support

Teaching assistantships and some research assistantships are available. Teaching assistants benefit from a structured program of training in university-level teaching.
Degrees

- Applied Mathematics (MS) (p. 466)
- Applied Mathematics (PhD) (p. 469)
- Applied Mathematics (PhD): Computational Mathematics Concentration (p. 470)
- Applied Mathematics (PhD): Interdisciplinary Applied Math Concentration (p. 472)
- Applied Mathematics (Minor) (p. 474)

Faculty

**Full Professors**

Bojko Nentchev Bakalov
Alina Emil Chertock
Moody Ten-Chao Chu
Jo-Ann D. Cohen
Patrick Louis Combettes
Pierre Alain Gremaud
Mansoor Abbas Haider
Hoon Hong
Ilse Ipsen
Kazufumi Ito
Naihuan Jing
Erich L. Kaltofen
Carl Timothy Kelley
Arkady Kheyfets
Irina Aleksandrovna Kogan
Zhilin Li
Xiao-Biao Lin
Alun L. Lloyd
Sharon R. Lubkin
Negash G. Medhin
Kailash Chandra Misra
Mette Olufsen
Tao Pang
Nathan P. Reading
Jesus Rodríguez
Michael Shearer
Jack William Silverstein

Ralph Conover Smith
Ernest Lester Stitzinger
Seth M. Sullivant
Agnes Szanto
Hien Trong Tran
Semyon Victor Tsynkov
Dmitry Valerievich Zenkov

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Min Jeong Kang
Ricky Ini Liu
Larry Keith Norris
David Papp
Arvind Krishna Saibaba
Cynthia Leslie Vinzant

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Mohammad Mehdi Farazmand
Kevin Bryant Flores
P. Ivanisvili
C. Jones
Yerkin Kitapbayev
Tye Lidman
P. McGrath
Ryan William Murray
Tien Khai Nguyen
A. Papanicolaou
T. Saksala
Radmila Sazdanovic

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Patricia L. Hersh
John Lavery
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Jessica Loock Matthews
Johnny T. Ottesen

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L. Castle
Alina Nicoleta Duca
Molly A. Fenn
Bevin Laurel Maultsby
S. Paul
Brenda B. Williams

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Stephen LaVern Campbell
Richard E. Chandler
H. Charlton
Ethelbert N. Chukwu
Lung-ock Chung
Joseph C. Dunn
Gary Doyle Faulkner
John E. Franke
Ronald O. Fulp
Dennis E. Garoutte
John Richard Griggs
Robert E. Hartwig
Aloysius G. Helminck
Robert H. Martin Jr
Carl Meyer Jr.
Thomas J. Lada
Joe A. Marlin
Larry Keith Norris
L. Page
Sandra Paur
E. Peterson

Mohan Sastri Putcha
N. Rose
Stephen Schecter
Jeffrey Scott Scroggs
James Francis Selgrade
C. Siewert
Robert Silber
Michael F. Singer
R. White

Applied Mathematics (MS)
Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Required Courses</strong></td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>See “Required Courses” listed below</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MA 676</td>
<td>Master's Project (Optional)</td>
<td></td>
</tr>
</tbody>
</table>

| **In Depth Courses** |                                |
| See “In Depth Course Sequences” listed below | |

Total Hours

1 At least 18 credits must be MA courses level (500+)

2 Up to 9 credits may be in math related disciplines, determined in conjunction with the academic committee

Required Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Continuous Mathematics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MA 513</td>
<td>Introduction To Complex Variables</td>
<td>3</td>
</tr>
<tr>
<td>MA 515</td>
<td>Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>MA 531</td>
<td>Dynamic Systems and Multivariable Control I</td>
<td>3</td>
</tr>
<tr>
<td>MA 532</td>
<td>Ordinary Differential Equations I</td>
<td>3</td>
</tr>
<tr>
<td>MA 534</td>
<td>Introduction To Partial Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>MA 546</td>
<td>Probability and Stochastic Processes I</td>
<td>3</td>
</tr>
<tr>
<td>MA 551</td>
<td>Introduction to Topology</td>
<td>3</td>
</tr>
<tr>
<td>MA 555</td>
<td>Introduction to Manifold Theory</td>
<td>3</td>
</tr>
</tbody>
</table>

**Discrete Mathematics**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA 505</td>
<td>Linear Programming</td>
<td>3</td>
</tr>
<tr>
<td>MA 520</td>
<td>Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MA 521</td>
<td>Abstract Algebra I</td>
<td>3</td>
</tr>
<tr>
<td>MA 523</td>
<td>Linear Transformations and Matrix Theory</td>
<td>3</td>
</tr>
<tr>
<td>MA 524</td>
<td>Combinatorics I</td>
<td>3</td>
</tr>
<tr>
<td>MA 526</td>
<td>Algebraic Geometry</td>
<td>3</td>
</tr>
</tbody>
</table>

**Computational Mathematics**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA 522</td>
<td>Computer Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MA 540</td>
<td>Uncertainty Quantification for Physical and Biological Models</td>
<td>3</td>
</tr>
<tr>
<td>MA/CS 565</td>
<td>Graph Theory</td>
<td>3</td>
</tr>
</tbody>
</table>
In Depth Course Sequences

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA 573</td>
<td>Mathematical Modeling of Physical and Biological Processes I</td>
<td>3</td>
</tr>
<tr>
<td>MA 580</td>
<td>Numerical Analysis I</td>
<td>3</td>
</tr>
</tbody>
</table>

Select two course sequences or three related courses from the categories below:

- **Analysis Course Sequence**
  - MA 515 Analysis I 3
  - MA 715 Analysis II 3

- **Linear & Lie Algebra Course Sequence**
  - MA 520 Linear Algebra 3
  - MA 720 Lie Algebras 3

- **Abstract Algebra Course Sequence**
  - MA 521 Abstract Algebra I 3
  - MA 721 Abstract Algebra II 3

- **Computer Algebra Course Sequence**
  - MA 522 Computer Algebra 3
  - MA 722 Computer Algebra II 3

- **Matrix Theory Course Sequence**
  - MA 523 Linear Transformations and Matrix Theory 3
  - MA 723 Theory of Matrices and Applications 3

- **Combinatorics Course Sequence**
  - MA 524 Combinatorics I 3
  - MA 724 Combinatorics II 3

- **Control Course Sequence**
  - MA 531 Dynamic Systems and Multivariable Control I 3
  - MA 731 Dynamic Systems and Multivariable Control II 3

- **PDEs Course Sequence**
  - MA 534 Introduction To Partial Differential Equations 3
  - MA 734 Partial Differential Equations 3

- **Probability Course Sequence**
  - MA 546 Probability and Stochastic Processes I 3
  - MA 747 Probability and Stochastic Processes II 3

- **Topology Course Sequence**
  - MA 551 Introduction to Topology 3
  - MA 753 Algebraic Topology 3

- **Differential Geometry Course Sequence**
  - MA 555 Introduction to Manifold Theory 3
  - MA 755 Introduction to Riemannian Geometry 3

- **Modeling Course Sequence**
  - MA 573 Mathematical Modeling of Physical and Biological Processes I 3
  - MA 574 Mathematical Modeling of Physical and Biological Processes II 3

- **Numerical Analysis Course Sequence**
  - MA 580 Numerical Analysis I 3
  - MA 780 Numerical Analysis II 3

- **Other**
  Three related courses approved in conjunction with the academic committee 9

**Faculty**

**Full Professors**

- Bojko Nentchev Bakalov
- Alina Emil Chertock
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N. Rose
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Jeffrey Scott Scroggs
James Francis Selgrade
C. Siewert

**Practice/Research/Teaching Professors**
Elisabeth M. M. Brown
Applied Mathematics (PhD)

Degree Requirements

<table>
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See "Required Courses" listed below

Total Hours 72

* Must contain a minimum of 30 credit hours of 500-level or above MA courses

Faculty

Full Professors
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N. Rose
Stephen Schecter
Jeffrey Scott Scroggs
James Francis Selgrade
C. Siewert
Robert Silber
Michael F. Singer
R. White

Applied Mathematics (PhD): Computational Mathematics Concentration

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<td>MA 565</td>
<td>Graph Theory</td>
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<td>MA 573</td>
<td>Mathematical Modeling of Physical and Biological Processes I</td>
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<td>MA 584</td>
<td>Numerical Solution of Partial Differential Equations—Finite Difference Methods</td>
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<td>Numerical Solution of Partial Differential Equations—Finite Element Method</td>
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<td>Nonlinear Equations and Unconstrained Optimization</td>
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<td>Operating Systems Principles</td>
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Applied Mathematics (PhD): Interdisciplinary Applied Math Concentration

Degree Requirements

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<th>Code</th>
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Gary Doyle Faulkner
John E. Franke
Ronald O. Fulp
Applied Mathematics (Minor)

Plan Requirements

Master's Requirements

<table>
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Required Courses

A minimum of nine hours of coursework in mathematics \(^1,2\)

Total Hours 9

PhD Requirements

<table>
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</table>

Required Courses

Select a minimum of twelve credit hours coursework in mathematics \(^1,2\)

Total Hours 12

---

\(^1\) Students must maintain a 3.0 GPA in all minor courses.

\(^2\) At least six credits must be taken at the 500- or 700-level.

---

Faculty

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C. Siewert
Biomathematics

Biomathematics is an interdisciplinary graduate program offering courses and research opportunities in basic and applied mathematical biology. Degree programs are flexible to accommodate students with backgrounds in the biological, mathematical or physical sciences. The program also offers Ph.D. and master's-level minors. Additional information on requirements, courses, faculty and current research can be found at the website www.ncsu.edu/biomath.

Admission Requirements

Applicants should have either a Bachelor's degree in biology with evidence of aptitude and interest in mathematics, or a bachelor's in a mathematical science with evidence of aptitude and interest in biology. Advanced (multivariate) calculus, linear algebra and general biology are prerequisites for all BMA courses, and deficiencies in these should be remedied during the first year of graduate study. The application must include a narrative statement (1-2 pages) of the applicant's goals and reasons for interest in the BMA program.

Master's Degree Requirements

The M.S. and M.BMA. degrees require BMA 771-772 and one other BMA course; two upper-level biology courses; and three courses from the mathematical sciences or statistical sciences. The M.S. degree requires a thesis, and the M.BMA. requires two additional courses and a written project.

Doctoral Degree Requirements

Course requirements consist of a "core" and a "concentration" in some area of biology or mathematical sciences. Core requirements are: BMA 771-772, 773 and 774; three upper-level biology courses from at least two areas (e.g., physiology and evolution); and additional courses from the mathematical or statistical sciences. Concentration consists of either a Ph.D. co-major in a biological or mathematical science or a coherent series of five graduate courses approved by the student's committee, which must include a two-semester sequence and at least one 700-level course.

Financial Assistance

TAs (generally in the Departments of Mathematics or Statistics). RAs and internships are available. Awards are based on GRE scores, transcripts, letters of recommendation, and the personal statement. RAs usually are held by continuing students. To receive full consideration for financial aid, the completed application must be received by January 15.

Other Relevant Information

All students are required to participate in the BMA Graduate Seminar. Course requirements can be met by examination or by demonstrating that an equivalent course was completed at another university.
Biomathematics (MR)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<td>or BMA 773 Stochastic Modeling</td>
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<td>or BMA 774 Partial Differential Equation Modeling in Biology</td>
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<td>BMA 771 Biomathematics I</td>
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1 BMA 801 Seminar must be repeated to meet the two credit hour requirement.

Statistics Course Options

**Option 1**

<table>
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**Option 2**

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<td>ST 512</td>
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</table>

Faculty

**Full Professors**

Kevin Gross
Mansoor Abbas Haider
Carol K. Hall
Jason M. Haugh
George R. Hess
Alun L. Lloyd
Sharon R. Lubkin
Spencer V. Muse
Mette Olufsen
Brian J. Reich
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- Gail G. McRae
- Kenneth Hugh Pollock
- Jim E. Riviere
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- Ronald Edwin Stinner

### Adjunct Faculty
- John Edward Banks
- Georgiy Bobashev
- James W. Gilliam
- Nicholas M. Haddad
- Julia S. Kimbell
- W. Owen McMillan III
- Johnny T. Ottesen
- Eric A. Stone

### Biomathematics (MS)

#### Degree Requirements

<table>
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<td>Modeling of Biological Systems</td>
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<tr>
<td>or BMA 773</td>
<td>Stochastic Modeling</td>
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<tr>
<td>or BMA 774</td>
<td>Partial Differential Equation Modeling in Biology</td>
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<td>BMA 801</td>
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</table>

| **Biological Science Courses** | 6 |

“Biological Science Courses” will be approved in conjunction with the academic committee.

| **Statistics Courses** | 3-6 |

Required “Statistics Courses” will be approved in conjunction with the academic committee – see “Statistic Course Options” listed below.

| **Mathematical Science Courses** | 6 |

“Mathematical Science Courses” will be approved in conjunction with the academic committee.

| Written Thesis | |

Students must complete a written thesis to receive a Master of Science Degree.

**Total Hours** 30

1 BMA 801 Seminar must be repeated to meet the two credit hour requirements.

### Statistics Course Options

#### Option 1

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Total Hours 6

#### Option 2

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</tr>
</tbody>
</table>

Total Hours 3

### Faculty

#### Full Professors
- Kevin Gross
- Mansoor Abbas Haider
- Carol K. Hall
- Jason M. Haugh
- George R. Hess
- Alun L. Lloyd
- Sharon R. Lubkin
- Spencer V. Muse
- Mette Olufsen
- Brian J. Reich
- Seth M. Sullivant
- Jeffrey L. Thorne
- Hien Trong Tran
- Zhaobang Zeng

#### Associate Professors
- Randall Brian Langerhans
- Charles Eugene Smith
- Rosangela Sozzani

#### Assistant Professors
- Belinda Sena Akpa
Biomathematics (PhD)

Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: "Doctor of Philosophy in Biomathematics" without track specifications.

Required "Statistics Courses" will be approved in conjunction with the academic committee – see "Statistic Course Options" listed below

**Mathematical Science Courses**

<table>
<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
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<tbody>
<tr>
<td>BMA 771</td>
<td>Biomathematics I</td>
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</tr>
<tr>
<td>BMA 772</td>
<td>Biomathematics II</td>
<td></td>
</tr>
<tr>
<td>BMA 773</td>
<td>Stochastic Modeling</td>
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</tr>
<tr>
<td>BMA 774</td>
<td>Partial Differential Equation Modeling in Biology</td>
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<tr>
<td>BMA 801</td>
<td>Seminar</td>
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</table>

**Biological Sciences Courses**

<table>
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<td>&quot;Biological Science Courses&quot;</td>
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**Statistics Courses**

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<th>Hours</th>
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<td>&quot;Statistic Course Options&quot;</td>
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**Focus Area Track**

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<tbody>
<tr>
<td>BMA 801</td>
<td>Seminar</td>
<td></td>
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</table>

Total Hours 51-54

1 BMA 801 Seminar needs to be repeated three times to meet the three credit hour requirement.
2 Must represent at least two different perspectives.
3 Must include at least one 700 level course.

Statistic Course Options

**Option 1**

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<thead>
<tr>
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<tr>
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<td>Statistical Methods For Researchers I</td>
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<td>ST 512</td>
<td>Statistical Methods For Researchers II</td>
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Total Hours 6

**Option 2**

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<tr>
<td>Option Two</td>
<td>ST 512</td>
<td>Statistical Methods For Researchers II (R)</td>
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</table>

Total Hours 3

**Focus Track Areas**

**Biological Sciences**

Select five courses, minimum of one form each of the following:

**Cellular and Molecular Biology**

**Genetics and Development**

**Biophysical and Biomedical Sciences and Physiology**

**Ecology and Evolution**

Total Hours 15

**Mathematical Methods**

Select five courses in the following or co-major:

**Mathematics**

**Statistics**

**Operations Research**

**Computer Studies**

Total Hours 15

Faculty

**Full Professors**

Kevin Gross

Mansoor Abbas Haider
Biomathematics (Minor)

Plan Requirements

**MS Student Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
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<td>Select two of the following:</td>
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<td></td>
<td>BMA 567 Modeling of Biological Systems</td>
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<tr>
<td></td>
<td>BMA 771 Biomathematics I</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BMA 772 Biomathematics II</td>
<td></td>
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<td></td>
<td><strong>Supporting Courses</strong></td>
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<tr>
<td></td>
<td>ST 511 Statistical Methods For Researchers I</td>
<td></td>
</tr>
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<td></td>
<td>ST 512 Statistical Methods For Researchers II</td>
<td></td>
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<td><strong>Total Hours</strong></td>
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</table>

*In lieu of these two courses, the single course ST 512 Statistical Methods For Researchers II R may be taken.

**PhD Student Requirements**

<table>
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<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
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<td></td>
<td><strong>Required Courses</strong></td>
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<tr>
<td></td>
<td>BMA 567 Modeling of Biological Systems</td>
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</tr>
<tr>
<td></td>
<td>BMA 771 Biomathematics I</td>
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</tr>
<tr>
<td></td>
<td>BMA 772 Biomathematics II</td>
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</tr>
<tr>
<td></td>
<td>BMA 801 Seminar</td>
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<tr>
<td></td>
<td><strong>Supporting Courses</strong></td>
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<tr>
<td></td>
<td>Select one quantitative biology course (500+ level)</td>
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<tr>
<td></td>
<td>Select two courses in biology, statistics, mathematics, or biomath</td>
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</tr>
<tr>
<td></td>
<td><strong>Total Hours</strong></td>
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</tr>
</tbody>
</table>

**Faculty**

**Full Professors**

Kevin Gross

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Kevin Bryant Flores

David Alan Rasmussen

**Emeritus Faculty**

William Reid Atchley

John William Bishir

Marlene L. Hauck

Gail G. McRae

Kenneth Hugh Pollock

Jim E. Riviere

Henry E. Schaffer

James Francis Selgrade

Ronald Edwin Stinner

**Adjunct Faculty**

John Edward Banks

Georgiy Bobashev

James W. Gilliam

Nicholas M. Haddad

Julia S. Kimbell

W. Owen McMillan III

Johnny T. Ottesen

Eric A. Stone
The Department of Chemistry offers programs of study leading to the Doctor of Philosophy and Master of Science degrees. These degrees are based on coursework and original research. Many research projects merge disciplines such as chemical/synthetic biology, biophysics/physics, computational science, informatics, photonics/photophysics and materials science with chemistry. General courses as well as advanced and special topics courses are offered.

**Admission Requirements**

Applicants should have an undergraduate degree in chemistry or in a closely related field with a strong chemistry background. A GPA of at least 3.0 in the sciences is needed for consideration. GRE General Test scores are not required. Admission decisions are made as completed applications are received. For most favorable consideration for the Fall term, all application materials should be received by January 15 (both domestic and international students).

**Master's Degree Requirements**

The Master of Science (M.S.) degree in chemistry is a research degree that requires six graduate courses, a minimum of 30 credit hours, and research leading to a thesis.

**Doctoral Degree Requirements**

In the doctoral program, emphasis is placed on original research and a comprehensive knowledge of one's chosen field.

**Student Financial Support**

Incoming graduate students are supported by departmental teaching assistantships. Outstanding applicants are eligible for supplemental fellowships during their first year of study. Research assistantships are normally available to second-, third-, and fourth-year students. The department also has fellowships for students interested in the area of electronic materials, biotechnology and pharmaceutical and synthetic organic chemistry, as well as travel funds to attend and deliver an oral presentation professional meeting(s).

**Other Relevant Information**

The Chemistry Department forms part of the College of Sciences. More than one dozen new faculty members have been added in the last ten years, thereby greatly enhancing opportunities for graduate research especially in cutting edge interdisciplinary programs.

**Degrees**

- Chemistry (MS) (p. 483)
- Chemistry (PhD) (p. 484)
- Chemistry (Minor) (p. 485)

**Faculty**

**Full Professors**

Dimitris S. Argyropoulos
Edmond F. Bowden
Felix Nicholas Castellano
Stefan Franzen
Christopher B. Gorman
Jonathan S. Lindsey
James D. Martin
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L. Sremaniak
M. Voynov
R. Warren

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S. Levine
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Suzanne T. Purrington
William L. Switzer
William P. Tucker
Dennis W. Wertz
Myung H. Whangbo
Jerry L. Whitten

Adjunct Faculty
V. Bornemann
Chemistry (MS)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH 610</td>
<td>Special Topics In Chemistry (Introduction to Graduate Studies)</td>
<td>15</td>
</tr>
<tr>
<td>CH 601</td>
<td>Seminar (two semesters)</td>
<td></td>
</tr>
<tr>
<td>CH 695</td>
<td>Master's Thesis Research</td>
<td></td>
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<tr>
<td>CH 699</td>
<td>Master's Thesis Preparation</td>
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Additional Courses

<table>
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<tr>
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<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
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Total Hours 33

Additional Courses

<table>
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<th>Hours</th>
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<td>Select a minimum of six recommended courses below:</td>
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<tr>
<td></td>
<td>Courses Analytical Division</td>
<td></td>
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<tr>
<td>CH 727</td>
<td>Biological Mass Spectrometry</td>
<td>3</td>
</tr>
<tr>
<td>CH 749</td>
<td>Analytical Spectroscopy</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Biorganic &amp; Organic Division</td>
<td></td>
</tr>
<tr>
<td>CH 721</td>
<td>Advanced Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CH 725</td>
<td>Physical Methods in Organic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CH 755</td>
<td>Organic Reaction Mechanisms</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Inorganic Division</td>
<td></td>
</tr>
<tr>
<td>CH 701</td>
<td>Advanced Inorganic Chemistry I: Structure and Bonding</td>
<td>3</td>
</tr>
<tr>
<td>CH 795</td>
<td>Special Topics in Chemistry</td>
<td>1-6</td>
</tr>
<tr>
<td>CH 721</td>
<td>Advanced Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>or CH 725</td>
<td>Physical Methods in Organic Chemistry</td>
<td></td>
</tr>
<tr>
<td>or CH 737</td>
<td>Quantum Chemistry</td>
<td></td>
</tr>
<tr>
<td>or CH 795</td>
<td>Special Topics in Chemistry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Physical Division</td>
<td></td>
</tr>
<tr>
<td>CH 737</td>
<td>Quantum Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CH 730</td>
<td>Advanced Physical Chemistry</td>
<td>3</td>
</tr>
</tbody>
</table>

* Additional courses will be approved in conjunction with the academic committee.

Faculty

Full Professors

Dimitris S. Argyropoulos
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Jerry L. Whitten

Adjunct Faculty
V. Bornemann

Chemistry (PhD)
Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<td>Required Courses</td>
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<td>CH 610</td>
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<tr>
<td>CH 895</td>
<td>Doctoral Dissertation Research</td>
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<td>CH 899</td>
<td>Doctoral Dissertation Preparation</td>
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See “Additional Courses” listed below

Total Hours 81

Additional Courses

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<th>Code</th>
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<th>Hours</th>
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<tbody>
<tr>
<td>CH 727</td>
<td>Biological Mass Spectrometry</td>
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<tr>
<td>CH 749</td>
<td>Analytical Spectroscopy</td>
<td>3</td>
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</table>

Biorganic & Organic Division

| CH 721 | Advanced Organic Chemistry I                                         | 3     |
| CH 725 | Physical Methods in Organic Chemistry                                | 3     |
| CH 755 | Organic Reaction Mechanisms                                          | 3     |

Inorganic Division

| CH 701 | Advanced Inorganic Chemistry I: Structure and Bonding               | 3     |
| CH 795 | Special Topics in Chemistry                                          | 1-6   |
| CH 721 | Advanced Organic Chemistry I                                        | 3     |
| CH 725 | Physical Methods in Organic Chemistry                                | 3     |
| CH 737 | Quantum Chemistry                                                    | 3     |
| CH 795 | Special Topics in Chemistry                                          | 3     |

Physical Division

| CH 737 | Quantum Chemistry                                                    | 3     |
| CH 730 | Advanced Physical Chemistry                                          | 3     |

* Additional courses will be approved in conjunction with the academic committee.

Faculty

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Adjunct Faculty
V. Bornemann

Chemistry (Minor)
Plan Requirements

<table>
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<th>Code</th>
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<th>Hours</th>
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Recommended Courses

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<tr>
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<td>Courses Analytical Division</td>
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<tr>
<td>CH 727</td>
<td>Biological Mass Spectrometry</td>
<td>3</td>
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<td>1-6</td>
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Chemistry (Minor)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tr>
<td>CH 721</td>
<td>Advanced Organic Chemistry I</td>
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</tr>
<tr>
<td>or CH 725</td>
<td>Physical Methods in Organic Chemistry</td>
<td></td>
</tr>
<tr>
<td>or CH 737</td>
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<td></td>
</tr>
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<td>or CH 795</td>
<td>Special Topics in Chemistry</td>
<td></td>
</tr>
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**Physical Division**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>CH 737</td>
<td>Quantum Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CH 730</td>
<td>Advanced Physical Chemistry</td>
<td>3</td>
</tr>
</tbody>
</table>

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Morteza Khaledi
S. Levine
Charles Moreland
Marine, Earth and Atmospheric Sciences

Graduate programs are offered in Atmospheric Science, Earth Science, and Marine Science. Within marine sciences the subdisciplines include: biological, chemical, geological and physical oceanography.

Admission Requirements

A Bachelor’s degree with research experience or a Master’s degree is required for entry into the Ph.D. program. A Bachelor’s degree in a science, mathematics or engineering is required for entry into the M.S. program in Atmospheric science, Earth Science, and Biological, Chemical, Geological or Physical Oceanography. Undergraduate field camp is required of all students in the M.S. program in earth science; this requirement may be fulfilled before or after admission. An M.S. degree with a non-thesis option for students is available and admission to this option must be requested at the time of application.

Master’s Degree Requirements

The M.S. degree requires a minimum of 30 credit hours. Specific course requirements are determined by the advisory committee of each student. However, MEA 601 Seminar is required of all thesis M.S. students no
later than the third semester in residence. Marine science students are required to take core courses in two of the three subdisciplines other than their own.

**Doctoral Degree Requirements**

Specific courses are determined by the student's advisory committee. Registration in seminar, MEA 801, is required of all Ph.D. students no later than the fourth semester in residence. Marine science students are required to take core courses in all three subdisciplines other than their own; this requirement may be fulfilled at the M.S. level.

**Student Financial Support**

Research and teaching assistantships are available.

**Other Relevant Information**

Students are assigned initial advisors upon admission. It is the student's responsibility to secure the consent of a faculty member to serve as the permanent advisor who will chair or co-chair the advisory committee.

**Degrees**

- Marine, Earth, and Atmospheric Sciences (MS) (p. 489)
- Marine, Earth, and Atmospheric Sciences (PhD) (p. 491)
- Marine, Earth, & Atmospheric Sciences (Minor) (p. 493)
- Climate Adaptation (Certificate) (p. 495)

**Faculty**

**Full Professors**

Viney Pal Aneja
DelWayne R. Bohnenstiehl
David B. Eggleston
David Paul Genereux
Peter Jeurgen Harries
Ruoying He
Gary M. Lackmann
Elana L. Leithold
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Satya Pal Singh Arya
Jerry M. Davis
David John DeMaster
Ronald Victor Fodor
John Crothers Fountain
Adjunct Faculty
William Howard Battye
Geoffrey Weszely Bell
Scott Anthony Braun
Michael Brennan
Subrahmanyam Bulusu
Brian A. Colle
Johannes Michael Leopold Dahl
Kathie Dello
David R. Easterling
Scott Howard Ensign
Peter Hamilton
Russel S. Harmon
Barron Halton Henderson
Nam-Young Kang
David E. Kingsmill
Branko Kosovic
Emlyn Howard Koster
Huiqing Liu
David Mechem
Andrew Newell
Sharon Phillips
Brandon Puckett
S. Trivikrama Rao
Joseph Rudek
Blake Schaeffer
Jenni Stanley
Robert Christopher Tacker
Susan White
Shaocai Yu
Yang Zhang

Marine, Earth, and Atmospheric Sciences (MS)

Degree Requirements
Graduate programs are offered in Atmospheric Science, Earth Science, and Marine Science. Specific course requirements are determined by the advisory committee of each student.

Degrees earned will be distributed as: "Master of Science in Marine, Earth, and Atmospheric Sciences" without track specifications.

Marine Science Track
Within marine sciences the subdisciplines include:

- Biological Oceanography
- Chemical Oceanography
- Geological Oceanography
- Physical Oceanography

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Total Hours 30

Earth Science Track

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| Area of Focus Courses |
|-----------------------|---|
| Courses in the "Area of Focus" are determined in conjunction with the academic committee | 6 |

| Total Hours |
|-------------|---|
| 30 |

| Courses Outside Area of Focus |
|-----------------------------|---|
| "Courses Outside Area of Focus" are determined in conjunction with the academic committee | 6 |
Courses in the "Area of Focus" are determined in conjunction with the academic committee.

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**Atmospheric Science Track**

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**Area of Focus Courses**

Courses in the "Area of Focus" are determined in conjunction with the academic committee.

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</table>

Total Hours 30

1 MEA 601 Seminar is required of all thesis M.S. students no later than the third semester in residence.

**Faculty**

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Seminar Course 2

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Area of Focus Courses

Courses in the "Area of Focus" are determined in conjunction with the academic committee.

Courses Outside Area of Focus

"Courses Outside Area of Focus" are determined in conjunction with the academic committee.

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Total Hours 72

Earth Science Track

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Area of Focus Courses

Courses in the "Area of Focus" are determined in conjunction with the academic committee.

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Total Hours 72

Atmospheric Science Track

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Courses in the "Area of Focus" are determined in conjunction with the academic committee.

| Total Hours | 72 |

1. Marine science students are required to take core courses in all three subdisciplines other than their own; this requirement may be fulfilled at the M.S. level.
2. MEA 801 is required of all Ph.D. students no later than the fourth semester in residence.

### Faculty

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- Thomas Sawyer Hopkins
- Daniel Kamykowski
- Leonard J. Langfelder
- Leonard J. Pietrafesa
- Sethu Raman
- Allen J. Riordan
- Dale A Russell
- Ping-Tung Shaw
- Edward F. Stoddard
- Charles W. Welby,
Plan Requirements

- 9 (MS student) or 12 (PhD student) credit hours

Marine, Earth, and Atmospheric Sciences Courses

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<td>Doctoral Dissertation Preparation</td>
<td>1-9</td>
</tr>
</tbody>
</table>

**Faculty**

**Full Professors**

- Viney Pal Aneja
- DelWayne R. Bohnenstiehl
- David B. Eggleston
- David Paul Genereux
- Peter Jeurgen Harries
- Ruoying He
- Gary M. Lackmann
- Elana L. Leithold

**Associate Professors**

- Anantha Aiyyer
- Paul Kevin Byrne
- Christopher Lee Osburn
- Astrid Schnetzer
- Karl William Wegmann

**Assistant Professors**

- Carli Arendt
- Stuart Bishop
- Ethan Gordon Hyland
- Sarah Larson
- Ryan William Paerl
- Arianna Soldati

**Practice/Research/Teaching Professors**

- Otis B. Brown
- Curtis Congreve
- Brian K. Eder
- Elisabeth Streit Falk
- Kenneth E. Kunkel
- Roberto Javier Mera
- Carrie J. Thomas
- Joseph Brendan Zambon
Emeritus Faculty
Fredrick Semazzi
Charles Ernest Knowles
Satya Pal Singh Arya
Jerry M. Davis
David John DeMaster
Ronald Victor Fodor
John Crothers Fountain
James Patrick Hibbard
Thomas Sawyer Hopkins
Daniel Kamykowski
Leonard J. Langfelder
Leonard J. Pietrafesa
Sethu Raman
Allen J. Riordan
Dale A Russell
Ping-Tung Shaw
Edward F. Stoddard
Charles W. Welby,
Donna Lee Wolcott
Thomas G. Wolcott
Barron Halton Henderson
Nam-Young Kang
David E. Kingsmill
Branko Kosovic
Emlyn Howard Koster
Huiqing Liu
David Mechem
Andrew Newell
Sharon Phillips
Brandon Puckett
S. Trivikrama Rao
Joseph Rudek
Blake Schaeffer
Jenni Stanley
Robert Christopher Tacker
Susan White
Shaocai Yu
Yang Zhang

Climate Adaptation (Certificate)
The Graduate Certificate in Climate Adaptation program at NC State University provides accredited, academic training in the emerging field of climate adaptation. The online, twelve credit program is designed to provide mid-career professionals and entry-level students with technological skills and specialization in climate adaptation. The certificate is a fully accredited credential and a potential path toward the Climate Adaptation degree program. Coursework includes Fundamentals of Climate Change Science, Climate Risk Analysis, Climate Communication and Introduction to Geographic Information Systems.

Admission Requirements
Applicants must meet one of the 3 following requirements:

- Be a graduate of an accredited four-year college or university, and have a GPA of at least 3.0 on a 4-point scale in their last 60 credit hours of undergraduate study.
- Have a Master's degree.
- Be a degree student in good standing in a NC State University graduate program.

We recommend that students in a NC State University graduate program may apply after completing two of the courses required for the graduate certificate program with at least B grades. The graduate certificate program Director will manage the admissions process in consultation with the MEAS Director of Graduate Programs.

Adjunct Faculty
William Howard Battye
Geoffrey Weszely Bell
Scott Anthony Braun
Michael Brennan
Subrahmanyam Bulusu
Brian A. Colle
Johannes Michael Leopold Dahl
Kathie Dello
David R. Easterling
Scott Howard Ensign
Peter Hamilton
Russel S. Harmon
Provisional Admission

Applicants who do not meet the graduate certificate program requirements for full admission may be admitted provisionally based on the quality of their letters of recommendation and other criteria at the discretion of the Certificate Program Director and MEAS Director of Graduate Programs. Students who are admitted provisionally must maintain a 3.0 GPA in order to obtain full admission into the certificate program.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
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<tr>
<td>MEA 517</td>
<td>Fundamentals of Climate Change Science</td>
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<td>MEA 518</td>
<td>Climate Risk Analysis</td>
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<td>MEA 519</td>
<td>Barriers to Climate Change Literacy</td>
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<tr>
<td>GIS 510</td>
<td>Fundamentals of Geospatial Information Science and Technology</td>
<td>3</td>
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</table>

Total Hours 12

Mathematics

The Department of Mathematics offers programs leading to the degrees of Master of Science and Doctor of Philosophy in Mathematics and in Applied Mathematics. Students may opt for the Concentration in Computational Mathematics, which is attached to the program in applied mathematics. The Concentration in Interdisciplinary Mathematics (MAI) is available to Ph.D. students in either Mathematics or Applied Mathematics. It is not available to Masters Students. Joint research endeavors with industrial and governmental partners are facilitated and encouraged. The Department of Mathematics also offers a Certificate.

Admissions Requirements

Applicants for admission should have an undergraduate or Master's degree in mathematics or applied mathematics. This should include courses in advanced calculus, analysis, modern algebra and linear algebra. Applicants with degrees in other subjects may be admitted but may be required to take certain undergraduate courses in mathematics without receiving graduate credit. GRE general scores are required. The GRE Subject Test in Mathematics is not required but a good score can be a positive factor in admission.

Master of Science Requirements

The M.S. degree requires a minimum of 30 credit hours with courses chosen to satisfy certain requirements to cover material from three different areas in the department, and some level of depth of material.

Ph.D. Requirements

The Ph.D. requires a minimum of 72 credit hours. A student will typically take 50-60 semester hours of course credits for the Ph.D. The written preliminary examination consists of examinations in three areas of mathematics chosen by the student from 12 possibilities. The research dissertation should represent a substantial contribution to an area of mathematics or its applications.

Student Financial Support

Teaching assistantships and some research assistantships are available. Teaching assistants benefit from a structured program of training in university-level teaching.

Degrees

- Mathematics (MS) (p. 498)
- Mathematics (PhD) (p. 500)
- Mathematics (PhD): Interdisciplinary Mathematics Concentration (p. 501)
- Mathematics (Minor) (p. 503)
- Mathematics (Certificate) (p. 506)

Faculty

Full Professors

Bojko Nentchev Bakalov
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Moody Ten-Chao Chu
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Patricia L. Hersh
John Lavery
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Jessica Loock Matthews
J. Ottesen

Mathematics (MS)

Degree Requirements

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<td>Continuous Mathematics</td>
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<tr>
<td>MA 513</td>
<td>Introduction To Complex Variables</td>
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<tr>
<td>MA 515</td>
<td>Analysis I</td>
<td></td>
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<tr>
<td>MA 531</td>
<td>Dynamic Systems and Multivariable Control I</td>
<td></td>
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<tr>
<td>MA 532</td>
<td>Ordinary Differential Equations I</td>
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<tr>
<td>MA 534</td>
<td>Introduction To Partial Differential Equations</td>
<td></td>
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<td>MA 546</td>
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<td>MA 551</td>
<td>Introduction to Topology</td>
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<td>MA 555</td>
<td>Introduction to Manifold Theory</td>
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<tr>
<td>Discrete Mathematics</td>
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<td>MA 505</td>
<td>Linear Programming</td>
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<tr>
<td>MA 520</td>
<td>Linear Algebra</td>
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<tr>
<td>MA 521</td>
<td>Abstract Algebra I</td>
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<tr>
<td>MA 523</td>
<td>Linear Transformations and Matrix Theory</td>
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<tr>
<td>MA 524</td>
<td>Combinatorics I</td>
<td></td>
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<tr>
<td>MA 526</td>
<td>Algebraic Geometry</td>
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<tr>
<td>Computational Mathematics</td>
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<tr>
<td>MA 522</td>
<td>Computer Algebra</td>
<td></td>
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<td>MA 540</td>
<td>Uncertainty Quantification for Physical and Biological Models</td>
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<td>MA 565</td>
<td>Graph Theory</td>
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<tr>
<td>MA 573</td>
<td>Mathematical Modeling of Physical and Biological Processes I</td>
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<tr>
<td>MA 580</td>
<td>Numerical Analysis I</td>
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<td>Select two course sequences, or one group of three thematically linked courses, approved in conjunction with the academic committee</td>
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<td><em>Additional Courses</em> are approved in conjunction with the academic committee to meet 30 total hours</td>
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</table>

Total Hours 30

Faculty

Full Professors
Bojko Nentchev Bakalov
Alina Emil Chertock
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### Mathematics (PhD)

#### Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
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* At least 30 credit hours of MA coursework must be at the graded 500- and 700-level.

#### Required Coursework by Category

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<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td><strong>Continuous Mathematics</strong></td>
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#### Faculty

**Full Professors**

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Mathematics (PhD):
Interdisciplinary Mathematics Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
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<td>Required Courses</td>
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</tbody>
</table>

See "Required Courses by Category" listed below
Additional Courses ¹, ²

“Additional Courses” are approved in conjunction with the academic committee to meet 72 total hours

Total Hours 72

¹ At least 30 credit hours of MA coursework must be at the graded 500- and 700-level.
² At least two courses should be from another discipline. One of these courses may be cross-listed with MA.

Required Coursework by Category

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
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</table>

Continuous Mathematics

- MA 513 Introduction To Complex Variables 3
- MA 515 Analysis I 3
- MA 531 Dynamic Systems and Multivariable Control I 3
- MA 532 Ordinary Differential Equations I 3
- MA 534 Introduction To Partial Differential Equations 3
- MA 546 Probability and Stochastic Processes I 3
- MA 551 Introduction to Topology 3
- MA 555 Introduction to Manifold Theory 3

Discrete Mathematics

- MA 505 Linear Programming 3
- MA 520 Linear Algebra 3
- MA 521 Abstract Algebra I 3
- MA 523 Linear Transformations and Matrix Theory 3
- MA 524 Combinatorics I 3
- MA 526 Algebraic Geometry 3

Computational Mathematics

- MA 522 Computer Algebra 3
- MA 540 Uncertainty Quantification for Physical and Biological Models 3
- MA 565 Graph Theory 3
- MA 573 Mathematical Modeling of Physical and Biological Processes I 3
- MA 580 Numerical Analysis I 3

Faculty

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Mathematics (Minor)
Plan Requirements
Master's Minor

<table>
<thead>
<tr>
<th>Code</th>
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Total Hours 9
## PhD Minor

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1. Student must maintain an average 3.0 GPA for courses to count toward a Mathematics minor.
2. At least six credit hours must be taken at the letter graded 500- or 700-level.

### Graduate Mathematics Courses

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<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>MA 501</td>
<td>Advanced Mathematics for Engineers and Scientists I</td>
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<tr>
<td>MA 502</td>
<td>Advanced Mathematics for Engineers and Scientists II</td>
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<td>MA 504</td>
<td>Introduction to Mathematical Programming</td>
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<tr>
<td>MA 505</td>
<td>Linear Programming</td>
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<tr>
<td>MA 507</td>
<td>Survey of Real Analysis</td>
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<tr>
<td>MA 508</td>
<td>Geometry For Secondary Teachers</td>
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<tr>
<td>MA 509</td>
<td>Survey of Abstract Algebra</td>
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<td>MA 510</td>
<td>Selected Topics In Mathematics For Secondary Teachers</td>
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<tr>
<td>MA 511</td>
<td>Advanced Calculus I</td>
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<tr>
<td>MA 512</td>
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<tr>
<td>MA 513</td>
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<tr>
<td>MA 514</td>
<td>Foundations of Cryptography</td>
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<tr>
<td>MA 515</td>
<td>Analysis I</td>
<td>3</td>
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<tr>
<td>MA 518</td>
<td>Geometry of Curves and Surfaces</td>
<td>3</td>
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<tr>
<td>MA 520</td>
<td>Linear Algebra</td>
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<td>MA 521</td>
<td>Abstract Algebra I</td>
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<td>MA 522</td>
<td>Computer Algebra</td>
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<td>MA 523</td>
<td>Linear Transformations and Matrix Theory</td>
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<tr>
<td>MA 524</td>
<td>Combinatorics I</td>
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<td>MA 526</td>
<td>Algebraic Geometry</td>
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<td>MA 528</td>
<td>Options and Derivatives Pricing</td>
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<td>MA 531</td>
<td>Dynamic Systems and Multivariable Control I</td>
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<tr>
<td>MA 532</td>
<td>Ordinary Differential Equations I</td>
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<td>MA 534</td>
<td>Introduction To Partial Differential Equations</td>
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<tr>
<td>MA 537</td>
<td>Nonlinear Dynamics and Chaos</td>
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<td>MA 540</td>
<td>Uncertainty Quantification for Physical and Biological Models</td>
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<td>MA 544</td>
<td>Computer Experiments In Mathematical Probability</td>
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<td>MA 546</td>
<td>Probability and Stochastic Processes I</td>
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<td>MA 547</td>
<td>Financial Mathematics</td>
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<td>MA 548</td>
<td>Monte Carlo Methods for Financial Math</td>
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<td>MA 549</td>
<td>Financial Risk Analysis</td>
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<td>Introduction to Manifold Theory</td>
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<td>MA 561 Set Theory and Foundations Of Mathematics</td>
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<td>MA 565 Graph Theory</td>
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<td>MA 583 Introduction to Parallel Computing</td>
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<td>MA 584 Numerical Solution of Partial Differential Equations--Finite Difference Methods</td>
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<td>MA 591 Special Topics</td>
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<tr>
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<td>MA 685 Master's Supervised Teaching</td>
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<td>MA 706 Nonlinear Programming</td>
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<td>MA 708 Integer Programming</td>
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<td>MA 715 Analysis II</td>
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<td>MA 716 Advanced Functional Analysis</td>
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<td>MA 719 Vector Space Methods in System Optimization</td>
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<td>MA 720 Lie Algebras</td>
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<td>MA 723 Theory of Matrices and Applications</td>
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<td>MA 725 Lie Algebra Representation Theory</td>
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<td>MA 731 Dynamic Systems and Multivariable Control II</td>
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<td>MA 732 Ordinary Differential Equations II</td>
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<td>MA 734 Partial Differential Equations</td>
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<td>MA 748 Stochastic Differential Equations</td>
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<td>MA 755 Introduction to Riemannian Geometry</td>
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<td>MA 766 Network Flows</td>
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<td>MA 771 Biomathematics I</td>
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<td>MA 772 Biomathematics II</td>
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<td>MA 773 Stochastic Modeling</td>
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<td>MA 774 Partial Differential Equation Modeling in Biology</td>
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<td>MA 784 Nonlinear Equations and Unconstrained Optimization</td>
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<td>MA 790 Advanced Special Topics System Optimization</td>
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<td>MA 791 Special Topics In Real Analysis</td>
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<tr>
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<td>MA 792 Special Topics In Algebra</td>
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<td>MA 793 Special Topics In Differential Equations</td>
<td>1-6</td>
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<td>MA 796 Special Topics In Combinatorial Analysis</td>
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<td>MA 797 Special Topics In Applied Mathematics</td>
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<td>MA 798 Special Topics In Numerical Analysis</td>
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<tr>
<td></td>
<td>MA 810 Special Topics</td>
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</tr>
</tbody>
</table>
Faculty

Full Professors
Bojko Nentchev Bakalov
Alina Emil Chertock
Moody Ten-Chao Chu
Jo-Ann D. Cohen
Patrick Louis Combettes
Pierre Alain Gremaud
Mansoor Abbas Haider
Hoon Hong
Ilse Ipsen
Kazuofumi Ito
Naihuan Jing
Erich L. Kaltofen
Carl Timothy Kelley
Arkady Kheyfets
Irina Aleksandrovna Kogan
Zhilin Li
Xiao-Biao Lin
Alun L. Lloyd
Sharon R. Lubkin
Negash G. Medhin
Kailash Chandra Misra
Mette Olufsen
Tao Pang
Nathan P. Reading
Jesus Rodriguez
Michael Shearer
Jack William Silverstein
Ralph Conover Smith
Ernest Lester Stitzinger
Seth M. Sullivan
Agnes Szanto
Hien Trong Tran

Semyon Victor Tsynkov
Dmitry Valerievich Zenkov

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Lorena Viorica Bociu
Min Jeong Kang
Ricky Ini Liu
Arvind Krishna Saibaba
David Papp
Cynthia Leslie Vinzant

Assistant Professors
Alen Alexanderian
Mohammad Mehdi Farazmand
Kevin Bryant Flores
P. Ivanisvili
C. Jones
Yerkin Kitapbayev
Tye Lidman
P. McGrath
Ryan William Murray
Tien Khai Nguyen
A. Papanicolaou
T. Saksala
Radmila Sazdanovic

Practice/Research/Teaching Professors
Elisabeth M. M. Brown
L. Castle
Alina Nicoleta Duca
Molly A. Fenn
Bevin Laurel Maultsby
S. Paul
Brenda B. Williams

Emeritus Faculty
John William Bishir
The Graduate Certificate in Mathematics is a one-year program that focuses on two groups of students. It is designed for students who have some mathematical training but do not have a full bachelor's degree in mathematics. It also targets students who have a bachelor's degree in mathematics but do not feel they are ready for graduate school.

The goal of the certificate is to prepare and motivate students through courses and careful mentoring. The program will deepen and broaden students' understanding of mathematics, the mathematics profession, and the mathematical community. Students will learn how the mathematics discipline can solve significant problems for government, industry, other scientists, and ultimately, society at large.

Admissions
Application to the program requires an online application form, three (3) letters of recommendation (two need to be academic), transcripts of all academic work after high school, and a written statement. GREs are highly desirable but not required for admission. Admission will be on a competitive basis.

Requirements
Students take a combination of graduate and undergraduate mathematics courses that are tailored to the individual student. The certificate requires 12 hours of mathematics courses, taken for a grade, and to be taken at NC State. There is no specific list of courses for the certificate.

Of the 12 hours, three (3) hours may be at the 400 level with prior approval of the Director of Graduate Programs. The other nine (9) hours will be at the 500 level or above. Students must take at least two (2) courses per semester to remain in good standing. A grade of C- is required for a course to count toward the certificate. A 3.00 GPA is required to earn the certificate.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Required Courses</td>
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<tr>
<td>One course may me taken at the 400-level with DGP approval</td>
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</tr>
<tr>
<td>A minimum of three courses must be taken at the 500- or 700-level</td>
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</table>

Total Hours 12

* Students must maintain an average 3.0 GPA in all MA courses.

Physics

Research opportunities in theoretical/computational physics are available in astrophysics, biophysics, chaos, condensed matter, nanoscience/nanomaterials, nuclear and particle physics, and relativity. Research opportunities in experimental physics are available in astronomy, atomic and molecular physics, biophysics, emergent phenomena, materials physics, nanoscale science, nonlinear systems, nuclear and particle physics, optics, soft-condensed-
matter physics and technology, and surface physics.

**Admission Requirements**

Bachelor's degree in physics or equivalent and related. General GRE and the GRE Physics subject test are accepted, but not required.

**Master's Degree Requirements**

A minimum of 30 credit hours beyond the Bachelor's degree with demonstrated mastery of aspects of the physics curriculum. Thesis and nonthesis options.

**Doctoral Degree Requirements**

A minimum of 72 credit hours beyond the Bachelor's degree with demonstrated mastery of the core physics curriculum (PY721, PY782, PY783 and PY785); pass an oral preliminary exam, prepare a dissertation, and an oral final defense.

**Student Financial Support**

Graduate teaching assistantships are available for new and continuing students. Research assistantships are available to continuing students and occasionally to new students. More than 95% of students are supported by assistantships.

**Degrees**

- Physics (MS) (p. 508)
- Physics (PhD) (p. 509)

**Faculty**

**Full Professors**

Harald Ade
David E. Aspnes
Robert J. Beichner
Jerzy Bernholc
John Michael Blondin
John D. Brown
Laura I. Clarke
Karen E. Daniels
William L. Ditto
Daniel B. Dougherty
Robert Golub
Kenan Gundogdu
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Thomas M. Schaefer
John E. Thomas
Mithat Unsal
Keith R. Weninger
Albert R. Young

**Associate Professors**

Carla Frohlich
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Sebastian Konig
Divine Philip Kumah
Sharonda Leblanc
Katherine Jean Mack
Vladimir Skokov
Dali Sun

**Practice/Research/Teaching Professors**

Jason Russell Bochinski
Kazimierz Borkowski
Abay Dinku
Brand Irving Fortner
Keith Heyward
### Physics (MS)

#### Degree Requirements

#### Non-Thesis Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td></td>
<td>Letter-Graded Courses</td>
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<tr>
<td></td>
<td>Select a minimum of six 500-level / 700-level graded courses</td>
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<tr>
<td></td>
<td>Department Qualifying Exam</td>
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</tr>
<tr>
<td></td>
<td>Students must pass the Department Qualifying Exam</td>
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<td>Total Hours</td>
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</table>

Excludes: PY 501 Quantum Physics I, PY 511 Mechanics I, and PY 514 Electromagnetism I.

#### Thesis Requirements

<table>
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<tr>
<th>Code</th>
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<tr>
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<td>Research Course</td>
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<tr>
<td>PY 695</td>
<td>Master's Thesis Research (Optional)</td>
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**Graduate Minor Courses**

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<tbody>
<tr>
<td></td>
<td>Select a minimum of six 500-level / 700-level graded courses</td>
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**Total Hours**

<table>
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<th>Hours</th>
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<tr>
<td>30</td>
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Minor Options

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<th>Hours</th>
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<tbody>
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<td></td>
<td><strong>Requirements with Minor</strong></td>
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<tr>
<td></td>
<td>Select 15 graduate credit hours in Physics</td>
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<tr>
<td></td>
<td>Select nine credit hours outside the department</td>
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1 Cannot include PY 501 Quantum Physics I, PY 502 Quantum Physics II, PY 512 Mechanics II, PY 515 Electromagnetism II

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td><strong>Requirements without a Minor</strong></td>
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<tr>
<td></td>
<td>Select 18 graduate credit hours minimum in Physics</td>
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<td>Total Hours</td>
<td>18</td>
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</table>

1 Cannot include PY 501 Quantum Physics I, PY 511 Mechanics I, PY 514 Electromagnetism I

### Faculty

#### Full Professors

- Harald Ade
- David E. Aspnes
- Robert J. Beichner
- Jerzy Bernholc
- John Michael Blondin
- John D. Brown
- Laura I. Clarke
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Parminder Kaur
John H. Kelley
Hayen Leendert
Kent Leung
Wenchang Lu
Vijaya Mehta
Zodiac T. Webster

**Emeritus Faculty**

Ruth W. Chabay
Kwong T. Chung
Raymond E. Fornes
David G. Haase
James W. Cook Jr.
Stephen R. Cotanch
William Robert Davis
Donald C. Ellison
Raymond Earl Fornes
Christopher Robert Gould
Karen L. Johnston
Gerald H. Katzin
Fred Lado Jr.
Gary E. Mitchell
George W. Parker III
Richard R. Patty
Stephen Reynolds
Phillip J. Stiles

**Physics (PhD)**

**Degree Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>PY 785</td>
<td>Advanced Electricity and Magnetism I</td>
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<tr>
<td>PY 721</td>
<td>Statistical Physics I</td>
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<tr>
<td>PY 782</td>
<td>Quantum Mechanics II</td>
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<td>PY 783</td>
<td>Advanced Classical Mechanics I</td>
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<td></td>
<td>Additional 700-level course ¹</td>
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<tr>
<td>PY 801</td>
<td>Seminar</td>
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Research Ethics Courses\(^1\)

Select four of the following elective courses: \(^2\)

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<th>Course Code</th>
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<tr>
<td>PY 711</td>
<td>Advanced Quantum Mechanics I</td>
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<td>PY 712</td>
<td>Advanced Quantum Mechanics II</td>
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<tr>
<td>PY 753</td>
<td>Condensed Matter Physics II</td>
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<tr>
<td>PY 506</td>
<td>Nuclear and Subatomic Physics</td>
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<td>PY 507</td>
<td>Elementary Particle Physics</td>
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<tr>
<td>PY 509</td>
<td>General Relativity</td>
</tr>
<tr>
<td>PY 516</td>
<td>Physical Optics</td>
</tr>
<tr>
<td>PY 517</td>
<td>Atomic and Molecular Physics</td>
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<td>PY 519</td>
<td>Biological Physics</td>
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<td>PY 525</td>
<td>Computational Physics</td>
</tr>
<tr>
<td>PY 528</td>
<td>Introduction to Plasma Physics and Fusion Energy</td>
</tr>
<tr>
<td>PY 543</td>
<td>Astrophysics</td>
</tr>
<tr>
<td>PY 552</td>
<td>Condensed Matter Physics I</td>
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<tr>
<td>PY 590</td>
<td>Special Topics In Physics (CM/Bio Seminar)</td>
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<tr>
<td>PY 590</td>
<td>Special Topics In Physics (Quantum Optics)</td>
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<tr>
<td>PY 599</td>
<td>Special Topics in Physics (PhysTec)</td>
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Half-Semester Specialized Courses

“Half-Semester Specialized Courses” are approved in conjunction with the academic committee to meet 72 total hours

Additional Courses in Related Fields

“Additional Courses” are approved in conjunction with the academic committee to meet 72 total hours

Total Hours 72

1 Cannot be PY 781 Quantum Mechanics I

2 Not an exhaustive list

Faculty

Full Professors

Harald Ade
David E. Aspnes
Robert J. Beichner
Jerzy Bernholc
John Michael Blondin
John D. Brown
Laura I. Clarke
Karen E. Daniels
William L. Ditto
Daniel B. Dougherty
Robert Golub
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Matthew Piron Green
Sebastian Konig
Divine Philip Kumah
Sharonda Leblanc
Katherine Jean Mack
Vladimir Skokov
Dali Sun

Practice/Research/Teaching Professors

Jason Russell Bochinski
Kazimierz Borkowski
Abay Dinku
Admission Requirements

The well-prepared applicant to the department's Master's programs has good grades in a three-semester calculus sequence, a two-semester advanced calculus sequence, a semester of linear algebra, and a two-semester sequence in probability and statistics. Some of these courses may be taken as part of the program, but this may result in lengthening the stay. Students may apply to either the Master's or PhD program directly from a Bachelor's degree. GRE General Test scores are required for the in-person program, but Subject Test scores are not. Due to the differences in student backgrounds, there is a separate admissions process for the online and in-person programs.

The written statement should not exceed two pages and should describe the applicant's academic and career goals as well as special interests in the area of statistics. Applicants may also submit a resume. Individuals applying for fall enrollment and who wish to be considered for financial aid should have their completed applications in by no later than December 15 of the preceding year. Applications arriving after that will be considered but may be assigned lower priority. Starting Summer of 2013, we will begin to offer courses to allow a student to complete the Master of Statistics degree in one calendar year. The one year masters program has the same requirements as the current Master of Statistics program. Since courses start in the summer, the deadline to submit completed applications is January 15 of the same year, and student should apply for 'Summer 1’ admission. Students are not normally admitted for spring.

Master's Degree Requirements

All Master's programs in statistics require a minimum of 34 credit hours, of which 12 are first-year core (ST 512, ST 521, ST 522, ST 552 and their labs), one is supervised consulting (ST 641). The remainders are statistics and/or supporting electives.

Doctoral Degree Requirements

The Ph.D. program in statistics requires 22 course credit hours beyond the Master's, of which 9 are Ph.D. core courses (ST 779, ST 793, and ST 758), one is supervised consulting (ST 841), and 12 are Ph.D.-level statistics electives.

Student Financial Support

Departmental assistantships and fellowships are awarded to students in the Ph.D. program each year on a competitive basis.

Other Relevant Information

With a large graduate faculty representing virtually all major statistical specializations, the department is recognized as a world leader in graduate education and research in statistics. The Department provides a dynamic environment for teaching, core research and collaborative research across disciplines, with formal program concentrations in biostatistics, bioinformatics, environmental, financial and mathematical statistics.

Degrees

- Statistics (MR) (p. 513)
- Statistics (MR): Biostatistics Concentration (p. 514)
- Statistics (MR): Distance Track (p. 515)
- Statistics (MR): Environmental Statistics Concentration (p. 516)
- Statistics (MR): Financial Concentration (p. 517)
- Statistics (MR): Statistical Genetics Concentration (p. 519)
- Statistics (PhD) (p. 520)
- Statistics (Minor) (p. 521)
- Applied Statistics and Data Management (Certificate) (p. 523)
- Statistics Education (Certificate) (p. 523)
Faculty

Full Professors
Dennis D. Boos
Marie Davidian
Sujit K. Ghosh
Subhashis Ghosal
Kevin Gross
Marcia Lynn Gumpertz
Jacqueline M. Hughes-Oliver
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John L. Wasik

Adjunct Faculty
Howard D. Bondell
Soumendra Nath Lahiri
Alison Anne Motsinger-Reif
Eric A. Stone
Yichao Wu

Statistics (MR)

Degree Requirements

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<td>Fundamentals of Linear Models and Regression</td>
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<td>Statistical Practice</td>
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<tr>
<td>&amp; ST 518</td>
<td>and Applied Statistical Methods II</td>
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Faculty

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## Statistics (MR): Biostatistics Concentration

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**Concentration Requirements**

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<td>ST 745</td>
<td>Analysis of Survival Data</td>
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</table>

**Total Hours**: 30

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Yichao Wu

**Statistics (MR): Distance Track**

**Degree Requirements**

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**Concentration Requirements**

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<td>ST 517 &amp; ST 518</td>
<td>Applied Statistical Methods I and Applied Statistical Methods II</td>
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Complete requirements for the Distance Track

Total Hours 0

**Faculty**

**Full Professors**

Dennis D. Boos
Marie Davidian
Sujit K. Ghosh
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Yichao Wu

Statistics (MR): Environmental Statistics Concentration

Degree Requirements

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<td>ST 542</td>
<td>Statistical Practice</td>
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<td>ST 555</td>
<td>Statistical Programming I</td>
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Concentration Requirements

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<td>ST 533/733</td>
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<td>ST 534</td>
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<td>ST 745</td>
<td>Analysis of Survival Data</td>
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Elective Courses

- Elective courses can fall within the following subjects: Environmental Policy, Economics, Epidemiology, Toxicology/Risk Assessment, Mathematics, MEAS, GIS, Botany & Ecology, Biomathematics, and Zoology.

Total Hours

33

Faculty

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**Statistics (MR): Financial Concentration**

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### ST 502/702 Fundamentals of Statistical Inference II
### ST 503/705 Fundamentals of Linear Models and Regression
### ST 542 Statistical Practice
### ST 555 Statistical Programming I
### ST 517 Applied Statistical Methods I
### & ST 518 Applied Statistical Methods II

#### Concentration Requirements

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<td>ST 534</td>
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</table>

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Statistics (MR): Statistical Genetics Concentration

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<td>ST 744</td>
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Select one of the following:

- ST 721 Genetic Data Analysis
- ST 590 Special Topics (Introduction to Bioinformatics)
- ST 590 Special Topics (Bioinformatics II)
- GN 703 Population and Quantitative Genetics
- ST/GN 756 Computational Molecular Evolution

Select six credit hours of the following:

- ST 721 Genetic Data Analysis
- ST 590 Special Topics (Introduction to Bioinformatics)
- ST 590 Special Topics (Bioinformatics II)
- GN 703 Population and Quantitative Genetics
- ST/GN 756 Computational Molecular Evolution

Total Hours: 30

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## Statistics (PhD)

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<td>ST 758</td>
<td>Computation for Statistical Research</td>
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<td>ST 841</td>
<td>Statistical Consulting</td>
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<tr>
<td>ST 810</td>
<td>Advanced Topics in Statistics (Ethics in Statistics)</td>
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<tr>
<td>PHI 816</td>
<td>Introduction to Research Ethics</td>
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<td>Select nine credit hours of the following:</td>
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<td>ST 732</td>
<td>Longitudinal Data Analysis</td>
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<td>ST 733</td>
<td>Spatial Statistics</td>
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<td>ST 740</td>
<td>Bayesian Inference and Analysis</td>
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<td>ST 746</td>
<td>Introduction To Stochastic Processes</td>
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<td>ST 790</td>
<td>Advanced Special Topics</td>
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</table>

1  Unless student has taken ST 542 Statistical Practice  
2  500 or 700 level course in Statistics or another department

## Faculty

### Full Professors

Dennis D. Boos  
Marie Davidian  
Sujit K. Ghosh  
Subhashis Ghosal  
Kevin Gross  
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- Moon Won Suh
- William H. Swallow
- Anastasios A. Tsiatis
- John L. Wasik

### Adjunct Faculty

- Howard D. Bondell
- Soumendra Nath Lahiri
- Alison Anne Motsinger-Reif
- Eric A. Stone
- Yichao Wu

### Statistics (Minor)

#### Plan Requirements

**MS Student**

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<thead>
<tr>
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<td>Select a two course sequence from group one or two</td>
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<td>Select three credit hours from another group or other 500/700 ST courses</td>
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**PhD Student**

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Groups

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<td>Group One: Sequence in Applied Statistics</td>
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<tr>
<td>ST 507</td>
<td>Statistics For the Behavioral Sciences I</td>
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<tr>
<td>&amp; ST 508</td>
<td>Statistics For the Behavioral Sciences II</td>
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<td>ST 511</td>
<td>Statistical Methods For Researchers I</td>
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<tr>
<td>&amp; ST 512</td>
<td>Statistical Methods For Researchers II</td>
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<tr>
<td>ST 515</td>
<td>Experimental Statistics for Engineers I</td>
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<td>&amp; ST 516</td>
<td>Experimental Statistics for Engineers II</td>
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<td>ST 513</td>
<td>Statistics for Management I</td>
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<tr>
<td>&amp; ST 514</td>
<td>Statistics For Management and Social Sciences II</td>
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<td>Group Two: Sequence in Probability &amp; Mathematical Statistics</td>
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<tr>
<td>ST 501</td>
<td>Fundamentals of Statistical Inference I</td>
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<tr>
<td>&amp; ST 502</td>
<td>Fundamentals of Statistical Inference II</td>
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<td>ST 421</td>
<td>Introduction to Mathematical Statistics I</td>
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</tr>
<tr>
<td>&amp; ST 422</td>
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<td></td>
</tr>
</tbody>
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Faculty

Full Professors

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Eric A. Stone
Yichao Wu

Applied Statistics and Data Management (Certificate)

In the Graduate Certificate in Applied Statistics and Data Management, students will learn statistical methods and how to apply them in real world settings and about statistical programming techniques that are required for managing data in a typical workplace environment.

Admissions

The application process is very simple, there are no official prerequisites except for an undergraduate degree. Applicants should demonstrate an appropriate level of mathematical maturity to allow them to succeed in the certificate program. Examples of this would include successful completion of undergraduate coursework or professional work in a quantitative field. Note that the GRE is not required to apply and we only accept students living in North America.

Plan Requirements

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<td>ST 555</td>
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<td>Statistical Programming II</td>
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<td>or ST 558</td>
<td>Data Science for Statisticians</td>
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<tr>
<td>ST 511</td>
<td>Statistical Methods For Researchers I *</td>
<td></td>
</tr>
<tr>
<td>or ST 513</td>
<td>Statistics for Management I</td>
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<td>ST 512</td>
<td>Statistical Methods For Researchers II *</td>
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<tr>
<td>or ST 514</td>
<td>Statistics For Management and Social Sciences II</td>
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Total Hours 12

* The course sequence ST 511 and ST 512 is similar to that of ST 513 and ST 514. The main difference is that ST 511 and ST 512 focus more heavily on analysis of designed experiments, where ST 513 and ST 514 focus more heavily on the analysis of observational data.

Statistics Education (Certificate)

In the Graduate Certificate in Statistics Education, students will learn statistical concepts, methods, and pedagogical techniques for teaching these statistical topics at the college (or high school) level. The emphasis of the program is on the effective use of modern technology for teaching statistics. The courses required for this graduate certificate are listed below.

- Statistical Methods I: ST511 (or ST513)
- Statistical Methods II: ST512 (or ST514)
- Teaching and Learning of Statistical Thinking: ST519
- Teaching Statistics with Technology: ST557

Admissions

The application process is very simple, there are no official prerequisites except for an undergraduate degree. Applicants should demonstrate an appropriate level of mathematical maturity to allow them to succeed in the certificate program. Examples of this would include successful completion of undergraduate coursework or professional work in a quantitative field. Note that the GRE is not required to apply and we only accept students living in North America.

Requirements

The certificate will be earned by successful completion of four courses listed above with an average GPA of at least 3.0.

Plan Requirements

<table>
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<tr>
<th>Code</th>
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<td></td>
<td>Required Courses</td>
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<td>ST 511</td>
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<td>ST 512</td>
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<td>ST 519</td>
<td>Teaching and Learning of Statistical Thinking</td>
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<td>ST 557</td>
<td>Using Technology to Teach Statistics</td>
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Total Hours 12

Toxicology

The Toxicology Program provides course work and research training to prepare prospective toxicologists and environmental health scientists for careers in academia, government, and industry. Research in the program spans an array of topics ranging from the molecular to population level consequences of toxicant exposure. Areas of research excellence within the program include elucidating relationships among cell signaling processes and stressor-induced disease and toxicity, establishing mechanisms of system-specific toxicity, using physiological and genomic approaches to understand differences in species and individual susceptibility to environmental contaminants, and unraveling gene-environment interactions. Some specific research areas include: apoptosis, endocrine disruption, trace metal bioaccumulation and detoxification, oxidative stress/gene regulation/cell toxicity, asthma and lung fibrosis, cancer and mutagenesis, ecotoxicology, developmental abnormalities, chemical exposure assessment and environmental epidemiology. Some examples of the types of environmental agents that are being investigated include chemical carcinogens, trace metals,
pesticides, particulates metals, endocrine disruptors, nanoparticles and UVB radiation.

**Admission Requirements**

Prospective students should have a strong background in the biological and physical sciences with a minimum undergraduate grade point average of 3.0 (on a 4.0 scale) and a minimum Quantitative GRE score in the 70th percentile. GRE subject tests are not required. International students whose primary language is not English must submit TOEFL scores. A written statement should describe the applicants academic and career goals as well as their area of interest. All applications are reviewed by an admissions committee. Students are encouraged to submit applications no later than December 15 for Fall admission.

**Master of Science Degree Requirements**

The M.S. is a research-oriented degree requiring a minimum of 30 credit hours and a written thesis. At least 20 credit hours must be graduate-level courses and a core curriculum is required.

**Master of Toxicology Degree Requirements**

The MTOX degree is a non-research degree designed for those interested in pursuing non-research careers in toxicology and environmental health science, and/or working professionals seeking to further their education and advance their careers. To accommodate working professionals the MTOX degree can be pursued on a part-time basis. A minimum of 30 credit hours is required, with at least 14 credit hours in toxicology courses.

**Doctoral Degree Requirements**

The Ph.D. program is designed to train students to become independent scholars capable of conducting unsupervised and original research. Students enroll in a core curriculum similar to that of the M.S. degree and additional courses as determined by his/her advisory committee. Normally a total of 72 credit hours is required, with the majority of these credits being dissertation research. Students must pass both a written and oral preliminary exam prior to advancing to Ph.D. candidacy. A doctoral dissertation presenting the students original research is written and defended in a final oral examination.

**Student Financial Support**

Financial assistance is available for qualified applicants through traineeships, fellowships, teaching assistantships and research assistantships.

**Other Relevant Information**

Students pursuing either the M.S. or Ph.D. degree may elect to specialize in General Toxicology, Environmental Toxicology, or Molecular and Cellular Toxicology. More details can be obtained on the Environmental and Molecular Toxicology web site.

**Degrees**

- Toxicology (MR) (p. 525)
- Toxicology (MS) (p. 525)
- Toxicology (PhD) (p. 526)
- Toxicology (Minor) (p. 527)

**Faculty**

**Full Professors**

- Ronald E. Baynes
- James C. Bonner
- Matthew Breen
- David Buchwalter
- William Gregory Cope
- Jane A. Hoppin
- Cathrine Hoyo
- Michael Hyman
- Detlef R. Knappe
- Seth William Kullman
- Jerry "Mac" Law
- Gerald Andre LeBlanc
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- Heather Patiwa
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- Yoshiaki Tsuji
- Fred Andrew Wright
- Jeffrey A. Yoder

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- David Lawrence Aylor
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- Shobhan Gaddameedhi
- Nanette M. Nascone-Yoder
- Antonio Planchart
- David Michael Reif
- Hong Wang
- Yihui Zhou
Assistant Professors
Michael S. Bereman
Michael Anthony Cowley
Denis Fourches
Kurt Marsden

Practice/Research/Teaching Professors
Jonathan Hall
David Allen Skaar
Elizabeth E. A. Thompson

Toxicology (MR)

Degree Requirements

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<tr>
<td>TOX 701</td>
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<td>TOX 710</td>
<td>Molecular and Biochemical Toxicology</td>
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<td>TOX 715</td>
<td>Environmental Toxicology</td>
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<tr>
<td>TOX 601</td>
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<td>TOX 620</td>
<td>Special Problems</td>
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<td>Molecular Genetics</td>
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Faculty

Full Professors
Ronald E. Baynes
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Toxicology (MS)

Degree Requirements

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**Core Courses**

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<td>Molecular and Biochemical Toxicology</td>
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<td>TOX 715</td>
<td>Environmental Toxicology</td>
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<td>TOX 801</td>
<td>Toxicology Seminar (enroll every semester)</td>
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<td>TOX 820</td>
<td>Special Problems In Toxicology (Lab Rotations)</td>
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<td>TOX 820</td>
<td>Special Problems In Toxicology (Responsible Conduct of Research)</td>
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**Elective Courses**

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<td>BIO 588</td>
<td>Neurobiology</td>
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*“Elective Courses” are approved in conjunction with the academic committee to meet 72 total hours
NC State University

BIT 510  Core Technologies in Molecular and Cellular Biology
BIT 562  Gene Expression Analysis: Microarrays
BIT 567  PCR and DNA Fingerprinting
BIT 568  Genome Mapping
BIT 569  RNA Purification and Analysis
BIT 595  Special Topics
BCH 553  Biochemistry of Gene Expression
BCH 701  Macromolecular Structure
BCH 703  Macromolecular Synthesis and Regulation
BCH 705  Molecular Biology Of the Cell
BCH 761  Advanced Molecular Biology Of the Cell
CBS 754  Epidemiology II
CBS 762  Principles of Pharmacology
CBS 795  Special Topics in Comparative Biomedical Sciences
CH 572  Proteomics
GN 735  Functional Genomics
HS 707  Environmental Stress Physiology
MB 751  Immunology
MEA 540  Principles of Physical Oceanography
PHY 503  General Physiology I
PHY 504  General Physiology II
PHY 780  Mammalian Endocrinology
ST 512  Statistical Methods For Researchers II

* Other courses must be approved in conjunction with the academic committee.

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Toxicology (Minor)

Plan Requirements

MS Student Requirements

<table>
<thead>
<tr>
<th>Code</th>
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Total Hours 9
### PhD Student Requirements

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<td>Molecular and Biochemical Toxicology</td>
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<td>TOX 715</td>
<td>Environmental Toxicology</td>
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<td>Toxicology Seminar</td>
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</table>

**Faculty**

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- Jane A. Hoppin
- Cathrine Hoyo
- Michael Hyman
- Detlef R. Knappe
- Seth William Kullman
- Jerry “Mac” Law
- Gerald Andre LeBlanc
- Carolyn Jane Mattingly
- Elizabeth Guthrie Nichols
- Jun Ninomiya-Tsuji
- Heather Patisaul
- Emilie Francesca Rissman
- Richard M. Roe
- Robert Charles Smart
- Yeshiaki Tsuji
- Fred Andrew Wright
- Jeffrey A. Yoder

**Assistant Professors**

- Shobhan Gaddameedhi
- Nanette M. Nascone-Yoder
- Antonio Planchart
- David Michael Reif
- Hong Wang
- Yihui Zhou

**Assistant Professors**

- Michael S. Bereman
- Michael Anthony Cowley
- Denis Fourches
- Kurt Marsden

**Practice/Research/Teaching Professors**

- Jonathan Hall
- David Allen Skaar
- Elizabeth E. A. Thompson

### Graduate Certificates - College of Sciences

**Certificates**

- Applied Statistics and Data Management (Certificate) (p. 523)
- Biology for Educators (Certificate) (p. 528)
- Climate Adaptation (Certificate) (p. 495)
- Mathematics (Certificate) (p. 506)
- Statistics Education (Certificate) (p. 523)

**Biology for Educators (Certificate)**

The Graduate Certificate in Biology for Educators will provide additional training in biological sciences to K-12 teachers and other educators. The certificate will provide recognition to those individuals who complete 12 credit hours of coursework in graduate level biology, with the option to complete up to 18 credit hours for those interested in teaching AP courses or teaching at the community college level (dependent on individual community college credential requirements). All students will choose between four and six courses (3 credits each) in topic areas that align with their own goals, including a capstone course in the science of learning. Course topics will include animal behavior, communicable and non-communicable diseases, toxicology, evolution, genetics and microbiology. Faculty are continuing to develop new courses to increase options.

Applicants must meet at least one of these three requirements:

- have earned a bachelor’s degree from an accredited college or university with minimum 3.0 GPA in the last 60 credit hours of undergraduate study
• be a graduate student in good standing in an education-related masters or doctoral program
• have earned a master's degree from an accredited college or university

In addition, applicants will be required to submit a one-page statement describing how this program will benefit their personal or professional development and career goals.

Financial aid support is not typically offered to students seeking certificates. However, we encourage prospective students to pursue the possibility of tuition reimbursement programs through their employer. Additionally, courses taken during the fall and spring terms can be paid for using the NC State payment plan (https://studentservices.ncsu.edu/your-money/bill/pay-your-bill/enroll-in-a-payment-plan/).

Plan Requirements

• Option One: Select 12 credits
• Option Two: Select 18 credits, gives Educators enough graduate-level courses to teach Advanced Placement (AP) classes at the high school level or to teach in community college

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<thead>
<tr>
<th>Code</th>
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<td>BIO 405</td>
<td>Functional Histology</td>
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<td>MB 411</td>
<td>Medical Microbiology</td>
<td>3</td>
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<td>MB 441</td>
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<td>MB 451</td>
<td>Microbial Diversity</td>
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<td>TOX 401</td>
<td>Principles of Toxicology</td>
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<td>TOX 415</td>
<td>Environmental Toxicology and Chemistry</td>
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<td>Studying Animal Behavior (Special Topics: Introduction to Animal Behavior)</td>
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<td>Humans and Disease: Communicable Diseases</td>
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<td>Topical Problems (Special Topics: Cancer Biology, Progression and Therapeutics)</td>
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<td>Topical Problems (Special Topics: Model Organisms in Cellular and Molecular Biology)</td>
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<td>Toxics, Human Health, and the Environment</td>
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<td>Topical Problems (Primate Behavior)</td>
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College of Veterinary Medicine

Programs

• Comparative Biomedical Sciences (p. 529)
• Nutrition (p. 151)
• Physiology (p. 160)

Degree Programs

MR

• Nutrition (MR) (p. 153)
• Physiology (MR) (p. 161)

MS

• Comparative Biomedical Sciences (MS) (p. 532)
• Nutrition (MS) (p. 155)
• Physiology (MS) (p. 162)

PhD

• Comparative Biomedical Sciences (PhD): Cell Biology Concentration (p. 536)
• Comparative Biomedical Sciences (PhD): Immunology Concentration (p. 538)
• Comparative Biomedical Sciences (PhD): Infectious Diseases Concentration (p. 540)
• Comparative Biomedical Sciences (PhD): Neurosciences Concentration (p. 542)
• Comparative Biomedical Sciences (PhD): Pathology Concentration (p. 544)
• Comparative Biomedical Sciences (PhD): Pharmacology Concentration (p. 546)
• Comparative Biomedical Sciences (PhD): Population Med and Vet Public Health Concentration (p. 548)
• Nutrition (PhD) (p. 156)

Minors

• Comparative Biomedical Science (Minor) (p. 550)
• Nutrition (Minor) (p. 158)
• Physiology (Minor) (p. 163)

Comparative Biomedical Sciences

Course offerings and research topics currently include, but are not limited to: cell biology, genomics, infectious diseases, developmental biology, immunology, cardiology, pharmacokinetics, oncology, toxicology, gastroenterology, neuroscience, reproductive physiology, biotechnology, microbiology, aquatic/wildlife biology, biomedical engineering, endocrinology, molecular biology, pulmonary biology, epidemiology, population medicine, health systems monitoring, transplantation and radiology.

Admission Requirements

All applications are reviewed by the Graduate Studies Committee of the CBS Program, composed of faculty members representing each area of the graduate program and a graduate student representative. Scores from the GRE are required for admission by all applicants except for applicants with a DVM degree. Candidates who do not have a DVM degree must have a baccalaureate degree or advanced degree from a college or university recognized as standard by a regional or general accrediting agency. Students with a 3.0 (on a 4.0 scale) undergraduate or DVM curriculum with appropriate course background will be considered for admission.

Doctoral Degree Requirements

Credit hour requirements for the Ph.D. degree are determined by the graduate student's committee with approval of the Director of Graduate Programs and the Graduate School.
Student Financial Support

Research assistantships are awarded to qualified candidates on the competitive basis by the College. These are for 12-month periods, and stipends are competitive with those of other programs. These positions are funded by the grants of individual faculty members and the state appropriations to the College and departments.

Other Relevant Information

The program is organized as seven areas of concentration which include: cell biology, immunology, population medicine, infectious diseases, pathology, pharmacology, and neuroscience. These provide extensive interdisciplinary training and maintain a highly effective liaison with graduate programs in other colleges of the university, as well as those of nearby Duke University and the University of North Carolina at Chapel Hill.

Degrees

- Comparative Biomedical Sciences (MS) (p. 532)
- Comparative Biomedical Sciences (PhD) (p. 534)
- Comparative Biomedical Sciences (PhD): Cell Biology Concentration (p. 536)
- Comparative Biomedical Sciences (PhD): Immunology Concentration (p. 538)
- Comparative Biomedical Sciences (PhD): Infectious Diseases Concentration (p. 540)
- Comparative Biomedical Sciences (PhD): Neurosciences Concentration (p. 542)
- Comparative Biomedical Sciences (PhD): Pathology Concentration (p. 544)
- Comparative Biomedical Sciences (PhD): Pharmacology Concentration (p. 546)
- Comparative Biomedical Sciences (PhD): Population Med and Vet Public Health Concentration (p. 548)
- Comparative Biomedical Science (Minor) (p. 550)

Faculty

Full Professors

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Donald E. Thrall
**Comparative Biomedical Sciences (MS)**

### Degree Requirements

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<td>Statistical Methods For Researchers I</td>
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### Concentrations

#### Cell Biology Concentration

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#### Pathology Concentration

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### Pharmacology Concentration

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<td>TOX 710</td>
<td>Molecular and Biochemical Toxicology</td>
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<td>CBS 762</td>
<td>Principles of Pharmacology</td>
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<td>CBS 787</td>
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### Population Medicine Concentration

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<tr>
<td>ST 512</td>
<td>Statistical Methods For Researchers II</td>
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<td>CBS 580</td>
<td>Clinical Veterinary Epidemiology</td>
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<td>CBS 754</td>
<td>Epidemiology II</td>
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<td>CBS 650</td>
<td>Population Medicine Forum (Other concentration seminars can be substituted)</td>
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</tbody>
</table>

### Faculty

**Full Professors**

- Kenneth B. Adler
- Glen William Almond
- Kevin L. Anderson
- Christopher M. Ashwell
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Adjunct Faculty
Jennifer Lynn Davis
Janice A. Dye
Johanna Rebecca Elfenbein

Comparative Biomedical Sciences (PhD)

Degree Requirements

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<td>ST 511</td>
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<td>or ST 517</td>
<td>Applied Statistical Methods I</td>
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<tr>
<td>CBS 662</td>
<td>Professional Conduct in Biomedical Research</td>
<td>1</td>
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<tr>
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Total Hours 10

Faculty

Full Professors
Kenneth B. Adler
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Kevin L. Anderson
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Comparative Biomedical Sciences (PhD): Cell Biology Concentration

Degree Requirements

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<td>CBS 565</td>
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Total Hours: 10

Concentration Requirements

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Total Hours: 9

1 Other concentration seminars can be substituted

Faculty

Full Professors
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Laurianne Chantal Van Landeghem

Practice/Research/Teaching Professors
Ricardo G. Maggi
Thierry Jean Marie Olivry

Emeritus Faculty
Harold J. Barnes
Comparative Biomedical Sciences (PhD): Immunology Concentration

Degree Requirements

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Other concentration seminars can be substituted

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Donald E. Thrall

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Janice A. Dye
Johanna Rebecca Elfenbein

Comparative Biomedical Sciences (PhD): Infectious Diseases Concentration

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Total Hours 3

1 Other concentration seminars can be substituted

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Comparative Biomedical Sciences (PhD): Neurosciences Concentration

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Total Hours: 10

Faculty

Full Professors
Kenneth B. Adler
Glen William Almond
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**Practice/Research/Teaching Professors**
Ricardo G. Maggi
Thierry Jean Marie Olivry

**Emeritus Faculty**
Harold J. Barnes
Talmage T. Brown Jr.
Comparative Biomedical Sciences (PhD): Pathology Concentration

Degree Requirements

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1 Other concentration seminars can be substituted

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Practice/Research/Teaching Professors
Ricardo G. Maggi
Thierry Jean Marie Olivry
Comparative Biomedical Sciences (PhD): Population Med and Vet Public Health Concentration

Emeritus Faculty
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Talmage T. Brown Jr.
John Michael Cullen
Lloyd Norman Fleisher
Oscar J. Fletcher Jr.
Sarah Y. Gardner
Marlene L. Hauck
Cynthia L. Hemenway
Suzanne Kennedy-Stoskopf
Michael Green Levy
David H. Ley
Nancy A. Monteiro-Riviere
William M. Morrow
Paul E. Orndorff
W. Rich Redding
Jim E. Riviere
Malcolm C. Roberts
Barbara Lynn Sherman
Clifford Richard Swanson
Donald E. Thrall

Adjunct Faculty
Jennifer Lynn Davis
Janice A. Dye
Johanna Rebecca Elfenbein

Comparative Biomedical Sciences (PhD): Population Med and Vet Public Health Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
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<tbody>
<tr>
<td>CBS 565</td>
<td>Fundamentals of Biomedical Sciences</td>
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<tr>
<td>ST 511</td>
<td>Statistical Methods For Researchers I</td>
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<tr>
<td>or ST 517</td>
<td>Applied Statistical Methods I</td>
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<td>CBS 662</td>
<td>Professional Conduct in Biomedical Research</td>
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<td>CBS 800</td>
<td>CBS Seminar</td>
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Concentration Requirements

<table>
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<tbody>
<tr>
<td>ST 512</td>
<td>Statistical Methods For Researchers II</td>
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<tr>
<td>CBS 580</td>
<td>Clinical Veterinary Epidemiology</td>
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</tr>
<tr>
<td>CBS 754</td>
<td>Epidemiology II</td>
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</tr>
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<td>CBS 650</td>
<td>Population Medicine Forum (Seminar in Pop Med)</td>
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</tr>
<tr>
<td>or CBS 595</td>
<td>Special Topics</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 12

1 Other concentration seminars can be substituted

Faculty

Full Professors
Kenneth B. Adler
Glen William Almond
Kevin L. Anderson
Christopher M. Ashwell
Ronald E. Baynes
Adam Joseph Birkenheuer
Anthony T. Bikslager
James C. Bonner
Russell J. Borski
Matthew Breen
Edward Bealmear Breitschwerdt
Ke Cheng
Maria T Correa
Paula J Cray
Rocio Crespo
Frederick J. Fuller
John E. Gadsby
Troy Ghashghaei
Isabel M. Gimeno
John R. Godwin
Jody L. Gookin
Bruce Hammerberg
Lee-Ann Jaykus
Samuel L. Jones
Matthew D. Koci
Seth William Kullman
Duncan X. Lascelles
Scott M. Laster
Jerry M. Law
Keith E. Linder
Carolyn Jane Mattingly
Kathryn Montgome Meurs
Paul Edward Mozdziak
Natasha J. Olby
Mark G. Papich
Heather Patsaul
Jorge A. Piedrahita
Emilie Francesca Rissman
Philip L. Sannes
Barbara Sherry
Robert Charles Smart
Geoffrey W. Smith
Michael K. Stoskopf
Siddhartha Thakur
Jeffrey A. Yoder

**Associate Professors**

Petra Bizikova
Luke B. Borst
Nicolas Emile Buchler
Jonathan E. Fogle
Derek M. Foster
Paul R. Hess
Megan E. Jacob
Cristina Lanzas
Sara K. Lyle
John Edward Meitzen
Nanette M. Nascone-Yoder
Michael Warren Nolan
Monique Danielle Pairis-Garcia
Xinxia Peng
Antonio Planchart
Marcelo Rodriguez-Puebla
Lauren V. Schnabel
Michael L. Sikes
Barrett D Slenning
Susan T. Tonkonogy

**Assistant Professors**

Belinda Sena Akpa
Tal Ben-Horin
Yevgeny Brudno
Benjamin John Callahan
Elisa Crisci
Glenn Paul Cruse
Christopher Matthew De Kaney
Liara M. Gonzalez
Margaret Elizabeth Gruen
Tobias Ernst Kaeser
Albert Jun Qi Keung
Raveendra Rangarao Kulkarni
Caroline Laplante
Elizabeth Lucas
Jennifer Ann Luff
Gustavo Machado
Kurt Marsden
Kelly Ann Meiklejohn
Kristen Michele Messenger
Santosh Kumar Mishra
Mary Katherine Sheats
Casey Michelle Theriot
Laurianne Chantal Van Landeghem

**Practice/Research/Teaching Professors**

Ricardo G. Maggi
Thierry Jean Marie Olivry
Emirutus Faculty
Harold J. Barnes
Talmage T. Brown Jr.
John Michael Cullen
Lloyd Norman Fleisher
Oscar J. Fletcher Jr.
Sarah Y. Gardner
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Malcolm C. Roberts
Barbara Lynn Sherman
Clifford Richard Swanson
Donald E. Thrall

Adjunct Faculty
Jennifer Lynn Davis
Janice A. Dye
Johanna Rebecca Elfenbein

Comparative Biomedical Science (Minor)

Plan Requirements
• 9 (MS student) or 12 (PhD student) credit hours

Faculty
Full Professors
Kenneth B. Adler
Glen William Almond
Kevin L. Anderson
Christopher M. Ashwell

Ronald E. Baynes
Adam Joseph Birkenheuer
Anthony T. Blikslager
James C. Bonner
Russell J. Borski
Matthew Breen
Edward Bealmear Breitschwerdt
Ke Cheng
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Heather Patisaul
Jorge A. Piedrahita
Emilie Francesca Rissman
Philip L. Sannes
Barbara Sherry
Robert Charles Smart
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Siddhartha Thakur
Jeffrey A. Yoder

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Caroline Laplante
Elizabeth Lucas
Jennifer Ann Luff
Gustavo Machado
Kurt Marsden
Kelly Ann Meiklejohn
Kristen Michele Messenger
Santosh Kumar Mishra
Mary Katherine Sheats
Casey Michelle Theriot
Laurianne Chantal Van Landeghem

Practice/Research/Teaching Professors
Ricardo G. Maggi
Thierry Jean Marie Olivry

Emeritus Faculty
Harold J. Barnes
Talmage T. Brown Jr.
John Michael Cullen
Lloyd Norman Fleisher
Oscar J. Fletcher Jr.
Sarah Y. Gardner
Marlene L. Hauck
Cynthia L. Hemenway
Suzanne Kennedy-Stoskopf
Michael Green Levy
David H. Ley
Nancy A. Monteiro-Riviere
William M. Morrow
Paul E. Orndorff
Institute for Advanced Analytics

Programs

- Analytics (p. 552)

Degree Programs

Master of Science (MS)

- Analytics (MS) (p. 552)

Analytics

The Master of Science in Analytics (MSA) is uniquely designed to equip students for the task of deriving and effectively communicating actionable insights from a vast quantity and variety of data. It is an intensive 10-month degree with a strong practical orientation focused on the tools and methods used by data scientists. It is a fully integrated course of study taught exclusively to MSA students and designed to produce well-rounded professionals. Student teams tackle genuine problems with data provided by industry and government sponsors.

Admission Requirements

Admission to the MSA program is highly competitive. The best-qualified applicants will be accepted up to the limited number of seats available for students each year. The Admissions Committee evaluates candidates on criteria such as:

- overall academic record and grade point average;
- academic performance in analytical/quantitative subjects;
- relevant employment experience and potential to succeed in the profession; and
- leadership potential, integrity, and other personal character traits.

The Institute welcomes applications from highly motivated individuals of exceptional talent regardless of undergraduate major. Applicants without prior coursework in statistics and/or experience with computer programming would need to complete a set of prerequisite courses before qualifying as a candidate for admission. More information can be found on the MSA website (http://analytics.ncsu.edu/).

Master’s Degree Requirements

Students complete 30 credit hours of defined coursework in a period of ten months beginning in Summer Session II and ending the following Spring semester. The integrated curriculum is designed to provide a focused education in the software tools, methods and applications of data analytics.

Other Relevant Information

Students must begin the degree program in the first semester (Summer Session II) and complete all 30 credit hours of the curriculum. The program is designed for full-time students only. Applications for admission are reviewed between September and April.

Degrees

- Analytics (MS) (p. 552)

Full Professors

Christopher G. Healey
Michael A. Rappa

Practice/Research/Teaching Professors

Shaina L. Race Bennett
Aric David LaBarr
Susan Jeanne Simmons
Andrea Villanes Arellano

Affiliate Faculty

Sarah Egan Warren
Christopher West

Analytics (MS)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
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<tr>
<td>AA 500</td>
<td>Analytics Tools and Techniques</td>
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<td>AA 501</td>
<td>Analytics Foundations</td>
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<td>AA 502</td>
<td>Analytics Methods and Applications I</td>
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<td>AA 504</td>
<td>Analytics Practicum I</td>
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<td>AA 503</td>
<td>Analytics Methods and Applications II</td>
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<tr>
<td>AA 505</td>
<td>Analytics Practicum II</td>
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</table>

Total Hours 30

Full Professors

Christopher G. Healey
Michael A. Rappa
Practice/Research/Teaching Professors
Shaina L. Race Bennett
Aric David LaBarr
Susan Jeanne Simmons
Andrea Villanes Arellano

Affiliate Faculty
Sarah Egan Warren
Christopher West

Poole College of Management

Programs
• Accounting (p. 553)
• Business Administration (p. 555)
• Economics (p. 564)
• Management (p. 572)

Degree Programs
Master’s (MR)
• Accounting (MR) (p. 554)
• Business Administration (MR): Full Time (p. 559)
• Business Administration (MR): Part Time (p. 560)
• Economics (MR) (p. 565)
• Management (MR): Global Luxury and Management Concentration (p. 573)

Minors
• Business Administration (Minor) (p. 561)
• Economics (Minor) (p. 570)

Certificates
• Finance (Certificate) (p. 562)
• Marketing (Certificate) (p. 563)
• Operations and Supply Chain Management (Certificate) (p. 563)
• Tax Analytics and Technology (Certificate) (p. 555)
• Technology Entrepreneurship and Commercialization (Certificate) (p. 563)

Accounting
The Jenkins Master of Accounting (MAC) program provides exceptional education and real-world experience that equip students to take their careers to the next level. Whether pursued on campus and in-person or taken entirely online, the program’s curriculum (https://poole.ncsu.edu/mac/academics/concentrations/) in Enterprise Risk Management, Information Technology or Tax Strategy.

The curriculum is focused on both preparing you for the CPA exam and developing real-world skills, and learning doesn’t stop in the classroom. MAC students can study abroad in Prague, lead financial literacy courses on campus or in the community, work with real companies in practicum exercises and take advantage of innovative learning opportunities.

Admission Requirements
Admission to the MAC program is competitive. The best-qualified applicants will be accepted up to the number of spaces available for new students. The Admissions Committee evaluates candidates on three criteria:

• undergraduate academic record and grade point average;
• GMAT score*;
• “Engagement & Leadership” -- relevant activities and/or work experience, student athletics, volunteer work/community involvement, study abroad, in-person MAC interview, overall presence, leadership experience and integrity.

[*The Admissions Committee requires all applicants who score below 530 on their first attempt to retake the GMAT exam prior to the application deadline.]

Individuals with a Bachelor's degree in any major may apply to the program; however, any applicant without a Bachelor's degree in Accounting must complete a series of undergraduate Accounting prerequisites before qualifying as a MAC degree candidate. These prereqs are available to take online (https://poole.ncsu.edu/mac/admissions/qualifications/accelerated-summer-accounting-prerequisite-program-asap-program/). More complete information can be found on the MAC website (https://poole.ncsu.edu/mac/admissions/).

Fellowships (On-campus)
As a part of the admissions process, applicants may be considered for Jenkins Graduate School's merit-based MAC fellowships. Students may qualify for a firm-sponsored or an academic fellowship. A fellowship may provide financial support for educational expenses and also may include an offer of employment upon graduation (firm-sponsored option). All required application materials must be submitted by the February 1st application deadline to be considered for a fellowship.

Scholarships
MAC scholarships are merit-based and are made possible through a partnership between sponsoring CPA firms, the NC State Graduate School, alumni and the Poole College of Management’s Department of Accounting. All students who submit an application no later than February 1st are considered for a scholarship award. Recipients of MAC scholarships are selected based on their scholarship, leadership, service, experience, presence and integrity. Scholarships range from $2,000 to $19,000.

Master’s Degree Requirements
Students complete an 11-course sequence that includes eight graduate-level Accounting courses and three elective courses (31 total credit hours). The curriculum is designed to provide a broad-based professional education. Students have the opportunity to focus their education by choosing one of our three optional concentrations: enterprise
risk management, information technology or tax strategy. These concentrations provide an additional depth of knowledge that can give students a leg up as they enter their chosen profession.

Other Relevant Information

On-Campus (https://poole.ncsu.edu/mac/academics/on-campus-mac/)
MAC

We accept applications starting in the fall but encourage interested applicants to apply early to be eligible for our many scholarship and fellowship opportunities.

- December 1: Early admission deadline
- February 1: Deadline for MAC scholarship and fellowship consideration
- March 1: Final admission deadline

Online (https://poole.ncsu.edu/mac/academics/online-mac/) MAC

Contact Jay Arrington, jmarring@ncsu.edu or 919-515-0223, for more information regarding online MAC applications.

Degrees

- Accounting (MR) (p. 554)
- Tax Analytics and Technology (Certificate) (p. 555)

Faculty

Full Professors

Mark S. Beasley
Marianne Bradford
Bruce C. Branson
Katherine Ann Krawczyk
Donald P. Pagach
Roby B. Sawyers
Eileen Z. Taylor

Assistant Professors

Nathan Goldman

Practice/Research/Teaching Professors

Ernest Carraway
Jennie Dirienzo
Bonnie Hancock
James Scalise
Scott Showalter

Accounting (MR)

Degree Requirements

Degrees earned will be distributed as: "Master of Accounting" without track specifications.

<table>
<thead>
<tr>
<th>Code</th>
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<td>ACC 519</td>
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<td>ACC 530</td>
<td>Advanced Income Tax</td>
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<tr>
<td>ACC 533</td>
<td>Accounting and Tax Research</td>
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<tr>
<td>ACC 540</td>
<td>IT Risks and Controls</td>
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<tr>
<td>ACC 600</td>
<td>Managerial and Career Effectiveness</td>
<td></td>
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<tr>
<td>ACC 508</td>
<td>Advanced Commercial Law</td>
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<tr>
<td>ACC 510</td>
<td>Advanced Financial Accounting</td>
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<tr>
<td>ACC 550</td>
<td>Advanced Auditing</td>
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<td>Enterprise Risk Management</td>
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<td>MBA 519</td>
<td>Enterprise Risk Management Practicum</td>
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<tr>
<td>BUS 590</td>
<td>Special Topics In Business Management (Strategic Risk Analysis Using Excel)</td>
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<tr>
<td>BUS 590</td>
<td>Special Topics In Business Management (Forecasting and Scenario Planning Using Monte Carlo)</td>
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<tr>
<td>BUS 590</td>
<td>Special Topics In Business Management (Creating Management Dashboards Using Tableau)</td>
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<td>MBA 511</td>
<td>Data Security and Privacy</td>
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<td>MBA 515</td>
<td>Enterprise Resource Planning Systems</td>
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<td>MBA 525</td>
<td>Taxes and Business Strategy</td>
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<td>BUS 590</td>
<td>Special Topics In Business Management (Corporate Tax Strategy)</td>
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<td>ACC 561</td>
<td>Database Management in Tax 1</td>
<td></td>
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<tr>
<td>ACC 564</td>
<td>Project Management and Process Documentation in Tax 1</td>
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</tr>
<tr>
<td>ACC 565</td>
<td>Visual Analytics in Tax 1</td>
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<tr>
<td>ACC 520</td>
<td>Advanced Management Accounting</td>
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<tr>
<td>MBA 523</td>
<td>Investment Theory and Practice</td>
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<tr>
<td>MBA 526</td>
<td>International Finance</td>
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<tr>
<td>MBA 582</td>
<td>Sustainability and Business</td>
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<tr>
<td>ACC 588</td>
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</tr>
<tr>
<td>MBA 590</td>
<td>Special Topics In Business Management</td>
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</tbody>
</table>

Total Hours 31

1 Must take all three to count toward one elective

Faculty

Full Professors

Mark S. Beasley
The Graduate Certificate in Tax Analytics and Technology is currently a two to three year online program that targets for enrollment MAC and MBA graduate students at NC State, graduate students at other universities and working professionals in the Research Triangle, national and global community. They will learn knowledge and skills to extract, manipulate, analyze, and summarize tax data to solve tax problems, identify opportunities for tax savings, and to effectively communicate actionable tax and business strategies to organizations.

Admissions Requirements
Graduate students at NC State must be in good standing. Students not enrolled at NC State must have completed a baccalaureate degree and have either taken some introductory/intermediate accounting and tax courses or have work experience in these areas. All students must submit an application to the certificate program which will be reviewed and evaluated by the coordinator. A minimum GPA of 3.0 (in undergraduate and/or prior graduate work) is required for admission to the program.

Program Requirements
The certificate program requires students to complete twelve (12) one-credit hour online courses with an overall 3.0 GPA in all courses. No transfer credits will be accepted in the program and it must be completed within four years.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACC 560</td>
<td>Tools for Tax Analytics</td>
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</tr>
<tr>
<td>ACC 561</td>
<td>Database Management in Tax</td>
<td></td>
</tr>
</tbody>
</table>

Business Administration

The Master of Business Administration (MBA) program develops business leaders for tomorrow’s global markets and technologies. The Jenkins MBA program provides students with the requisite foundation in general business management, while also allowing time to focus on an area of particular interest. In pairing academic excellence with real-world experience, Jenkins MBA students are ready to meet global challenges head-on with practical, technology-driven solutions.

Students may choose to pursue an MBA through one of four platforms: the Full-time program on NC State’s main campus; the Professional Evening program with locations on NC State’s main campus as well as a RTP location; or the Online program.

Admission Requirements
In addition to the basic Graduate School admission requirements, full-time MBA applicants must submit recent GMAT/GRE scores, unless approved for a test waiver. Admission decisions for both full-time and working professional applicants are based on academic performance and potential, GMAT or GRE scores (when applicable), essays, recommendations, relevant work experience and an interview. Students must have previous coursework in statistics before entering the program. For further information, please visit the MBA website (https://mba.ncsu.edu/).

Master of Business Administration

The MBA program requires every student to complete the core curriculum that includes coursework in accounting, economics, finance, marketing, operations / supply chain, organizational behavior, statistics and strategy, as well as communications and critical thinking and writing. Full-time students must complete a minimum of 54 credit hours; Professional Evening and Online students must complete a minimum of 40 credit hours.

Additional Requirements

Full-time
In addition to the core curriculum, students must complete a minimum of 12 elective hours within a concentration; an advanced analytics course; and a practicum. Students then have the opportunity to choose from a variety of elective courses to meet the 54 credit hour minimum.
Professional Evening and Online
In addition to the core curriculum, students must complete a minimum of 6 elective hours within an area of emphasis; an advanced analytics course; and a practicum. Students then choose from a variety of elective courses to meet the 40 credit hour minimum.

Minor in Management
Students enrolled in Master's and doctoral programs can complete the minor by taking courses that meet requirements within the MBA degree. Master's students must take 9 hours; doctoral students must take 15 hours.

Degrees
- Business Administration (MR) (p. 557)
- Business Administration (MR): Full Time (p. 559)
- Business Administration (MR): Part Time (p. 560)
- Business Administration (Minor) (p. 561)
- Finance (Certificate) (p. 562)
- Marketing (Certificate) (p. 563)
- Operations and Supply Chain Management (Certificate) (p. 563)
- Technology Entrepreneurship and Commercialization (Certificate) (p. 563)

Faculty
Full Professors
Steven G. Allen
Steve H. Barr
Jonathan D. Bohlmann
Marianne Bradford
Joseph F. Brazel
Jon Carr
Yuang Sung Al Chen
Robert L. Clark
Robert B. Handfield
Hans Sebastian Heese
David H. Henard
Stacy W. King
Bradley Lane Kirkman
Stephen K. Markham
Roger C. Mayer
Donald P. Pagach
Fay Cobb Payton
Eileen Z. Taylor
Beverly B. Tyler

Associate Professors
Turanay Caner
Bartley R. Danielsen
Julia B. Earp
Jesse Aaron Ellis
Eda Kemahlioglu-Ziya
Srinivasan Krishnamurthy
Karlyn Mitchell
Paul W. Mulvey
Jeffrey M. Pollack
William Michael Rand
Stefanie Mora Robinson
Michael A. Stanko
Jeffrey S. Stonebraker
Donald P. Warsing

Assistant Professors
Nachiket Meghashyam Bhawe
Heather Johnson Dretsch
Patrick James Flynn
Timothy Charles Kraft
Elena Kulchina
Elizabeth Erin Powell
Rishika Rishika
Jared Smith
Qingqing Wu

Emeritus Faculty
Jon W. Bartley
David L. Baumer
Stephen N. Chapman
K. Shannon Davis
Gary W. Dickson
Practice/Research/Teaching Professors
Leigh Shamblin

Business Administration (MR)

Full-Time Degree Requirements

Degrees earned will be distributed as: "Master of Business Administration" without focus area specifications.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td><strong>Core Courses</strong></td>
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<tr>
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<td>&quot;See &quot;Core Courses&quot; listed below&quot;</td>
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<tr>
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<td><strong>Concentration Area Courses</strong></td>
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<td>&quot;Concentration Area Courses&quot; are approved in conjunction with the academic committee</td>
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<tr>
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<tr>
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<tr>
<td></td>
<td><strong>Total Hours</strong></td>
<td>54</td>
</tr>
</tbody>
</table>

1 "Depth Area Courses" must be a minimum of two courses in life sciences management, entrepreneurship, finance, innovation management, marketing, or operations.
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4 "Elective Courses" may include any graduate course in the Poole College of Management; courses outside the College must be approved by the academic director of the NC State MBA.

Core Courses

All courses in the following categories are required by all MBA students:

Markets and Finance

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBA 501</td>
<td>Financial Accounting for Decision Makers</td>
<td>1</td>
</tr>
<tr>
<td>MBA 502</td>
<td>Managerial Accounting for Decision Makers</td>
<td>1</td>
</tr>
<tr>
<td>MBA 505</td>
<td>Essential Economics for Managers</td>
<td>2</td>
</tr>
<tr>
<td>MBA 520</td>
<td>Financial Management of Corporations</td>
<td>2</td>
</tr>
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</table>

Analyzing the Value Chain

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBA 506</td>
<td>Data-Driven Managerial Decisions 1</td>
<td>1</td>
</tr>
<tr>
<td>MBA 507</td>
<td>Data-Driven Managerial Decisions 2</td>
<td>1</td>
</tr>
<tr>
<td>MBA 540</td>
<td>Principles of Operations and Supply Chain Management</td>
<td>2</td>
</tr>
<tr>
<td>MBA 560</td>
<td>Marketing Management and Strategy</td>
<td>2</td>
</tr>
</tbody>
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Managing the Organization

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>MBA 510</td>
<td>Critical Thinking for Managers</td>
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<tr>
<td>MBA 530</td>
<td>Leading People</td>
<td>3</td>
</tr>
<tr>
<td>MBA 580</td>
<td>Creating Value in Organizations</td>
<td>3</td>
</tr>
<tr>
<td>MBA 590</td>
<td>Special Topics In Business Management</td>
<td>1-6</td>
</tr>
</tbody>
</table>

Part-Time Degree Requirements

Degrees earned will be distributed as: "Master of Business Administration" without focus area specifications.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBA 501</td>
<td>Financial Accounting for Decision Makers</td>
<td>1</td>
</tr>
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<td>Essential Economics for Managers</td>
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<td>Financial Management of Corporations</td>
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1 "Depth Area Courses" must be a minimum of two courses in life sciences management, entrepreneurship, finance, innovation management, marketing, or operations.
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“Elective Courses” may include any graduate course in the Poole College of Management; courses outside the College must be approved by the academic director of the NC State MBA.

Faculty

Full Professors
Steven G. Allen
Steve H. Barr
Jonathan D. Bohlmann
Marianne Bradford
Joseph F. Brazel
Jon Carr
Yuangsung Al Chen
Robert L. Clark
Robert B. Handfield
Hans Sebastian Heese
David H. Henard
Stacy W. King
Bradley Lane Kirkman
Stephen K. Markham
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Beverly B. Tyler
Mark D. Walker
Richard Simon Warr
Ira R. Weiss

Associate Professors
Turanay Caner
Bartley R. Danielsen
Julia B. Earp
Jesse Aaron Ellis
Eda Kemahlioglu-Ziya

Srinivasan Krishnamurthy
Karlyn Mitchell
Paul W. Mulvey
Jeffrey M. Pollack
William Michael Rand
Stefanie Mora Robinson
Michael A. Stanko
Jeffrey S. Stonebraker
Donald P. Warsing

Emeritus Faculty
Jon W. Bartley
David L. Baumer
Stephen N. Chapman
K. Shannon Davis
Gary W. Dickson
Cleon W. Harrell Jr.
Duncan M. Holthausen
Charles P. Jones
Stephen E. Margolis
John K. McCreery
Elizabeth A. McDermed
Julius C. Poindexter Jr.

Practice/Research/Teaching Professors
Leigh Shamblin
Business Administration (MR): Full Time

Full-Time Degree Requirements

Degrees earned will be distributed as: "Master of Business Administration" without focus area specifications.

<table>
<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
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</thead>
<tbody>
<tr>
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<td>Core Courses</td>
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<tr>
<td></td>
<td>See &quot;Core Courses&quot; listed below</td>
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<tr>
<td></td>
<td>Concentration Area Courses</td>
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<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td>&quot;Analytics / Quantitative Course&quot; is approved in conjunction with the academic committee</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Practicum Course</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>&quot;Practicum Course&quot; is approved in conjunction with the academic committee</td>
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</tr>
<tr>
<td></td>
<td>Elective Courses</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>Total Hours</td>
<td>54</td>
</tr>
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Core Courses

All courses in the following categories are required by all MBA students:

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<td>MBA 505</td>
<td>Essential Economics for Managers</td>
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<td>Financial Management of Corporations</td>
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<th>Hours</th>
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<tbody>
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<td>Data-Driven Managerial Decisions 1</td>
<td>1</td>
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<tr>
<td>MBA 507</td>
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</tr>
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</table>

Managing the Organization

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<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBA 540</td>
<td>Principles of Operations and Supply Chain Management</td>
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</tr>
<tr>
<td>MBA 560</td>
<td>Marketing Management and Strategy</td>
<td>2</td>
</tr>
</tbody>
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Elena Kulchina
Elizabeth Erin Powell
Rishika Rishika
Jared Smith
Qingqing Wu

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Leigh Shamblin

Business Administration (MR): Part Time

Part-Time Degree Requirements
Degrees earned will be distributed as: "Master of Business Administration" without focus area specifications.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Courses</td>
<td>See &quot;Core Courses&quot; listed below</td>
<td>19</td>
</tr>
<tr>
<td>Depth Area Courses</td>
<td>&quot;Depth Area Courses&quot; are approved in conjunction with the academic committee</td>
<td>6</td>
</tr>
<tr>
<td>Analytics / Quantitative Course</td>
<td>&quot;Analytics / Quantitative Course&quot; is approved in conjunction with the academic committee</td>
<td>3</td>
</tr>
<tr>
<td>Practicum Course</td>
<td>&quot;Practicum Course&quot; is approved in conjunction with the academic committee</td>
<td>3</td>
</tr>
<tr>
<td>Elective Courses</td>
<td>&quot;Elective Courses&quot; are approved in conjunction with the academic committee</td>
<td>9</td>
</tr>
</tbody>
</table>

Total Hours: 40

1 "Depth Area Courses" must be a minimum of two courses in life sciences management, entrepreneurship, finance, innovation management, marketing, or operations.
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Practice/Research/Teaching Professors

Leigh Shamblin

Business Administration (Minor)

TEXT

Faculty

Full Professors

Steven G. Allen
Steve H. Barr
Jonathan D. Bohlmann
Marianne Bradford
Joseph F. Brazel
Jon Carr
Yuang Sung Al Chen
Robert L. Clark
The Graduate Certificate in Finance is a one to two year program designed for working professionals in the Raleigh and Research Triangle community. They will obtain advanced skills in capital budgeting, managing risk, and asset valuation.

Admissions requirements
For admission requirements, please visit the admissions website (https://mba.ncsu.edu/academics/certificate-programs/admissions-2/).

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>MBA 520</td>
<td>Financial Management of Corporations</td>
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</tr>
<tr>
<td>MBA 501</td>
<td>Financial Accounting for Decision Makers</td>
<td>1</td>
</tr>
<tr>
<td>MBA 521</td>
<td>Advanced Corporate Finance</td>
<td>3</td>
</tr>
<tr>
<td>MBA 523</td>
<td>Investment Theory and Practice</td>
<td>3</td>
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<tr>
<td></td>
<td>Select one of the following:</td>
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<tr>
<td>MBA 524</td>
<td>Equity Valuation</td>
<td></td>
</tr>
<tr>
<td>MBA 525</td>
<td>Taxes and Business Strategy</td>
<td></td>
</tr>
<tr>
<td>MBA 526</td>
<td>International Finance</td>
<td></td>
</tr>
</tbody>
</table>
Marketing (Certificate)

The Graduate Certificate in Marketing is a one to two year program designed for working professionals in the Raleigh and Research Triangle community. They will obtain advanced skills in consumer behavior, marketing research, product management, innovation, and relationship management.

Admission requirements

For admission requirements, please visit the admissions website (https://mba.ncsu.edu/academics/certificate-programs/admissions-2/).

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBA 560</td>
<td>Marketing Management and Strategy</td>
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</tr>
<tr>
<td>MBA 561</td>
<td>Consumer Behavior</td>
<td>3</td>
</tr>
<tr>
<td>Select marketing elective</td>
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<tr>
<td>Select one of the following research-oriented electives:</td>
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<tr>
<td>MBA 562</td>
<td>Research Methods In Marketing</td>
<td>3</td>
</tr>
<tr>
<td>MBA 565</td>
<td>Marketing Analytics</td>
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</tr>
<tr>
<td>MBA 566</td>
<td>Digital Marketing</td>
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Select one of the following:
- MBA 562 Research Methods In Marketing
- MBA 563 Product and Brand Management
- MBA 564 Business Relationship Management
- MBA 565 Marketing Analytics
- MBA 566 Digital Marketing

Total Hours 12

Operations and Supply Chain Management (Certificate)

The Graduate Certificate in Supply Chain Management is a one to two year program working professionals in the Raleigh and Research Triangle community. They will obtain advanced skills in strategies, processes, planning and control, quality, scheduling, work design, and advanced operations techniques using a variety of managerial and quantitative models.

Admission requirements

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Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBA/MSE 576</td>
<td>Technology Entrepreneurship and Commercialization I</td>
<td>3</td>
</tr>
<tr>
<td>MBA/MSE 577</td>
<td>Technology Entrepreneurship and Commercialization II</td>
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</table>
Select two of the following:  

<table>
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<tr>
<th>Course Code</th>
<th>Course Name</th>
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</thead>
<tbody>
<tr>
<td>MBA 572</td>
<td>Venture Opportunity Analysis Analytics</td>
</tr>
<tr>
<td>MBA 578</td>
<td>Venture Launch</td>
</tr>
<tr>
<td>MBA 579</td>
<td>Entrepreneurship Clinic Practicum</td>
</tr>
</tbody>
</table>

Total Hours 12

Economics

The graduate program in economics is a joint program of the Department of Agricultural and Resource Economics in the College of Agriculture and Life Sciences and the Department of Economics in the Poole College of Management. Emphasis is placed on economic theory and quantitative economic analysis and their application to economic problems. Master’s students can choose between the terminal master’s track and the PhD-prep track. In both tracks, they may further tailor their experience by choosing to concentrate in one or multiple of the four fields: financial/macro econometrics; international trade and development; natural resource and environmental economics and economic policy. Students can also choose between engaging in a research project culminating in a thesis (the Master of Science in economics degree) and simply pursuing a coursework only option (the Master of Economics degree). The major fields of specialization for doctoral students are: agricultural economics, development and labor economics, econometrics, environmental/resource economics, international economics, macro-monetary economics and microeconomic theory and industrial organization.

Admission Requirements

Minimum background for admission for Master’s study includes intermediate microeconomics and intermediate macroeconomics, calculus I and calculus II, and one semester of statistics (econometrics courses included). For doctoral study, prerequisites are intermediate microeconomics, intermediate macroeconomics, intermediate microeconomics, intermediate macroeconomics, calculus I-III, linear algebra, and a course in mathematical statistics. GRE scores are required for doctoral applicants only.

Master’s Degree Requirements

Both the Master of Science in economics and the Master of Economics degrees require core courses in microeconomics, macroeconomics and econometrics. Each degree also carries additional elective requirements. The M.S. degree requires a thesis. Both degrees offer two tracks: a terminal master’s track and a PhD-prep track. Specific course requirements for both the Master of Science and the Master of Economics can be found on the Graduate Program in Economics website (https://poole.ncsu.edu/gradecon/academics/master-degree-programs/). Both Master’s degrees require a total of 30 credit hours. Accelerated Bachelor’s/Master’s degree programs are available for non-thesis options.

Doctoral Degree Requirements

The Ph.D. program requires a minimum of 72 hours and at least six semesters of work beyond the Bachelor’s degree. Students must pass written comprehensive examinations in microeconomics and macroeconomics. Course requirements include two semesters of econometrics and six field courses.

Student Financial Support

Fellowships, research and teaching assistantships are available and are awarded competitively on a merit basis. These fellowships and assistantships go to Ph.D. students only; there is no financial support for Master’s students. Prospective doctoral students who wish to be considered for fellowships and assistantships should apply for fall admission by January 1.

Other Relevant Information

Graduate students on financial support are provided office space or study carrels. Other students may be assigned study carrels if available. All students have access to the economics graduate student computer lab.

Degrees

- Economics (MR) (p. 565)
- Economics (MS) (p. 567)
- Economics (PhD) (p. 569)
- Economics (Minor) (p. 570)

Faculty

Full Professors

Steven G. Allen
Alvin B. Brown
Mehmet Caner
Robert L. Clark
Lee A. Craig
Paul L. Fackler
Barry K. Goodwin
David N. Hyman
Melinda Sandler Morrill
Thayer Stephen Morrill
Nicholas E. Piggott
Roderick M. Rejesus
Erin Sills
Walter N. Thurman
Roger H. von Haefen
Tomislav Vukina
Michael L. Walden
Mark Walker
Kelly D. Zering
Xiaoyong Zheng

Associate Professors

Kathryn Boys
Zachary Brown
Assistant Professors
Eric Edwards
Raymond Guiteras
Ayse Kabukcuoglu-Dur
Ilze Kalnina
Daisoon Kim
Zheng Li
Heidi Schweizer
Daniel Tregeagle

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Michele C. Marra
Elizabeth A. McDermed
Michael B. McElroy
Charles Lee Moore Sr.
Arnold W. Oltmans
Raymond B. Palmquist
Mitch Renkow
Charles D. Safley
Ronald A. Schrimper
V. Kerry Smith
Walter J. Wessels
Michael K. Wohigenant

Economics (MR)

Degree Requirements

Students may select between two of the following degree tracks: Terminal Master's Track and PhD-Prep Track.

Degrees earned will be distributed as: "Master of Economics" without track specifications.

Terminal Master's Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Core Courses</td>
<td></td>
</tr>
<tr>
<td>ECG 561</td>
<td>Applied Econometrics I</td>
<td>12</td>
</tr>
<tr>
<td>ECG 562</td>
<td>Applied Econometrics II</td>
<td></td>
</tr>
<tr>
<td>ECG 700</td>
<td>Fundamentals of Microeconomics</td>
<td></td>
</tr>
<tr>
<td>ECG 703</td>
<td>Fundamentals of Macroeconomics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elective Courses</td>
<td>12-18</td>
</tr>
<tr>
<td></td>
<td>See &quot;Elective Courses&quot; listed below</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other Electives 1</td>
<td>0-6</td>
</tr>
<tr>
<td></td>
<td>&quot;Other Electives&quot; will be determined in conjunction with the academic committee</td>
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</tr>
<tr>
<td></td>
<td>Total Hours</td>
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</tr>
</tbody>
</table>

1 Students may select any 400-level or above course offered by other departments in conjunction with the academic committee.

Elective Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Select at least four courses of the following:</td>
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<tr>
<td>ECG/MA 528</td>
<td>Options and Derivatives Pricing</td>
<td>3</td>
</tr>
<tr>
<td>MA 591</td>
<td>Special Topics</td>
<td>1-6</td>
</tr>
</tbody>
</table>
ECG/MA 766  Computational Methods in Economics and Finance  3
ECG 540  Economic Development  3
ECG 548  International Economics  3
PS 539  International Political Economy  3
ECG 515  Environmental and Resource Policy  3
ECG 715  Environmental and Resource Economics  3
FOR 519  Forest Economics  3
ECG 563  Applied Microeconometrics  3
ECG 750  Introduction to Econometric Methods  3
ECG 765  Mathematical Methods For Economics  3
ECG 590  Special Economics Topics  1-6
ARE 590  Special Topics in ARE  1-99

PhD-Prep Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td><strong>Core Courses</strong></td>
<td><strong>12</strong></td>
</tr>
<tr>
<td>ST 501</td>
<td>Fundamentals of Statistical Inference I</td>
<td></td>
</tr>
<tr>
<td>ST 502</td>
<td>Fundamentals of Statistical Inference II</td>
<td></td>
</tr>
<tr>
<td>ECG 700</td>
<td>Fundamentals of Microeconomics</td>
<td></td>
</tr>
<tr>
<td>ECG 703</td>
<td>Fundamentals of Macroeconomics</td>
<td></td>
</tr>
<tr>
<td>ECG 750</td>
<td>Introduction to Econometric Methods</td>
<td></td>
</tr>
<tr>
<td>ECG 765</td>
<td>Mathematical Methods For Economics</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Elective Courses</strong></td>
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<td><strong>Other Electives</strong></td>
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1 Students may select any 400-level or above course offered by other departments in conjunction with the academic committee.

Elective Courses

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<tr>
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<th>Title</th>
<th>Hours</th>
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<td><strong>Select at least four courses from the following:</strong></td>
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</tr>
<tr>
<td>ECG/MA 528</td>
<td>Options and Derivatives Pricing</td>
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<tr>
<td>MA 591</td>
<td>Special Topics</td>
<td>1-6</td>
</tr>
<tr>
<td>ECG/MA 766</td>
<td>Computational Methods in Economics and Finance</td>
<td>3</td>
</tr>
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<td>ECG 540</td>
<td>Economic Development</td>
<td>3</td>
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<td>ECG 548</td>
<td>International Economics</td>
<td>3</td>
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<td>PS 539</td>
<td>International Political Economy</td>
<td>3</td>
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<tr>
<td>ECG 515</td>
<td>Environmental and Resource Policy</td>
<td>3</td>
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<tr>
<td>ECG 715</td>
<td>Environmental and Resource Economics</td>
<td>3</td>
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<td>FOR 519</td>
<td>Forest Economics</td>
<td>3</td>
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<td>ECG 563</td>
<td>Applied Microeconometrics</td>
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<tr>
<td>ECG 590</td>
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</tr>
<tr>
<td>ARE 590</td>
<td>Special Topics in ARE</td>
<td>1-99</td>
</tr>
</tbody>
</table>

Faculty

Full Professors

Steven G. Allen

Associate Professors

Kathryn Boys
Zachary Brown
Umut Dur
Harrison Fell
Giuseppe Fiori
Ivan Todorov Kandilov
Karlyn Mitchell
Denis Pelletier

Assistant Professors

Eric Edwards
Raymond Guiteras
Ayse Kabukcuoglu-Dur
Ilze Kalnina
Daisoon Kim
Economics (MS)

Degree Requirements

Students may select between two of the following degree tracks: Terminal Master of Science Track and PhD-Prep Track.

Degrees earned will be distributed as: "Master of Science in Economics" without track specifications.

Terminal Master of Science Track

<table>
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<td></td>
<td>ECG 562 Applied Econometrics II</td>
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<tr>
<td></td>
<td>ECG 700 Fundamentals of Microeconomics</td>
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</tr>
<tr>
<td></td>
<td>ECG 703 Fundamentals of Macroeconomics</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Elective Courses</strong></td>
<td>12-18</td>
</tr>
<tr>
<td></td>
<td>See &quot;Elective Courses&quot; listed below</td>
<td></td>
</tr>
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</tr>
<tr>
<td></td>
<td>&quot;Other Elective Courses&quot; will be determined in conjunction with the academic committee ¹</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Thesis Research Course</strong></td>
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</tr>
<tr>
<td></td>
<td>ECG 695 Master's Thesis Research</td>
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<tr>
<td></td>
<td><strong>Total Hours</strong></td>
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</tr>
</tbody>
</table>

¹ Students can take 400-level or above courses offered by other departments determined in conjunction with the academic committee.

Elective Courses

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<td></td>
<td>ECG/MA 766 Computational Methods in Economics and Finance</td>
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</tr>
<tr>
<td></td>
<td>ECG 540 Economic Development</td>
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</tr>
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<td></td>
<td>ECG 548 International Economics</td>
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</tr>
<tr>
<td></td>
<td>PS 539 International Political Economy</td>
<td>3</td>
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<tr>
<td></td>
<td>ECG 515 Environmental and Resource Policy</td>
<td>3</td>
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<tr>
<td></td>
<td>ECG 715 Environmental and Resource Economics</td>
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<td>FOR 519 Forest Economics</td>
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<td></td>
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<td>ECG 765 Mathematical Methods For Economics</td>
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<td>ECG 590 Special Economics Topics</td>
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## PhD-Prep Track

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<tr>
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<td>ECG 703</td>
<td>Fundamentals of Macroeconomics</td>
<td></td>
</tr>
<tr>
<td>ECG 750</td>
<td>Introduction to Econometric Methods</td>
<td></td>
</tr>
<tr>
<td>ECG 765</td>
<td>Mathematical Methods For Economics</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Elective Courses</strong></td>
<td>6-12</td>
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<tr>
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<td>See &quot;Elective Courses&quot; listed below</td>
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<td><strong>Other Elective Courses</strong></td>
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<td>&quot;Other Elective Courses&quot; are determined in conjunction with the academic committee</td>
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<tr>
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<td><strong>Thesis Research Course</strong></td>
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<td>ECG 695</td>
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</table>

1. Students can take 400-level or above courses offered by other departments determined in conjunction with the academic committee.

### Elective Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tr>
<td>ECG/MA 528</td>
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<td>Special Topics</td>
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<td>Economic Development</td>
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<td>ECG 548</td>
<td>International Economics</td>
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<td>PS 539</td>
<td>International Political Economy</td>
<td>3</td>
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<td>ECG 515</td>
<td>Environmental and Resource Policy</td>
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<tr>
<td>ECG 715</td>
<td>Environmental and Resource Economics</td>
<td>3</td>
</tr>
<tr>
<td>FOR 519</td>
<td>Forest Economics</td>
<td>3</td>
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<td>ECG 563</td>
<td>Applied Microeconometrics</td>
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<td>ECG 590</td>
<td>Special Economics Topics</td>
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</tr>
<tr>
<td>ARE 590</td>
<td>Special Topics in ARE</td>
<td>1-99</td>
</tr>
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</table>

### Faculty

**Full Professors**

- Steven G. Allen
- Alvin B. Brown
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- Julianne Treme
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Edmund A. Estes
Douglas Fisher
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Thomas J. Grennes
Duncan M. Holthausen
Thomas Johnson
Charles Edward Joyner
Charles Robert Knoeber
John S. Lapp
Stephen E. Margolis
Michele C. Marra
Elizabeth A. McDermed
Michael B. McElroy
Charles Lee Moore Sr.
Arnold W. Oltmans
Raymond B. Palmquist
Mitch Renkow
Charles D. Safley
Ronald A. Schrimper
V. Kerry Smith
Walter J. Wessels
Michael K. Wohlgenant

Economics (PhD)

Degree Requirements

<table>
<thead>
<tr>
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<td>ECG 702</td>
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<td>ECG 704</td>
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<td>ECG 705</td>
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<td>ECG 751</td>
<td>Econometric Methods</td>
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<tr>
<td>ECG 752</td>
<td>Time Series Econometrics</td>
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<tr>
<td>or ECG 753</td>
<td>Microeconometrics</td>
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<td>Select six of the following courses:</td>
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<tr>
<td>ECG 706</td>
<td>Industrial Organization</td>
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<td>ECG 708</td>
<td>Advanced Microeconomic Theory</td>
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<td>ECG 709</td>
<td>Behavioral and Experimental Economics</td>
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<td>ECG 715</td>
<td>Environmental and Resource Economics</td>
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<td>ECG 716</td>
<td>Topics In Environmental and Resource Economics</td>
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<td>ECG 730</td>
<td>Labor Economics</td>
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<td>ECG 739</td>
<td>Empirical Methods for Development Economics and Applied Microeconomics</td>
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<td>ECG 740</td>
<td>Economic Growth and Development</td>
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<tr>
<td>ECG 741</td>
<td>Agricultural Production and Supply</td>
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<tr>
<td>ECG 742</td>
<td>Consumption, Demand and Market Interdependency</td>
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<tr>
<td>ECG 748</td>
<td>Theory Of International Trade</td>
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<td>ECG 749</td>
<td>Monetary Aspects Of International Trade</td>
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<td>Microeconometrics</td>
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<td>ECG 785</td>
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<td>ECG 790</td>
<td>Advanced Special Topics</td>
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<td>Additional 700-level statistics courses may be determined in conjunction with the academic committee</td>
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Dissertation Research Course

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<tbody>
<tr>
<td>ECG 895</td>
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</table>

Total Hours 72

1. Four courses must be two 2-course sequences
2. To complete the econometrics field, an ST 700 level course must be taken in addition to ECG 752 Time Series Econometrics and ECG 753 Microeconometrics.

Faculty

Full Professors

Steven G. Allen
Alvin B. Brown
Mehmet Caner
Robert L. Clark
Lee A. Craig
Paul L. Fackler
Barry K. Goodwin
David N. Hyman
Economics (Minor)

Melinda Sandler Morrill
Thayer Stephen Morrill
Nicholas E. Piggott
Roderick M. Rejesus
Erin Sills
Walter N. Thurman
Roger H. von Haefen
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Walter J. Wessels
Michael K. Wohlgenant

Economics (Minor)

Plan Requirements

MS Student Requirements

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<thead>
<tr>
<th>Code</th>
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<td>ECG 700</td>
<td>Fundamentals of Microeconomics</td>
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### PhD Student Requirements

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<td>ECG 703</td>
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<tr>
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<td>Select two additional electives in conjunction with the academic committee</td>
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<tr>
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<td>Select one 700-level elective determined in conjunction with the academic committee</td>
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<tr>
<td>Total Hours</td>
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<td><strong>12</strong></td>
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</table>

### Faculty

#### Full Professors
- Steven G. Allen
- Alvin B. Brown
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- David Joseph Flath
- Thomas J. Grennes
- Duncan M. Holthausen
- Thomas Johnson
The Jenkins Graduate School of Management, part of the North Carolina State University Poole College of Management, in partnership with the Skema Business School in Paris, France, offers a Master's degree in Management (MM) as part of the Global Luxury and Management program. The curriculum is designed to give students with a range of backgrounds a strong exposure to core business management skills while providing in-depth exposure to the global luxury industry. It was designed specifically for students who are looking to create a personal competitive advantage for today's global luxury job market.

Students in the program come from around the world and classes will be held in both the United States and France. Students are taught by international professors who are leaders in their fields. Interactions with global luxury firms will occur in the classroom, study tours and via internships.

Admission Requirements

Applicants are required to complete the standard NC State Graduate School application process. Applicant assessments will be done on an individual-by-individual basis. Concurrent acceptance activities will be at both Skema and NC State. GMAT or GRE scores are not required of applicants. International applicants must complete the TOEFL or IELTS. U.S. applicants will need a valid U.S. passport and visa for traveling to France. Upon acceptance to the program, students can apply for a visa. Applicants should also be prepared for additional program costs (airfare to and from Europe and travels within Europe, lodging and meals while in France).

Master's Degree Requirements

The MM degree requires 33 credit hours and can be completed in one year. It does not require courses in subject areas such as economics and operations management which are required in the MBA. This one-year program awards two master degrees: (1) a Master of Management degree with a concentration in Global Luxury from NC State University and (2) a Master of Science in Global Luxury Management degree from Skema Business School.

Other Relevant Information

After two years of full-time work experience, qualified students who earn the dual master degree in Management are eligible to apply to the NC State MBA program. This would require an additional 30 hours of study. Students must complete a separate application to the MBA program.

Degrees

- Management (MR) (p. 572)
- Management (MR): Global Luxury and Management Concentration (p. 573)

Full Professors

Steven G. Allen
David H. Henard

Associate Professors

John Kuzenski

Practice/Research/Teaching Professors

Genessa Devine
Cara Fratto
Donnie Hale
Kristie McGowan
Bradley Ashbaugh
Patrice Nealon

Management (MR)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Required Courses</td>
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<tr>
<td></td>
<td>Elective Courses</td>
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</table>

"Elective Courses" are determined in conjunction with the academic committee to meet the 30 total credit hours.

Full Professors

Steven G. Allen
Management (MR): Global Luxury and Management Concentration

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td></td>
<td><strong>NC State Core Courses</strong></td>
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<td></td>
<td>See “NC State Core Courses” listed below</td>
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<td></td>
<td><strong>SKEMA (Paris) Business School Courses</strong></td>
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NC State Core Courses

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>MBA 564</td>
<td>Business Relationship Management</td>
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<tr>
<td>BUS 590</td>
<td>Special Topics In Business Management (Analytic Decision Making)</td>
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<td>BUS 590</td>
<td>Special Topics In Business Management (Business and Legal Ethics)</td>
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<tr>
<td>BUS 590</td>
<td>Special Topics In Business Management (Global Luxury Digital Marketing and Social Media)</td>
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<tr>
<td>BUS 590</td>
<td>Special Topics In Business Management (Global Luxury Leadership, Communication and Negotiation)</td>
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<tr>
<td>BUS 590</td>
<td>Special Topics In Business Management (Luxury Professional Development)</td>
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<tr>
<td>BUS 590</td>
<td>Special Topics In Business Management (Luxury Consumer Seminar)</td>
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<tr>
<td>BUS 590</td>
<td>Special Topics In Business Management (Luxury Marketing Strategy)</td>
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</tr>
<tr>
<td>BUS 590</td>
<td>Special Topics In Business Management (Supply Management)</td>
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<tr>
<td>BUS 590</td>
<td>Special Topics In Business Management (Luxury Research and Thesis Writing)</td>
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</tr>
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</table>

Wilson College of Textiles

Programs

- Fiber & Polymer Science (p. 574)
- Textile Chemistry (p. 578)
- Textile Engineering (p. 581)
- Textile Technology Management (p. 585)
- Textiles (p. 589)

Degree Programs

Master of Science (MS)

- Textile Chemistry (MS) (p. 579)
- Textile Engineering (MS) (p. 583)

Doctor of Philosophy (PhD)

- Fiber and Polymer Science (PhD) (p. 576)
- Textile Technology Management (PhD) (p. 587)

Minors

- Textile and Apparel Management (Minor) (p. 593)
- Textile Chemistry (Minor) (p. 580)
- Textile Engineering (Minor) (p. 584)

Certificates

- Consumer Textile Product Design and Development (Certificate) (p. 594)
- Nonwoven Science and Technology (Certificate) (p. 595)
- Textile Brand Management and Marketing (Certificate) (p. 595)
- Textile Supply Chain Management (Certificate) (p. 585)
Fiber & Polymer Science

This multidisciplinary program brings together the disciplines of mathematics, chemistry, physics, and engineering for the development of the independent scholars versed in the fields of polymer, fiber, and textile science. The program is coordinated by the Wilson College of Textiles and leads to the degree of Doctor of Philosophy.

The polymer, fiber, and textile sciences are concerned with polymeric materials and fibers produced from them; textile assemblies in one, two, and three-dimensional forms; and the chemistry of dyeing, finishing, and other wet processes. This broad field of study permits a wide range of useful concentrations. The candidate is expected to concentrate in one area and to acquire a reasonable perspective in other relevant areas. Generally, a student specializes in the areas of (1) polymer chemistry and synthesis, (2) fiber and polymer physics and physical chemistry, (3) the production, processing and properties of fibrous materials, or (4) chemistry of dyes, finishes, and their processes. The student’s research is usually based within one of these areas or another suitable one.

Admission Requirements

Students with a Master of Science (M.S.) degree in a related field may apply to the Fiber and Polymer Science program. Typically the minimum acceptable overall grade point average (GPA) is a 3.0 out of 4.0, based on most current U.S. universities. Students without a master’s degree may also apply if met the following conditions:

1. the undergraduate degree from a well-known and robust research active program with a cumulative GPA of 3.5 or above;
2. strong recommendation letters from faculty adviser(s) indicating research experience or suggesting research potential; and
3. strong publication record/experience or extensive industry experience in related industry/profession.

Applicants should plan to take the GRE or GMAT examination, which is required for all applicants. The GRE/GMAT scores should be sent to NC State University electronically and be available online.

For International students, TOEFL or IELTS is required for the application. Students must rank in a competitive percentile in order to be considered for acceptance into NC State University.

- TOEFL: A total score of 80+ on IBT. Minimum scores of 18 points for each section; or
- IELTS: An overall band score of 6.5+. Minimum scores of 6.5 points for each section

Scholarships and Assistantships

Competitive scholarships and assistantships from the program as well as the University are available to incoming new students. All incoming students will be considered for the funding opportunities. No separate application for assistantships/scholarships is needed.

Degrees

- Fiber and Polymer Science (PhD) (p. 576)
Richard Spontak
Alan E. Tonelli
Richard A. Venditti
Yingjiao Xu
Xiangwu Zhang

Associate Professors
Katherine Emma Annett-Hitchcock
Pamela Banks-Lee
Kristin Anne Barletta
Philip Bradford
Emiel DenHartog
Wei Gao
Helmut H. Hergeth
George Lawrence Hodge
Jesse Stephen Jur
Richard Kotek
Wendy E. Krause
Jerome Lavelle
Shuang Lim
Lucian Lucia
Kavita Mathur
Lokendra Pal
Lisa Parrillo-Chapman
Sonja Salmon
Minyoung Suh
Nelson Vinueza

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Eunkyoung Shim
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Rong Yin
Mengmeng Zhu

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Harold B. Hopfenberg
Samuel Clyde Winchester Jr
Stephen Michielsen
Gary N. Mock
Mansour H. Mohamed
William Oxenham
Nancy Powell
Suzanne Townsend Purrington
William C. Stuckey Jr
Carl B. Smith
Gary W. Smith
Moon Won Suh
Michael Herbert Theil
Charles Tomasono
Carl F. Zorowski

Adjunct Faculty
Genevieve Garland
Abhay Sham Jojode
Behnam Pourdeyhimi
Orlando Jose Rojas
Antony Williams
Fiber and Polymer Science (PhD)

Degree Requirements

The Ph.D. degree in Fiber and Polymer Science symbolizes the ability of the recipient to undertake original and scholarly work at the highest levels without supervision. The degree is, therefore, not granted simply upon the completion of a stated amount of course work but rather upon demonstration by the student of a comprehensive knowledge base and high attainment in scholarship. The student demonstrates this ability by passing a series of courses, creating a written critical literature review and original research proposal, defending an oral preliminary examination, writing a dissertation reporting the results of an original investigation, and making a final oral defense of the research before the student’s advisory committee and other interested members of the University community.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>FPS 801</td>
<td>Seminar</td>
<td>1</td>
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<tr>
<td>FPS 770</td>
<td>Advances in Polymer Science</td>
<td>2</td>
</tr>
<tr>
<td>TMS 762</td>
<td>Physical Properties Of Fiber Forming Polymers, Fibers and Fibrous Structures</td>
<td>2</td>
</tr>
<tr>
<td>Select two additional Courses from the following:</td>
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<td></td>
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<tr>
<td>Polymer Science</td>
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<td></td>
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<tr>
<td>TC 771</td>
<td>Polymer Microstructures, Conformations and Properties</td>
<td></td>
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<tr>
<td>Fiber Science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TC 704</td>
<td>Fiber Formation--Theory and Practice</td>
<td></td>
</tr>
<tr>
<td>TMS 761</td>
<td>Mechanical and Rheological Properties Of Fibrous Material</td>
<td></td>
</tr>
<tr>
<td>TMS 763</td>
<td>Characterization Of Structure Of Fiber Forming Polymers</td>
<td></td>
</tr>
<tr>
<td>Coloration and Wet Processing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TC 706</td>
<td>Color Science</td>
<td></td>
</tr>
<tr>
<td>&amp; TC 707</td>
<td>Color Laboratory</td>
<td></td>
</tr>
<tr>
<td>TC/FPS 710</td>
<td>Science of Dye Chemistry, Dyeing, Printing and Finishing</td>
<td></td>
</tr>
<tr>
<td>TC 720</td>
<td>Chemistry Of Dyes and Color</td>
<td></td>
</tr>
<tr>
<td>Formation and Properties of Textile Products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FPS 750</td>
<td>Advances in Fabric Formation, Structure, and Properties</td>
<td></td>
</tr>
</tbody>
</table>

Additional Courses 58

"Elective Courses" that will be applied to reach 72 credit hours will be determined in conjunction with the academic committee

Total Hours 72

1 All students must take two (2) semesters of FPS 801 Seminar.
2 Every student must obtain a grade of B or better in each of the four qualifying courses chosen.

Additional Requirements

- A minimum of 72 credit hours is required of students entering the program with a B.S. degree, or a minimum of 54 credit hours beyond the M.S. degree is required. (Students, who enter the Ph.D. program directly upon completion of an M.S. at NC State, may be allowed credit for up to 30 hours of their M.S. and thus would require 42 additional credit hours to complete the Ph.D.)
- Most of these credit hours are expected to be research credits (FPS 893 Doctoral Supervised Research or FPS 895 Doctoral Dissertation Research).
- Following successful course completion, the student needs to pass the defense of a research proposal to obtain the candidacy for the Ph.D degree.
- The final examination is an oral exam where the student presents and defends her/his research procedures, results and conclusions. The presentation will be made to an examining committee consisting of the student’s advisory committee and is open to interested faculty, staff and students. After the presentation the student will be orally examined by the examining committee. The final oral examination can be scheduled once all coursework requirements have been fulfilled and the committee is satisfied that the dissertation is complete, but not earlier than one semester after admission to candidacy.
- The anticipated time for completion of the Ph.D. program is four years for a student entering from a B.S. degree and three years for entry from an M.S. degree. The minimum time required (in exceptional cases) is two years beyond entry if the student obtained an M.S. degree from NC State.

Faculty

Full Professors

Harald Ade
Charles M. Balik
Roger L. Barker
Keith R. Beck
Carl L. Bumgardner
Timothy Clapp
Ahmed Mohamed El-Shafei
Peter Fedkiw
Harold S. Freeman
Jan Genzer
A. Blanton Godfrey
Maureen Grasso
David Hinks
Cynthia L. Istook
Saad A. Khan
Tushar K. Ghosh
Russell E. Gorga
Christopher B. Gorman
Peter J. Hauser  
Samuel Mack Hudson  
Warren J. Jasper  
Jeffrey Allen Joines  
Martin William King  
Traci Ann May Lamar  
Karen Leonas  
Trevor J. Little  
Marian G. McCord  
Roger Narayan  
Melissa Pasquinelli  
Behnam Pourdeyhimi  
Jon Paul Rust  
Abdel-fattah Mohamed Seyam  
Renzo Shamey  
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Richard A. Venditti  
Yingjiao Xu  
Xiangwu Zhang

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Jesse Stephen Jur  
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Shuang Lim  
Lucian Lucia

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Raymond Earl Fornes  
Perry L. Grady  
Bhupender S. Gupta  
Harold B. Hopfenberg  
Samuel Clyde Winchester Jr  
Stephen Michielsen  
Gary N. Mock  
Mansour H. Mohamed  
William Oxenham
M.S. TC Option B (Non-Thesis Degree) Program Requirements

MS TC Option B (Non-Thesis) requires a minimum of 32 credit hours, with a minimum of 24 credit hours (8 courses) meeting the following requirements:

- At least 12 credit hours of courses with substantial chemistry content, mostly CH or TC, or from the approved TC offerings table. Substitutions must be approved by the Director of Graduate Programs;
- A minimum of 15 credit hours of courses that are offered by the TECS Department, which may have the following prefixes: TC (PCC), TE, TMS, NW, TT, FPS, and TTM. Note: not all courses with these prefixes are offered by the TECS Department;
- Two semesters of TC601 (Graduate Seminar) are required;
- At least six credit hours of project-related work in textile chemistry at the 600 level or above, such as TC 630 (Independent Study) or an internship, which will be advised by and evaluated by at least one Graduate Faculty Member in Textile Chemistry.

Degrees

- Textile Chemistry (MS) (p. 579)
- Textile Chemistry (Minor) (p. 580)

Faculty

Full Professors

Roger L. Barker
Harold S. Freeman
Tushar Ghosh
David Hinks
Ahmed Mohamed El-Shafei
Russell E. Gorga
Peter J Hauser
Samuel Mack Hudson
Warren J Jasper
Jeffrey Allen Joines
Martin William King
Marian G McCord
Melissa Anne Pasquinelli
Behnam Pourdeyhimi
Jon Paul Rust
Renzo Shamey
Richard J Spontak
Alan E Tonelli
Xiangwu Zhang
Adjunct Faculty

Behnam Pourdeyhimi

Textile Chemistry (MS)

Degree Requirements

<table>
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<tr>
<th>Code</th>
<th>Core Courses 1</th>
<th>Title</th>
<th>Hours</th>
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<tr>
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<td>Select minimum of five courses from the following:</td>
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<tr>
<td>TC 530</td>
<td>The Chemistry Of Textile Auxiliaries</td>
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<tr>
<td>TC 561</td>
<td>Organic Chemistry Of Polymers</td>
<td></td>
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<td>TC 565</td>
<td>Polymer Applications and Technology</td>
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<tr>
<td>TC 589</td>
<td>Special Studies In Textile Engineering and Science</td>
<td></td>
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<tr>
<td>TC 704</td>
<td>Fiber Formation--Theory and Practice</td>
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<td></td>
</tr>
<tr>
<td>TC 705</td>
<td>Theory Of Dyeing</td>
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<tr>
<td>TC 706</td>
<td>Color Science</td>
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<td></td>
</tr>
<tr>
<td>TC 707</td>
<td>Color Laboratory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TC 710</td>
<td>Science of Dye Chemistry, Dyeing, Printing and Finishing</td>
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<tr>
<td>TC 720</td>
<td>Chemistry Of Dyes and Color</td>
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<tr>
<td>TC 771</td>
<td>Polymer Microstructures, Conformations and Properties</td>
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<td>TC 791</td>
<td>Special Topics In Textile Science</td>
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<td>TC 792</td>
<td>Special Topics In Fiber Science</td>
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<tr>
<td>TMS 761</td>
<td>Mechanical and Rheological Properties Of Fibrous Material</td>
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<td>TMS 762</td>
<td>Physical Properties Of Fiber Forming Polymers, Fibers and Fibrous Structures</td>
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<td>TMS 763</td>
<td>Characterization Of Structure Of Fiber Forming Polymers</td>
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<tr>
<td>FPS 710</td>
<td>Science of Dye Chemistry, Dyeing, Printing and Finishing</td>
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<tr>
<td>FPS 750</td>
<td>Advances in Fabric Formation, Structure, and Properties</td>
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</tr>
<tr>
<td>FPS 770</td>
<td>Advances in Polymer Science</td>
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</tbody>
</table>

Chemistry Content Courses 1

Select minimum of four courses from the following:

- Any graded (non-research) TC course at the 500 level or higher
- Any graded (non-research) CH course at the 500 level or higher
- TT/NW 503 Materials, Polymers, and Fibers used in Nonwovens
- TE/PY 570 Polymer Physics
- TMS 762 Physical Properties Of Fiber Forming Polymers, Fibers and Fibrous Structures
- TMS/MSE 763 Characterization Of Structure Of Fiber Forming Polymers
- MSE/CHE 761 Polymer Blends and Alloys
- CHE/BEC 562 Fundamentals of Bio-Nanotechnology

Additional Requirements on Research, Independent Studies and Seminar

<table>
<thead>
<tr>
<th>Seminar Course</th>
<th>Hours</th>
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<tbody>
<tr>
<td>TC 601 Seminar 2</td>
<td>8</td>
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<tr>
<td>Option A: Thesis 3</td>
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</table>
TC 630 Independent Study
TC 693 Master's Supervised Research
TC 695 Master's Thesis Research
TC 696 Summer Thesis Research

**Option B: Non-Thesis**

TC 630 Independent Study

**Total Hours:** 30

1. A total of 8 courses (24 credits of graded course work), meeting criteria #1 and #2 below, may count towards both criteria. Additional courses must be of the graduate level (500-level or above) and be relevant to the field of study.

2. 2 semesters of TC 601 Seminar required (2 credits).

3. At least 6 credits of research or independent study courses, the first 6 credits are always recommended to be TC 630 Independent Study.

4. TC 630 Independent Study must be repeated to meet 6 units.

**Faculty**

**Full Professors**
Roger L. Barker
Harold S. Freeman
Tushar Ghosh
David Hinks
Ahmed Mohamed El-Shafei
Russell E. Gorga
Peter J Hauser
Samuel Mack Hudson
Warren J Jasper
Jeffrey Allen Joines
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Bhupender S. Gupta
Gary N. Mock
Mansour H. Mohamed
Carl B. Smith
Michael Herbert Theil
Charles Tomasino

**Adjunct Faculty**
Behnam Pourdeyhimi

**Textile Chemistry (Minor)**
Plan Requirements
• 9 (MS student) or 12 (PhD student) credit hours

Faculty

Full Professors
Roger L. Barker
Harold S. Freeman
Tushar Ghosh
David Hinks
Ahmed Mohamed El-Shafei
Russell E. Gorga
Peter J Hauser
Samuel Mack Hudson
Warren J Jasper
Jeffrey Allen Joines
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Jesse Jur
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Mansour H. Mohamed
Carl B. Smith
Michael Herbert Theil
Charles Tomasino

Adjunct Faculty
Behnam Pourdeyhimi

Textile Engineering

Degree Requirements Master of Science in Textile Chemistry (MS/TE)
The Masters of Science in Textile Engineering (MS TE) has two options, a thesis option (Option A) and a non-thesis option (Option B).

M.S. TE Option A (Thesis Degree) Program Requirements
MS TE Option A (Thesis) requires a minimum of 32 credit hours, with a minimum of 24 credit hours (8 courses) meeting the following requirements:
• At least 12 credit hours of courses with substantial engineering content, including courses with TE and
TMSS prefixes. Substitutions must be approved by the Director of Graduate Programs;

- A minimum of 15 credit hours of courses that are offered by the TECS Department, which may have the following prefixes: TC (PCC), TE, TMS, NW, TT, FPS, and TTM. Note: not all courses with these prefixes are offered by the TECS Department;
- Two semesters of TE601 (Graduate Seminar) are required;
- For the thesis a minimum of six hours of thesis related research is required (TE 695, TE693 or TE693).

Master’s Thesis. The Master’s thesis should be a research exercise that necessitates expertise at the M.S. level and is concentrated in the textile engineering area on a well-defined topic that has a restricted scope.

M.S. TE Option B (Non-Thesis Degree)

Program Requirements

MS TE Option B (Non-Thesis) requires a minimum of 32 credit hours, with a minimum of 24 credit hours (8 courses) meeting the following requirements:

- At least 12 credit hours of courses with substantial engineering content, including courses with TE and TMSS prefixes. Substitutions must be approved by the Director of Graduate Programs;
- A minimum of 15 credit hours of courses that are offered by the TECS Department, which may have the following prefixes: TC (PCC), TE, TMS, NW, TT, FPS, and TTM. Note: not all courses with these prefixes are offered by the TECS Department;
- Two semesters of TE601 (Graduate Seminar) are required;
- At least six credit hours of project-related work in textile engineering at the 600 level or above, such as TE 630 (Independent Study) or an internship, which will be advised by and evaluated by at least one Graduate Faculty Member in Textile Engineering.

Degrees

- Textile Engineering (MS) (p. 583)
- Textile Engineering (Minor) (p. 584)
- Textile Supply Chain Management (Certificate) (p. 585)

Faculty

Full Professors

Roger L. Barker
Ahmed El-Shafei
Harold S. Freeman
David Hinks
Tushar K. Ghosh
Russell E. Gorga
Peter J Hauser
Samuel Mack Hudson
Warren J. Jasper
Jeffrey Allen Joines

Martin William King
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Xiaomeng Fang
Ericka Ford
Wei Gao
Jessica Gluck
Bryan Ormand
Eunkyoung Shim
Mengmeng Zhu

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Raymond Earl Fornes
Hechmi Hamouda
Benoit Maze
Textile Engineering (MS)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>TE 505</td>
<td>Textile Systems and Control</td>
<td></td>
</tr>
<tr>
<td>TE 533</td>
<td>Lean Six Sigma Quality</td>
<td></td>
</tr>
<tr>
<td>TE 540</td>
<td>Textile Information Systems Design</td>
<td></td>
</tr>
<tr>
<td>TE 550</td>
<td>Clothing Comfort and Personal Protection Science</td>
<td></td>
</tr>
<tr>
<td>TE 551</td>
<td>Human Physiology for Clothing and Wearables</td>
<td></td>
</tr>
<tr>
<td>TE 562</td>
<td>Simulation Modeling</td>
<td></td>
</tr>
<tr>
<td>TE 565</td>
<td>Textile Composites</td>
<td></td>
</tr>
<tr>
<td>TE 566</td>
<td>Polymeric Biomaterials Engineering</td>
<td></td>
</tr>
<tr>
<td>TE 570</td>
<td>Polymer Physics</td>
<td></td>
</tr>
<tr>
<td>TE 589</td>
<td>Special Studies In Textile Engineering and Science</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>Any</td>
<td>Any graded (non-research) TC course at the 500 level or higher</td>
<td>12</td>
</tr>
<tr>
<td>TT/NW 503</td>
<td>Materials, Polymers, and Fibers used in Nonwovens</td>
<td></td>
</tr>
<tr>
<td>TE/PY 570</td>
<td>Polymer Physics</td>
<td></td>
</tr>
<tr>
<td>TMS 762</td>
<td>Physical Properties Of Fiber Forming Polymers, Fibers and Fibrous Structures</td>
<td></td>
</tr>
<tr>
<td>TMS/MSE 763</td>
<td>Characterization Of Structure Of Fiber Forming Polymers</td>
<td></td>
</tr>
<tr>
<td>MSE/CHE 761</td>
<td>Polymer Blends and Alloys</td>
<td></td>
</tr>
<tr>
<td>CHE/BEC 562</td>
<td>Fundamentals of Bio-Nanotechnology</td>
<td></td>
</tr>
</tbody>
</table>

Additional Requirements on Research, Independent Studies and Seminar 8

Seminar Course
TC 601 Seminar 2

Option A: Thesis 3
TC 630 Independent Study
TC 693 Master's Supervised Research
TC 695 Master's Thesis Research
TC 696 Summer Thesis Research

Option B: Non-Thesis
TC 630 Independent Study 4

Total Hours: 30

Faculty

Full Professors
Roger L. Barker
Ahmed El-Shafei
Harold S. Freeman
David Hinks
Tushar K. Ghosh
Russell E. Gorga
Peter J Hauser
Samuel Mack Hudson
Warren J. Jasper
Jeffrey Allen Joines
Martin William King
Marian G. McCord
Behnam Pourdeyhimi
Jon Paul Rust
Renzio Shamey
Richard J. Spontak
Alan E. Tonelli
Xiangwu Zhang

Pamela Banks-Lee

Associate Professors
Textile Engineering (Minor)

Plan Requirements
- 9 (MS student) or 12 (PhD student) credit hours

Faculty
Full Professors
Roger L. Barker
Ahmed El-Shafei
Harold S. Freeman
David Hinks
Tushar K. Ghosh
Russell E. Gorga
Peter J Hauser
Samuel Mack Hudson
Warren J. Jasper
Jeffrey Allen Joines
Martin William King
Marian G. McCord
Behnam Pourdeyhimi
Jon Paul Rust
Renzo Shamey
Richard J. Spontak
Alan E. Tonelli
Xiangwu Zhang

Associate Professors
Pamela Banks-Lee
Philip Bradford
Emiel DenHartog
George Lawrence Hodge
Jesse Jur
Richard Kotek
Wendy E. Krause
Jerome Lavelle
Sonja Salmon

Assistant Professors
Januka Budhathoki-Uprety
Xiaomeng Fang
Ericka Ford
Wei Gao
Jessica Gluck
Bryan Ormand
Eunkyoung Shim
Mengmeng Zhu

Practice/Research/Teaching Professors
Raymond Earl Fornes
Hechmi Hamouda
Benoit Maze

Emeritus Faculty
Robert A. Barnhardt
Robert Alan Donaldson
Aly H. El-Shiekh
Raymond Earl Fornes
Perry L. Grady
Bhupender S. Gupta
Gary N. Mock
Mansour H. Mohamed
William Oxenham
Stephen Dean Roberts
Carl B. Smith
Moon Won Suh
Michael Herbert Theil
Admission

Applicants must meet one of the 3 following requirements:

• Be a graduate of an accredited four-year college or university, and have a GPA of at least 3.0 on a 4-point scale in their last 60 credit hours of undergraduate study;
• Be a degree student in good standing in a NC State University graduate program; and
• Have a Master’s degree.

Provisional Admission

Applicants who do not meet the GPA requirements may be admitted provisionally based on past work experiences as a professional in textiles or a textile related field. Supporting documentation of professional experience in textiles should be submitted for provisional admission. Students who are admitted provisionally must earn at least a “B” average in the first three courses of the certificate program in order obtain full admission into the certificate program.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Required Courses</td>
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</tr>
<tr>
<td>TTM 501</td>
<td>Textile Enterprise Integration</td>
<td>3</td>
</tr>
<tr>
<td>TTM 761</td>
<td>Supply Chain Management and Information Technology</td>
<td>3</td>
</tr>
<tr>
<td>TE 533</td>
<td>Lean Six Sigma Quality</td>
<td>3</td>
</tr>
<tr>
<td>or TE 540</td>
<td>Textile Information Systems Design</td>
<td></td>
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<tr>
<td>Select two of the following advanced courses:</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>TTM 530</td>
<td>Textile Quality and Process Control</td>
<td></td>
</tr>
<tr>
<td>TTM 583</td>
<td>Strategic Planning for Textile Firms</td>
<td></td>
</tr>
<tr>
<td>TTM 588</td>
<td>Global Perspectives in Textiles Supply Chain</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Management (USA)</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 15

1 either or both - spare will be used as an "advanced course"

Textile Technology Management

The Ph.D. in Textile Technology Management program is designed to educate students for research and management careers in textile technology management in the fiber, textile, apparel, retail and related industries complex, as well as for positions in government and academe.

Numerous competitive challenges are facing the global textile complex. There is a need for industry and government leaders who can provide knowledge of products, processes and business strategies to effectively position companies to compete in this global marketplace. The Ph.D. in Textile Technology Management program is designed to educate students for research and management careers in textile technology management in the fiber, textile, apparel, retail and related industries complex, as well as for positions in government and academe.

The graduates of this program are expected to play several roles in industry, government, and other institutions, including:

1. Carrying out research on issues that relate to the technologies of design, characterization, and manufacture of fibers and fibrous products, management of production and sourcing activities,
marketing and distribution of products, international trade, and information requirements. The plethora of raw materials and product specific technologies extant in the industry coupled with the rapid rate at which these technologies are changing challenge students in the program to be innovative in approaches to product development, processes, and strategic business practices. Graduates assume positions in the industry with prime responsibilities for developing policy alternatives for strategic and long range planning.

2. Contributing to the teaching and research in institutions concerned with fiber, textile, apparel, and retail programs.

3. Developing policies at the highest level where broad technical and managerial expertise is required to ensure proper decision-making.

The educational objectives of the TTM Ph.D. program are two-fold:

1. To prepare managers for the research and technological enterprises within the fiber, textile, apparel, retail and related industries. To achieve this objective, the programs of study will be designed for each student to acquire and integrate knowledge of the materials and technologies used in the industrial complex by applying those quantitative, qualitative, and analytical techniques of management that would be most useful for their career goals.

2. To prepare graduates to be faculty members in the numerous international colleges and universities.

Admission Requirements

Students with a Master of Science (M.S.) degree in a related field may apply to the Textile Technology Management program. Typically the minimum acceptable overall grade point average (GPA) is a 3.0 out of 4.0, based on most current U.S. universities. Students without a master's degree may also apply if met the following conditions:

1. the undergraduate degree from a well-known and robust research active program with a cumulative GPA of 3.5 or above;
2. strong recommendation letters from faculty adviser(s) indicating research experience or suggesting research potential; and
3. strong publication record/experience or extensive industry experience in related industry/profession.

Applicants should plan to take the GRE or GMAT examination, which is required for all applicants. The GRE/GMAT scores should be sent to NC State University electronically and be available online.

For International students, TOEFL or IELTS is required for the application. Students must rank in a competitive percentile in order to be considered for acceptance into NC State University and our department.

- TOEFL: A total score of 80+ on IBT. Minimum scores of 18 points for each section; or
- IELTS: An overall band score of 6.5+. Minimum scores of 6.5 points for each section

Scholarships and Assistantships

Competitive scholarships and assistantships from the program as well as the University are available to incoming new students. All incoming students will be considered for the funding opportunities. No separate application for assistantships/scholarships is needed.

Degrees

- Textile Technology Management (PhD) (p. 587)

Full Professors

Roger Barker
Keith Beck
Timothy Clapp
Ahmed Mohamed El-Shafei
Shu-Cherng Fang
Harold Freeman
Tushar Ghosh
A. Blanton Godfrey
Russell Gorga
Maureen Grasso
Robert Handfield
Peter Hauser
David Hinks
Cynthia Istook
Warren Jasper
Byoungho Jin
Jeffrey Joines
Martin King
Russell King
Traci Lamar
Karen Leonas
Trevor Little
Marquerite Moore
Melissa Pasquinelli
Behnam Pourdeyhimi
Michael Rappa
Jon Rust
Abdel-fattah Mohamed Seyam
Renzl Shamey
Yingjiao Xu
**Associate Professors**

Katherine Emma Annett-Hitchcock  
Pamela Banks-Lee  
Kristin Barletta  
Philip Bradford  
Emiel DenHartog  
Wei Gao  
Helmut Hergeth  
George Hodge  
Richard Kotek  
Wendy Krause  
Jerome Lavelle  
Lisa Parrillo-Chapman  
Lori Rothenberg  
Sonja Salmon  
Minyoung Suh  
Andre West  

---

**Assistant Professors**

Xiaomeng Fang  
Ericka Ford  
Jessica Gluck  
Delisia Matthews  
Robert Ormond  
Jane Porterfield  
Elizabeth Powell  
Eunkyoung Shim  
Januka Budhathoki Uprety  
Jamie Woodbridge  
Rong Yin  
Mengmeng Zhu  

---

**Emeritus Faculty**

Robert Barnhardt  
Subhash Batra  
Stephen Chapman  
Robert Donaldson  
Aly El-Shiekh  
Perry Grady  
Bhupender Gupta  
Thom Hodgson  
Duncan Holthausen  
Stephen Margolis  
John McCreery  
Stephen Michielsen  
Gary Mock  
Mansour Mohamed  
William Oxenham  
Nancy Powell  
Carl Smith  
Gary Smith  
Moon Won Suh  
Charles Tomasino  
James Wilson  
Samuel Winchester  

---

**Adjunct Faculty**

Genevieve Garland  
Abhay Sham Joijode  
Samuel Moore  
Behnam Pourdeyhimi  
Antony J. Williams  
Julie Ann Willoughby  
Bong-Yeol Yeom  

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**Textile Technology Management (PhD)**
Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>TTM 710</td>
<td>Textile Technology Management</td>
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<tr>
<td>TTM 785</td>
<td>Doctoral Research Methods</td>
<td></td>
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<tr>
<td>TTM 750</td>
<td>Advances in Fabric Formation, Structure, and Properties</td>
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</tr>
<tr>
<td>TTM 731</td>
<td>Decision Models and Applications in Textile and Apparel Management</td>
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Seminar Courses

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<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>TTM 801</td>
<td>Seminar</td>
<td>2</td>
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Additional Courses

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<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
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<td>&quot;Additional Courses&quot; are approved in conjunction with the academic committee</td>
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Elective Courses

<table>
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<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&quot;Elective Courses&quot; that will be applied to reach 72 credit hours will be determined in conjunction with the academic committee</td>
<td>52</td>
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</table>

Total Hours

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>72</td>
</tr>
</tbody>
</table>

1 All students must complete two (2) semesters of TTM 801 Seminar (which may be waived for students who have taken TC 601 Seminar, TE 601 Seminar, or TT 601 Seminar during their master's program at NC State).

2 Additionally, all students need to take a minimum of two (2) additional courses, which should be selected with input from the advisory committee and can be part of an "official minor", which will require approval from the Minor Director of Graduate Programs, or can be courses chosen to provide a better foundation for the research work.

Additional Requirements

- A minimum of 72 credit hours is required of students entering the program with a B.S. degree, or a minimum of 54 credit hours beyond the M.S. degree is required. (Students, who enter the Ph.D. program directly upon completion of an M.S. at NC State, may be allowed credit for up to 30 hours of their M.S. and thus would require 42 additional credit hours to complete the Ph.D.) Most of these credit hours are expected to be research credits (TTM 893 Doctoral Supervised Research or TTM 895 Doctoral Dissertation Research).
- Following successful course completion, the student needs to pass the defense of a research proposal to obtain the candidacy for the Ph.D. degree.
- The final examination is an oral exam where the student presents and defends her/his research procedures, results and conclusions. The presentation will be made to an examining committee consisting of the student’s advisory committee and is open to interested faculty, staff and students. After the presentation the student will be orally examined by the examining committee. The final oral examination can be scheduled once all coursework requirements have been fulfilled and the committee is satisfied that the dissertation is complete, but not earlier than one semester after admission to candidacy.
- The anticipated time for completion of the Ph.D. program is four years for a student entering from a B.S. degree and three years for entry from an M.S. degree. The minimum time required (in exceptional cases) is two years beyond entry if the student obtained an M.S. degree from NC State.

Full Professors

Roger Barker
Keith Beck
Timothy Clapp
Ahmed Mohamed El-Shafei
Shu-Cherng Fang
Harold Freeman
Tushar Ghosh
A. Blanton Godfrey
Russell Gorga
Maureen Grasso
Robert Handfield
Peter Hauser
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Byoungho Jin
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Trevor Little
Marquerite Moore
Melissa Pasquinelli
Behnam Pourdeyhimi
Michael Rappa
Jon Rust
Abdel-fattah Mohamed Seyam
Renzo Shamey
Yingjiao Xu

Associate Professors

Katherine Emma Annett-Hitchcock
Pamela Banks-Lee
Kristin Barietta
Textiles

NC State’s College of Textiles, and the Department of Textile and Apparel, Technology and Management (TATM), prepares future leaders for the textile, apparel, home/furniture, fashion and retail industries. Based in Raleigh, North Carolina, undergraduate and graduate programs (Fashion and Textile Management; Fashion and Textile Design) incorporate global marketplace dynamics with a strategic management focus. Our graduates incorporate “art/design” + “science/technology” + “management” concepts in creative problem-solving. Our program
is equipped with access to and experiences utilizing the latest industry technologies. The majority of the students have an enriching and intensive study abroad experience. Our program faculty works closely with industry partners, including the Department’s 24-member Industry Advisory Board, to develop academic and experiential “real world” learning experiences. Student internships combined with a global alumni network provide an additional “value-added” experience, with our students prepared to make an immediate impact in diverse companies throughout the global supply chain. Career paths of our graduates are in the areas of: brand marketing, merchandising, retail, sourcing, private brand development, market analyst, design, product development, supply chain, and public relations and communications.

Master of Science in Textiles Degree

The objective of the Master of Science (MS) in Textiles is to prepare students for careers that require independent research skills, including designing, planning, and carrying out research projects. Students can choose to focus their studies in one of the following areas of specializations: Textile and Fashion Design, Retail and Brand Management, Textile Technology, and Textile Management. The MS degree requires a minimum of 36 hours of study including a thesis and typically takes 2 years to complete. Students interested in continuing with a Ph.D. in Textile Technology and Management (TTM) or Fiber and Polymer Science (FPS) are encouraged to pursue the MS degree.

Master of Textiles Degree

The Non-Thesis Master of Textiles (MT) program offers preparation and career advancement for students with interests in the design, management, and technological perspectives of the textile industry. The program is available on campus and online via Distance Education (DE) with flexibility to accommodate a breadth of student needs. The MT degree requires a minimum of 30 credit hours and can be completed in only two semesters (1 year) of full-time on campus study or up to a maximum of six (6) years for part time on-campus or DE students.

Accelerated Bachelor’s and Master’s Degrees

The Accelerated Bachelor’s and Master’s (ABM) degrees in the Department of Textile and Apparel, Technology and Management (TATM) are designed to provide exceptional undergraduate students in the Fashion and Textile Management (FTM) and Fashion and Textile Design (FTD) programs with the opportunity to complete a BS degree (in FTM or FTD) and a TATM Master’s degree in 5 to 5 1/2 years. Students in the ABM program can choose to pursue a non-thesis track in which they can potentially complete a Master of Textiles (MT) degree within 12 months after obtaining a Bachelor’s (BS) degree in FTM or FTD. Alternatively, students can choose the thesis track in which they can potentially complete a Master of Science in Textiles (MS) degree within the 18 months following obtaining a BS degree in FTM or FTD.

Admission Requirements

Students with a Bachelor of Science or a Bachelor of Arts degree may apply to either of the degree programs. Students apply with degrees in textiles, engineering, management, or design. The minimum acceptable overall Grade Point Average (GPA) is a 3.0 out of 4.0, based on most current U.S. universities. Students should have 20 credit hours in mathematics and natural sciences in their undergraduate degree. Degrees must be obtained from a four-year, accredited university. Graduate transfer credits can only be from other U.S. universities, and must be approved by the student’s graduate committee. Certificates and diplomas are not recognized as undergraduate degrees.

Click Application (https://textiles.ncsu.edu/tatm/application-procedure/) for more information on application procedures and requirements.

Student Financial Support

Competitive financial aid in the form of assistantships may be available for full-time Master of Science students.

Other Relevant Information

The Department of Textile and Apparel, Technology and Management houses a Digital Design lab which specializes in 3D Body Scanning, Direct Digital Printing, Whole Body Knitted Garments, and Computer Aided Apparel and Fabric Design. Additionally, the department includes the Fashion Studio, The Textile Management Sciences Lab, Textile Design Studio, Braiding Lab, Three-Dimensional Weaving Lab, and an Advanced Testing Lab that will allow students to experience hands-on advanced textile technology and management.

Degrees

- Textiles (MR) (p. 591)
- Textiles (MS) (p. 592)
- Textile and Apparel Management (Minor) (p. 593)
- Consumer Textile Product Design and Development (Certificate) (p. 594)
- Textile Brand Management and Marketing (Certificate) (p. 595)

Faculty

Full Professors
Tushar K. Ghosh
A. Blanton Godfrey
Maureen Grasso
David Hinks
Cynthia L. Istook
Byoungho Ellie Jin
Martin William King
Traci Ann May Lamar
Trevor J. Little
Marguerite Murray Moore
Behnam Pourdeyhimi
Abdel-fattah Mohamed Seyam
Renzo Shamey
Kristin Thoney-Barletta
Yingjiao Xu
NC State University

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Helmut H. Hergeth
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Lisa Lynne Parrillo-Chapman
Lori Fay Rothenberg
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Delisha R. Matthews
Kate E. Nartker
Anne Porterfield
Eunkyoung Shim
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Hawthorne A. Davis
Robert Alan Donaldson
Aly H. El-Shiekh
Peyton B. Hudson
Mendel L. Robinson Jr.
Samuel Clyde Winchester Jr.
William C. Stuckey Jr.
Mansour H. Mohamed
William Oxenham
Nancy C. Powell
Gary W. Smith
Moon Won Suh

Textiles (MR)

Degree Requirements
• Required: 30 credit hours at 500 level or above
• Optional: maximum of 12 credit hours outside of department

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>TT 630</td>
<td>Independent Study in Textile Technology</td>
<td></td>
</tr>
<tr>
<td>TTM 632</td>
<td>Special Studies in Textile Product Development</td>
<td></td>
</tr>
</tbody>
</table>

Optional: maximum of two credit hours seminar
| TT/TTM 601 | Seminar | |

Optional: online courses
| TT 500 | Understanding the Textile Complex | |
| TT 503 | Materials, Polymers, and Fibers used in Nonwovens | |
| TT 504 | Introduction to Nonwovens Products and Processes | |
| TT 505 | Advanced Nonwovens Processing | |
| TT 507 | Nonwoven Characterization Methods | |
| TT 508 | Nonwoven Product Development | |
| TT 520 | Yarn Processing Dynamics | |
| TT 521 | Filament Yarn Production Processing and Properties | |
| TT 549 | Warp Knit Engineering and Structural Design | |
| TT 550 | Production Mechanics and Properties of Woven Fabrics | |
| TT 551 | Advanced Woven Fabric Design | |
| TT 553 | Formation and Structure of Woven and Knitted Fabrics | |
| TT 591 | Special Studies in Textile Technology | |
| TTM 501 | Textile Enterprise Integration | |
| TTM 561 | Strategic Technology Management in the Textile Complex | |
| TTM 573 | Management of Textile Product Development | |
| TTM 581 | Global Textile and Apparel Business Dynamics | |
| TTM 582 | Global Textile Brand Management and Marketing | |
| TTM 583 | Strategic Planning for Textile Firms | |
| TTM 585 | Market Research In Textiles | |
| TTM 588 | Global Perspectives in Textiles Supply Chain Management | |
| TTM 591 | Special Studies in Textile Technology Management | |
| TT/TTM 601 | Seminar | |
| TT/TTM 630 | Independent Study in Textile Technology | |

Faculty

Full Professors
Tushar K. Ghosh
A. Blanton Godfrey
Maureen Grasso
David Hinks
Textiles (MS)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>TT/TTM 601</td>
<td>Seminar</td>
<td>1</td>
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</table>

Select six to ten credit hours of the following 600-level courses: 6-10

- TT/TTM 630 Independent Study in Textile Technology
- TT/TTM 693 Master’s Supervised Research
- TT/TTM 695 Master’s Thesis Research

Select 15 credits in the “Specializations” listed below

Textile Design & Fashion

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>TT 551</td>
<td>Advanced Woven Fabric Design</td>
<td>3</td>
</tr>
<tr>
<td>TT 570</td>
<td>Textile Digital Design and Technology</td>
<td>3</td>
</tr>
<tr>
<td>TT 571</td>
<td>Professional Practices in Textile Design and Technology</td>
<td>3</td>
</tr>
<tr>
<td>TTM 510</td>
<td>Apparel Technology Management</td>
<td>3</td>
</tr>
<tr>
<td>TTM 515</td>
<td>Apparel Production</td>
<td>3</td>
</tr>
<tr>
<td>TTM 517</td>
<td>Advanced Computer-Aided-Design for Fashion</td>
<td>3</td>
</tr>
<tr>
<td>TTM 632/TT 676</td>
<td>Special Studies in Textile Product Development</td>
<td>1-6</td>
</tr>
</tbody>
</table>

Branding and Retail

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTM 561</td>
<td>Strategic Technology Management in the Textile Complex</td>
<td>3</td>
</tr>
<tr>
<td>TTM 573</td>
<td>Management of Textile Product Development</td>
<td>3</td>
</tr>
<tr>
<td>TTM 582</td>
<td>Global Textile Brand Management and Marketing</td>
<td>3</td>
</tr>
<tr>
<td>TTM 583</td>
<td>Strategic Planning for Textile Firms</td>
<td>3</td>
</tr>
</tbody>
</table>

Course lists not exhaustive; can alternatively choose multiple specializations or specialization with minor. TT 591 Special Studies in Textile Technology/TTM 591 Special Studies in Textile Technology Management 1-4 credits recommended for all specializations.

1 Does not count toward 15 credit hour requirement
TTM 585  Market Research In Textiles  3
TTM 588  Global Perspectives in Textiles Supply Chain Management  3

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>TT 504</td>
<td>Introduction to Nonwovens Products and Processes</td>
<td>3</td>
</tr>
<tr>
<td>TT 520</td>
<td>Yarn Processing Dynamics</td>
<td>3</td>
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<tr>
<td>TT 530</td>
<td>Textile Quality and Process Control</td>
<td>3</td>
</tr>
<tr>
<td>TT 550</td>
<td>Production Mechanics and Properties of Woven Fabrics</td>
<td>3</td>
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<table>
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<tr>
<td>TTM 530</td>
<td>Textile Quality and Process Control</td>
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<td>TTM 533</td>
<td>Lean Six Sigma Quality</td>
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<td>TTM 535</td>
<td>Research Methods and Management</td>
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<td>TTM 561</td>
<td>Strategic Technology Management in the Textile Complex</td>
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<td>TTM 581</td>
<td>Global Textile and Apparel Business Dynamics</td>
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<td>TTM 583</td>
<td>Strategic Planning for Textile Firms</td>
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</tr>
</tbody>
</table>

**Faculty**

**Full Professors**

Tushar K. Ghosh
A. Blanton Godfrey
Maureen Grasso
David Hinks
Cynthia L. Istook
Byoungho Ellie Jin
Martin William King
Traci Ann May Lamar
Trevor J. Little
Marguerite Murray Moore
Behnam Pourdeyhimi
Abdel-fattah Mohamed Seyam
Renzo Shamey
Kristin Thoney-Barletta
Yingjiao Xu

**Assistant Professors**

Katherine Emma Annett-Hitchcock
Pamela Banks-Lee

**Emeritus Faculty**

Robert A. Barnhardt
Subhash K. Batra
Nancy Cassill
Hawthorne A. Davis
Robert Alan Donaldson
Aly H. El-Shiekh
Peyton B. Hudson
Mendel L. Robinson Jr.
Samuel Clyde Winchester Jr.
William C. Stuckey Jr.
Mansour H. Mohamed
William Oxenham
Nancy C. Powell
Gary W. Smith
Moon Won Suh

**Textile and Apparel Management (Minor)**

**Plan Requirements**

- 9 (MS student) or 12 (PhD student) credit hours
Consumer Textile Product Design and Development (Certificate)

The Graduate Certificate in Consumer Textile Product Design and Development (GCCTPDD), offered by the Department of Textile and Apparel, Technology and Management, will provide NC State graduate students the opportunity to develop recognized academic credentials in Consumer Textile Product Design and Development in addition to their major area of graduate study. Also it will offer non-degree graduate-level students the opportunity to develop recognized advanced expertise in Consumer Textile Product Design and Development.

Applications

New applicants to the university must submit a Program Application, a resume identifying educational preparation and work experiences, and official transcripts of all undergraduate and graduate course work. You must apply online through the Graduate School application portal. Prior to completing the first course after being accepted into the program, students prepare and submit two copies of a contract using the Certificate Contract Application. The contract includes a statement of career goals, a rationale for completing the certificate program, and a timeline for certificate completion. Students can always elect to review their application with the Certificate Coordinator prior to contract preparation.

Academic Requirements

Applicants must meet one of the three following requirements:

- Be a graduate of an accredited four-year college or university, and have a GPA of at least 3.0 on a 4-point scale in their last 60 credit hours of undergraduate study;
• Be a degree student in good standing in an NC State University graduate program;
• Have a Master’s degree.

Plan Requirements

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<tr>
<td>TTM 580</td>
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<td>TTM 585</td>
<td>Market Research In Textiles</td>
<td>3</td>
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<td>Select three of the following:</td>
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<td>TTM 515</td>
<td>Apparel Production</td>
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<tr>
<td>TTM 517</td>
<td>Advanced Computer-Aided-Design for Fashion</td>
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<tr>
<td>TT 570</td>
<td>Textile Digital Design and Technology</td>
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<td>TT 571</td>
<td>Professional Practices in Textile Design and Technology</td>
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<tr>
<td>TTM 510</td>
<td>Apparel Technology Management</td>
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<td>TTM 632</td>
<td>Special Studies in Textile Product Development</td>
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</tr>
</tbody>
</table>

Total Hours: 15

Textile Brand Management and Marketing (Certificate)

The Graduate Certificate Program in Textile Brand Management and Marketing provides graduate students with the opportunity to develop academic credentials in branding fundamentals and theories for a globalized industry and market research while complementing this knowledge with topics of strategic management, product development, supply chain management and technology management. The program also provides non-degree graduate-level students with the opportunity to develop recognized advanced expertise in Textile Brand Management and Marketing.

Admission

Applications must meet one of the following three requirements:

• Be a graduate of an accredited four-year college or university and have a grade point average of at least 3.0 on a 4-point scale in their last 60 credit hours of undergraduate study;
• Be a degree student in good standing in an NC State University graduate program; or
• Have a Master’s degree.

Applicants who do not meet the GPA requirements may be admitted professionally based on past work experience as a professional in textiles or a textile related field. Supporting documentation of professional experience in textile should be submitted for provisional admission. Students who are admitted provisionally must earn at least a “B” average in the first three courses of the certificate program in order to obtain full admission into the certificate program.

Requirements

A minimum of 15 credit hours is required to complete the certificate program and student must have a minimum 3.0 grade point average on all certificate course work. Transfer credit from other universities is not allowed. All work must be completed in four (4) calendar years, beginning from the time the student begins course work for the Certificate.

Plan Requirements

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<td>TTM 561</td>
<td>Strategic Technology Management in the Textile Complex</td>
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<td>TTM 573</td>
<td>Management of Textile Product Development</td>
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<td>TTM 583</td>
<td>Strategic Planning for Textile Firms</td>
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<tr>
<td>TTM 588</td>
<td>Global Perspectives in Textiles Supply Chain Management</td>
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</tr>
<tr>
<td>TTM 630</td>
<td>Independent Study in Textile Technology Management</td>
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</tr>
</tbody>
</table>

Total Hours: 12

Graduate Certificate - Wilson College of Textiles

Certificates

• Consumer Textile Product Design and Development (Certificate) (p. 594)
• Nonwoven Science and Technology (Certificate) (p. 595)
• Textile Brand Management and Marketing (Certificate) (p. 595)
• Textile Supply Chain Management (Certificate) (p. 585)

Nonwoven Science and Technology (Certificate)

The Nonwovens Institute offers a University Graduate Certificate in Nonwovens Science and Engineering through the Wilson College of Textiles. The program is available to students currently enrolled in a graduate degree program at NC State as well as non-degree seeking graduate level students. Any student seeking a certificate in Nonwovens Science and Engineering must be a graduate of an accredited four-year college or university. The goal of this certificate is to provide recognized academic credentials in Nonwoven Science and Engineering.

Eligibility

Applicants must apply through the Graduate School for the Graduate Certificate in Nonwovens Science and Engineering. Applicants submit a resume identifying educational preparation and work experiences and official transcripts of all undergraduate and graduate coursework.

Applicants must meet one of the three following requirements:

1. Be a graduate of an accredited four-year college or university, and have a GPA of at least 3.0 on a 4-point scale in their last 60 credit hours of undergraduate study
2. Be a degree student in good standing in an NC State University graduate program
3. Have a master’s degree

The certificate must be completed within four (4) calendar years from the date the student starts the first course. Awarding of the certificate requires a minimum GPA of 3.0 or better in all of the required courses.
Plan Requirements

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<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<td>NW/TT 504</td>
<td>Introduction to Nonwovens Products and Processes</td>
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<td>NW/TT 503</td>
<td>Materials, Polymers, and Fibers used in Nonwovens</td>
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<tr>
<td>or TMS 762</td>
<td>Physical Properties Of Fiber Forming Polymers, Fibers and Fibrous Structures</td>
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</tr>
<tr>
<td>NW/TT 505</td>
<td>Advanced Nonwovens Processing</td>
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<tr>
<td>NW/TT 507</td>
<td>Nonwoven Characterization Methods</td>
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<tr>
<td>NW/TT 508</td>
<td>Nonwoven Product Development</td>
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Interdisciplinary

Programs

- Bioinformatics (p. 596)
- Biomathematics (p. 476)
- Financial Mathematics (p. 601)
- Fisheries, Wildlife, and Conservation Biology (p. 603)
- Functional Genomics (p. 607)
- Genetics (p. 616)
- Interdisciplinary Minors (p. 634)
- Operations Research (p. 626)

Degree Programs

Master's (MR)

- Bioinformatics (MR) (p. 598)
- Financial Mathematics (MR) (p. 601)
- Fisheries, Wildlife, and Conservation Biology (MR) (p. 604)
- Functional Genomics (MR) (p. 609)
- Genetics (MR) (p. 618)
- Operations Research (MR) (p. 628)

Master of Science (MS)

- Fisheries, Wildlife, and Conservation Biology (MS) (p. 605)
- Functional Genomics (MS) (p. 610)
- Genetics (MS) (p. 620)
- Operations Research (MS) (p. 629)

Doctor of Philosophy (PhD)

- Bioinformatics (PhD) (p. 599)
- Fisheries, Wildlife, and Conservation Biology (PhD) (p. 606)
- Functional Genomics (PhD) (p. 612)
- Genetics (PhD) (p. 622)
- Operations Research (PhD) (p. 631)

Minors

- Bioinformatics (Minor) (http://catalog.ncsu.edu/graduate/interdisciplinary/bioinformatics/bioinformatics-minor/)
- Biotechnology (Minor) (p. 634)
- Ecology (Minor) (p. 635)
- Environmental Remote Sensing & Image Analysis (Minor) (p. 635)
- Food Safety (Minor) (p. 635)
- Functional Genomics (Minor) (p. 614)
- Genetics (Minor) (p. 624)
- Geographic Information Systems (Minor) (p. 636)
- Interdisciplinary (Minor) (p. 637)
- Operations Research (Minor) (p. 632)
- Water Resources (Minor) (p. 637)
- Women's and Gender Studies (Minor) (p. 638)

Bioinformatics

Genomic sciences has two components. Functional genomics, the generation of large bodies of data relating to organism function, encompasses gene discovery, gene expression, protein and nucleic acid structure and function, gene and gene product interactions, and genomic approaches to breeding and comparative studies relevant to ecology and evolutionary biology. Bioinformatics is the analysis of these vast and complex data sets including methods to analyze extremely large sets of genomic information such as DNA sequences and expression from DNA microarrays. Students register in either of these two fields but also receive a solid grounding in the other through core courses common to both programs. Unique and exceptional resources include the Bioinformatics Research Center and the Genome Research Laboratory.

Admission Requirements

Students should have an undergraduate major in the biological or physical sciences, mathematics, statistics or computer science and have completed calculus and other comparable courses. In addition to the other application requirements, a student should submit a statement of interests and career goals.

Master's Degree Requirements

Students take a 15-credit core curriculum of courses common to both programs followed by courses specific to the degree and discipline. The Master's of Bioinformatics requires a minimum of 33 credit hours. The Master's of Functional Genomics requires a minimum of 30 credit hours, and the Master's of Science in Functional Genomics requires a minimum of 36 credit hours.

Doctoral Degree Requirements

The Ph.D. program requires a total of 72 credits, and all students participate in a journal club, monthly seminar series and research ethics training. A co-mentoring system exists between bioinformatics and functional genomics through which each student has advisors from both disciplines. Throughout the program they will have the opportunity to gain practical experience in the Genome Research Laboratory, Bioinformatics Research Center and DNA Sequencing Facility.

Student Financial Support

A significant number of fellowships are available through the genomics program, and students may also be supported by research grant funds awarded to genomics faculty members.
Degrees
- Bioinformatics (MR) (p. 598)
- Bioinformatics (PhD) (p. 599)

Full Professors
Jose Miguel Alonso
Christopher M. Ashwell
David M. Bird
Donald L. Bitzer
Russell J. Borski
Matthew Breen
Dennis T. Brown
Ignazio Carbone
Marie Davidian
Jon Doyle
Robert Graham Franks
Sujit K. Ghosh
Amy Michele Grunden
Jason M. Haugh
Jacqueline M. Hughes-Oliver
Erich L. Kaltofen
Robert M. Kelly
Matthew D. Koci
Bailian Li
Hsiao-Ching Liu
Christian Maltecca
Earl S. Maxwell
Melissa Schuster Merrill
David C. Muddiman
Spencer V. Muse
Charles H. Opperman
James N. Petitte
Robert M. Petters
Jorge A. Piedrahita
Brian J. Reich
Maria C. Sagui
Barbara Sherry

Seth M. Sullivant
Jeffrey L. Thorne
Jung-Ying Tzeng
Miaden Alan Vouk
Ross W. Whetten
Fred Andrew Wright
Qiuyun Xiang
Zhaobang Zeng
Daowen Zhang

Associate Professors
David Lawrence Aylor
Nicolas Buchler
Gavin Clay Conant
Michael B. Goshe
Steffen Heber
Slavko Komarnytsky
David S. Lalush
Terri A. Long
Arnab Maity
Flora Meilleur
Dahlia M. Nielsen
Jonathan W. Olson
Xinxia Peng
David Michael Reif
Michael L. Sikes
Charles Eugene Smith
Lori June Unruh Snyder
Yihui Zhou

Assistant Professors
Hamid Ashrafi
Benjamin J. Callahan
Denis Fourches
Amanda Marie Hulse
David Rasmussen
Bioinformatics (MR)

**Degree Requirements**

<table>
<thead>
<tr>
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<td><strong>Genomics Sciences Core Courses</strong></td>
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<tr>
<td>ST 590</td>
<td>Special Topics (Bioinformatics I)</td>
<td></td>
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<tr>
<td>GN 735</td>
<td>Functional Genomics</td>
<td></td>
</tr>
<tr>
<td>PP 610</td>
<td>Special Topics (Genomic Sciences Journal Club)</td>
<td></td>
</tr>
<tr>
<td>GN 701</td>
<td>Molecular Genetics</td>
<td></td>
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<tr>
<td>or BCH 703</td>
<td>Macromolecular Synthesis and Regulation</td>
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<tr>
<td>GN 850</td>
<td>Professionalism and Ethics</td>
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<tr>
<td><strong>Bioinformatics Core Courses</strong></td>
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<tr>
<td>ST 590</td>
<td>Special Topics (Bioinformatics II)</td>
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<tr>
<td>CSC 530</td>
<td>Computational Methods for Molecular Biology</td>
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<tr>
<td>ST 512</td>
<td>Statistical Methods For Researchers II</td>
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<tr>
<td>ST 610</td>
<td>Topics in Stat</td>
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<td><strong>Elective Courses</strong></td>
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<td><strong>Total Hours</strong></td>
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</table>

1. PP 610 Genomic Sciences Journal Club is to be completed twice.

**Full Professors**

- Jose Miguel Alonso
- Christopher M. Ashwell
- David M. Bird
- Donald L. Bitzer
- Russell J. Borski
- Matthew Breen
- Dennis T. Brown
- Ignazio Carbone
- Marie Davidian
- Jon Doyle
- Robert Graham Franks
- Sujit K. Ghosh
- Amy Michele Grunden
- Jason M. Haugh
- Jacqueline M. Hughes-Oliver
- Erich L. Kaltofen
- Robert M. Kelly
- Matthew D. Koci
- Bailian Li
- Hsiao-Ching Liu
- Christian Maltecca
- Earl S. Maxwell
- Melissa Schuster Merrill
- David C. Muddiman
- Spencer V. Muse
- Charles H. Opperman
- James N. Petitte
- Robert M. Petters
- Jorge A. Piedrahita
- Brian J. Reich
- Maria C. Sagui
- Barbara Sherry
- Seth M. Sullivant
- Jeffrey L. Thorne
- Jung-Ying Tzeng
- Miaden Alan Vouk
- Ross W. Whetten
- Fred Andrew Wright
- Qiuyun Xiang
Bioinformatics (PhD)

Degree Requirements

<table>
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<td>ST 590</td>
<td>Special Topics (Bioinformatics I)</td>
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<td>GN 735</td>
<td>Functional Genomics</td>
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<td>PP 810</td>
<td>Special Topics (Genomic Sciences Journal Club)</td>
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<tr>
<td>GN 701</td>
<td>Molecular Genetics</td>
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</tr>
<tr>
<td></td>
<td>or BCH 703 Macromolecular Synthesis and Regulation</td>
<td></td>
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<tr>
<td>GN 850</td>
<td>Professionalism and Ethics</td>
<td></td>
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</table>

Bioinformatics Core Courses

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<th>Hours</th>
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<tbody>
<tr>
<td>ST 590</td>
<td>Special Topics (Bioinformatics II)</td>
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<tr>
<td>CSC 530</td>
<td>Computational Methods for Molecular Biology</td>
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<td>ST 512</td>
<td>Statistical Methods For Researchers II</td>
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<td>ST 810</td>
<td>Advanced Topics in Statistics (Bioinformatics Consulting)</td>
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Bioinformatics PhD Courses

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<td>Special Topics (Genomic Sciences Journal Club)</td>
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<tr>
<td>ST 501</td>
<td>Fundamentals of Statistical Inference I</td>
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<td>ST 502</td>
<td>Fundamentals of Statistical Inference II</td>
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Elective Courses

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Doctoral Research Courses

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<td></td>
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</tbody>
</table>

Total Hours: 73

1 PP 810 Genomic Sciences Journal Club should be repeated four times (twice for “Genomic Sciences Core Courses” and twice for “Bioinformatics PhD Courses”).
Russell J. Borski
Matthew Breen
Dennis T. Brown
Ignazio Carbone
Marie Davidian
Jon Doyle
Robert Graham Franks
Sujit K. Ghosh
Amy Michele Grunden
Jason M. Haugh
Jacqueline M. Hughes-Oliver
Erich L. Kaltofen
Robert M. Kelly
Matthew D. Koci
Bailian Li
Hsiao-Ching Liu
Christian Maltecca
Earl S. Maxwell
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Charles H. Opperman
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Robert M. Petters
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Slavko Komarnytsky
David S. Lalush
Terri A. Long
Arnab Maity
Flora Meilleur
Dahlia M. Nielsen
Jonathan W. Olson
Xinxia Peng
David Michael Reif
Michael L. Sikes
Charles Eugene Smith
Lori June Unruh Snyder
Yihui Zhou

Assistant Professors
Hamid Ashrafi
Benjamin J. Callahan
Denis Fourches
Amanda Marie Hulse
David Rasmussen
Christina Zakas

Practice/Research/Teaching Professors
Patricia A. Estes
Jane L. Lubischer

Emeritus Faculty
William Reid Atchley
Wendy F. Boss
Financial Mathematics

The Departments of Mathematics, Agricultural and Resource Economics, Economics, Industrial and Systems Engineering, Statistics and Business management offer a program leading to the degree of Master of Financial Mathematics. Students choose core courses and electives to suit their individual needs and interests.

Admissions Requirements

Applicants for admission should have an undergraduate degree that would preferably include courses in advanced calculus, linear algebra, probability and statistics.

Master of Financial Mathematics Requirements

In addition to course requirements (six core courses and five electives), the Master of Financial Mathematics degree requires completion of a 1-credit internship or research project.

Student Financial Support

Some funding is available through a limited number of fellowships. Consideration for the support is automatic. There are no teaching assistantships or research assistantships for this Professional Science Masters.

Degrees

• Financial Mathematics (MR) (p. 601)

Full Professors

David Dickey
Paul Fackler
Sujit Ghosh
Kazufumi Ito
Negash Medhin
Tao Pang
Tom Vukina
Mark Walker
Richard Warr

Associate Professors

Min Kang
Denis Pelletier
Charlie Smith

Assistant Professors

Ilze Kalnina
Yerkin Kitapbayev

Practice/Research/Teaching Professors

Wei Chen
Richard Ellson
Jeffrey High
Ram Valluru

Emeritus Faculty

Richard Bernhard
Peter Bloomfield
Jeffrey Scroggs
John Seater
Jim Wilson

Financial Mathematics (MR)

Degree Requirements

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<tr>
<th>Code</th>
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<th>Hours</th>
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<td>Core Courses</td>
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<tr>
<td>FIM/ECG/MA/ MBA 528</td>
<td>Options and Derivatives Pricing</td>
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<tr>
<td>ST 501</td>
<td>Fundamentals of Statistical Inference I</td>
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<td>ISE 711</td>
<td>Capital Investment Economic Analysis</td>
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<td>FIM 601</td>
<td>Seminar in Financial Mathematics</td>
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</table>
1 Students need to take FIM 601 (1 credit) in their second and third semesters for a total of 2 credits

### Elective Courses

<table>
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**Select at least three courses listed below:** 9

#### Risk Management Track
- FIM/MA 549 Financial Risk Analysis 3
- ISE 519 Database Applications in Industrial and Systems Engineering 3
- MBA 518 Enterprise Risk Management 3
- MBA 521 Advanced Corporate Finance 3

#### Data Science for Finance Track
- ISE 519 Database Applications in Industrial and Systems Engineering 3
- ST 503 Fundamentals of Linear Models and Regression 3
- ST 516 Experimental Statistics For Engineers II 3
- ST 540 Applied Bayesian Analysis 3
- ST 590 Special Topics (Applied Time Series) 1-6
- ST 562 Data Mining with SAS Enterprise Miner 3
- ST 555 Statistical Programming I 3

#### Portfolio Management Track
- OR/MA 504 Introduction to Mathematical Programming 3
- OR/ISE 505 Linear Programming 3
- OR 506 Algorithmic Methods in Nonlinear Programming 3
- MBA 523 Investment Theory and Practice 3
- MBA 524 Equity Valuation 3
- MA 531 Dynamic Systems and Multivariable Control I 3
- ISE 519 Database Applications in Industrial and Systems Engineering 3

#### Actuarial Science Track
- ECG 701 Microeconomics I 3
- ECG 702 Microeconomics II 3
- ECG/ST 750 Introduction to Econometric Methods 3
- ECG/ST 751 Econometric Methods 3
- ECG/ST 752 Time Series Econometrics 3
- ECG/ST 753 Microeconometrics 3
- MA/ST 747 Probability and Stochastic Processes II 3
- MBA 518 Enterprise Risk Management 3

#### PhD Preparation Track
- OR/ISE 505 Linear Programming 3
- ECG/ST 751 Econometric Methods 3
- ECG/ST 752 Time Series Econometrics 3
- MA 523 Linear Transformations and Matrix Theory 3
- MA 540 Uncertainty Quantification for Physical and Biological Models 3
- MA/ST 546 Probability and Stochastic Processes I 3
- ST 730 Applied Time Series Analysis 3
- ST 740 Bayesian Inference and Analysis 3
- MA 791 Special Topics In Real Analysis (Functional Analysis) 1-6

#### Other
- CSC 505 Design and Analysis Of Algorithms 3
- CSC 522 Automated Learning and Data Analysis 3
- CSC 540 Database Management concepts and Systems 3
- CSC 541 Advanced Data Structures 3
- CSC/MA 580 Numerical Analysis I 3
- CSC/MA 583 Introduction to Parallel Computing 3
- ISE 712 Bayesian Decision Analysis For Engineers and Managers 3
- MBA 515 Enterprise Resource Planning Systems 3
- MBA 526 International Finance 3
- MA 515 Analysis I 3
- MA 520 Linear Algebra 3
- MA 532 Ordinary Differential Equations I 3
- MA 534 Introduction To Partial Differential Equations 3
- MA 544 Computer Experiments In Mathematical Probability 3
- MA 555 Introduction to Manifold Theory 3
- MA/BMA 573 Mathematical Modeling of Physical and Biological Processes I 3
- MA/BMA 574 Mathematical Modeling of Physical and Biological Processes II 3
- MA 584 Numerical Solution of Partial Differential Equations--Finite Difference Methods 3
- MA 587 Numerical Solution of Partial Differential Equations--Finite Element Method 3
- MA 715 Analysis II 3
- MA 723 Theory of Matrices and Applications 3
- MA/ST 746 Introduction To Stochastic Processes 3
- MA/ST 748 Stochastic Differential Equations 3
- OR/ISE 501 Introduction to Operations Research 3
- OR/MA 504 Introduction to Mathematical Programming 3
- OR/E/MA 531 Dynamic Systems and Multivariable Control I 3
- OR/MA 719 Vector Space Methods in System Optimization 3
- OR/ISE 772 Stochastic Simulation Design and Analysis 3
- OR/BMA/MA/ST 773 Stochastic Modeling 3
- ST 505 Applied Nonparametric Statistics 3
- ST 512 Statistical Methods For Researchers II 3
- ST 556 Statistical Programming II 3
- ST 563 Introduction to Statistical Learning 3

#### Full Professors
- David Dickey
- Paul Fackler
- Sujit Ghosh
- Kazufumi Ito
- Negash Medhin
- Tao Pang
- Tom Vukina
- Mark Walker
Master’s Degree Requirements
The M.S. degree program requires a minimum of 30 credit hours, including 1-2 hours of seminar and no more than six hours of research. A research-based thesis is required, as is a minor (usually 9-10 hours). The Master of Fisheries, Wildlife, and Conservation Biology degree requires a minimum of 36 credits, including 4-6 hours of special problems and 1-2 hours of seminars, and a professional paper is required. For either degree, further requirements may be imposed by the advisory committee and/or department.

Doctoral Degree Requirements
The Ph.D. program requires 36 to 54 credits of course work beyond the Master’s degree, including two seminars and an ethics course, and a dissertation. Exceptionally well-prepared students may petition to have their degree objective changed to Ph.D. before completing the Master’s degree.

Student Financial Support
Graduate research and teaching assistantships are offered for qualified students through participating departments. Commitments for assistantships are normally made at the time of admission to graduate study.

Other Relevant Information
Research near campus is facilitated by excellent field, laboratory and computer resources. Off-campus research is conducted at the Pamlico Aquaculture Field Laboratory, research and extension centers in eastern and western NC, The Center for Marine Sciences and Technology in Morehead City, Bull Neck Swamp, Hill Forest, and at facilities of state and federal agencies and private organizations. For additional information, see the Fisheries, Wildlife, and Conservation Biology graduate webpage (http://cnr.ncsu.edu/fer/grad/future/).

Degrees
- Fisheries, Wildlife, and Conservation Biology (MR) (p. 604)
- Fisheries, Wildlife, and Conservation Biology (MS) (p. 605)
- Fisheries, Wildlife, and Conservation Biology (PhD) (p. 606)

Faculty

Full Professors
David Derek Aday
Russell J. Borski
Jeffrey A. Buckel
Jaime A. Collazo
William Gregory Cope
Maria T. Correa
Frederick Willis Cubbage
Robert R. Dunn
Kevin Gross
Elsa Youngsteadt

Practice/Research/Teaching Professors
Jesse Robert Fischer
Roland Wesley Kays
Lara B. Pacifici
Martha Burford Reiskind
Kara Kristina Walker

Fisheries, Wildlife, and Conservation Biology (MR)

Degree Requirements

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<td>FW 693</td>
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<tr>
<td></td>
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Faculty

Full Professors
David Derek Aday
Russell J. Borski
Jeffrey A. Buckel
Jaime A. Collazo
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Frederick Willis Cubbage
Robert R. Dunn
Kevin Gross
Harry Valentine Daniels III
Christopher S. DePerno
David B. Eggleston
John R. Godwin
Craig A. Harms
George R. Hess
Jeffrey M. Hinshaw
Jay Frederick Levine

Associate Professors
Caren Beth Cooper
Madhusudan V. Katti
Randall Brian Langerhans
Theodore Henry Shear

Assistant Professors
Jie Cao
Tara Myers Harrison
Lincoln Ray Larson
Jamian Krishna Pacifici
Olivia Anne Petritz
Benjamin J. Reading
Kathryn Tate Stevenson
Bradley William Taylor

Harry Valentine Daniels III
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Fisheries, Wildlife, and Conservation Biology (MS)

Degree Requirements

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Faculty

Full Professors

David Derek Aday
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William Gregory Cope
Maria T. Correa
Frederick Willis Cubbage
Robert R. Dunn
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Thomas M. Losordo
Kathryn Montgome Meurs
Christopher E. Moorman
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Bradley William Taylor
Elsa Youngsteadt

Practice/Research/Teaching Professors

Jesse Robert Fischer
Roland Wesley Kays
Lara B. Pacifici
Martha Burford Reiskind
Kara Kristina Walker
Fisheries, Wildlife, and Conservation Biology (PhD)

Degree Requirements

<table>
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<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>FW 730</td>
<td>Ethics in Fisheries and Wildlife Sciences</td>
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**Additional Courses**

“Additional Courses” are approved in conjunction with the academic committee to meet 72 total hours.

**Total Hours**

72

**Faculty**

**Full Professors**

David Derek Aday
Russell J. Borski
Jeffrey A. Buckel
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William Gregory Cope
Maria T. Correa
Frederick Willis Cubbage
Robert R. Dunn
Kevin Gross
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Thomas M. Losordo
Kathryn Montgome Meurs
Christopher E. Moorman
Stacy Arnold Charles Nelson
Markus Nils Peterson
Luis Alonso Ramirez-Ulate
Robert Jeryl Richardson
Ann Helen Ross
Robert Michael Scheller
Clyde E. Sorenson
Michael K. Stoskopf
Functional Genomics

Genomic sciences has two components. Functional genomics, the generation of large bodies of data relating to organism function, encompasses gene discovery, gene expression, protein and nucleic acid structure and function, gene and gene product interactions, and genomic approaches to breeding and comparative studies relevant to ecology and evolutionary biology. Bioinformatics is the analysis of these vast and complex data sets including methods to analyze extremely large sets of genomic information such as DNA sequences and expression from DNA microarrays. Students register in either of these two fields but also receive a solid grounding in the other through core courses common to both programs. Unique and exceptional resources include the Bioinformatics Research Center and the Genome Research Laboratory.

Admission Requirements

Students should have an undergraduate major in the biological or physical sciences, mathematics, statistics or computer science and have completed calculus and other comparable courses. In addition to the other application requirements, a student should submit a statement of interests and career goals.

Master's Degree Requirements

Students take a 15-credit core curriculum of courses common to both programs followed by courses specific to the degree and discipline. The Master's of Bioinformatics requires a minimum of 33 credit hours. The Master's of Functional Genomics requires a minimum of 30 credit hours, and the Master's of Science in Functional Genomics requires a minimum of 36 credit hours.

Doctoral Degree Requirements

The Ph.D. program requires a total of 72 credits, and all students participate in a journal club, monthly seminar series and research ethics training. A co-mentoring system exists between bioinformatics and functional genomics through which each student has advisors from both disciplines. Throughout the program they will have the opportunity to gain practical experience in the Genome Research Laboratory, Bioinformatics Research Center and DNA Sequencing Facility.

Student Financial Support

A significant number of fellowships are available through the genomics program, and students may also be supported by research grant funds awarded to genomics faculty members.

Degrees

- Functional Genomics (MR) (p. 609)
- Functional Genomics (MS) (p. 610)
- Functional Genomics (PhD) (p. 612)
- Functional Genomics (Minor) (p. 614)

Faculty

Full Professors

Kenneth B. Adler
Jose Miguel Alonso
Prema Arasu
Christopher M. Ashwell
David M. Bird
Russell J. Borski
Rebecca S. Boston
Matthew Breen
Edward Bealmear Breitschwerdt
Dennis T. Brown
James W. Brown
Ignazio Carbone
Margaret E. Daub
Gregg A. Dean
Ralph A. Dean
Ralph E. Dewey
Charlotte E. Farin
Robert Graham Franks
Frederick J. Fuller
John E. Gadsby
John R. Godwin
Major M. Goodman
Amy Michele Grunden
Linda Kay Hanley-Bowdoin
Jason M. Haugh
James B. Holland
Jonathan M. Horowitz
Sophia Kathariou
Robert M. Kelly
Matthew D. Koci
Bailian Li
Jonathan S. Lindsey
Hsiao-Ching Liu
Steven Lommel
James W. Mahaffey
Earl S. Maxwell
Steven Edward McKeand
Melissa Schuster Merrill
Eric S. Miller
Paul Edward Mozdziak
David C. Muddiman
Jack Odle
Charles H. Opperman
James N. Petitte
Robert M. Petters
Jorge A. Piedrahita
Brian J. Reich
Jean B. Ristaino
Maria C. Sagui
Heike Inge Ada Sederoff
Barbara Sherry
Robert Charles Smart
William F. Thompson
Ross W. Whetten
Brian M. Wiegmann
Qiuyun Xiang
Deyu Xie
Jeffrey A. Yoder

Associate Professors
Nicolas E. Buchler
Michael B. Goshe
Steffen Heber
David S. Lalush
Flora Meilleur
Jonathan W. Olson
Lina Quesada
Marcelo Rodriguez-Puebla
Michael L. Sikes

Assistant Professors
Caitlin S. Heil
Ruben Rellan Alvarez
Benjamin John Callahan
Ilenys Muniz Perez Diaz
Manuel Kleiner
Kurt Marsden
David Alan Rasmussen
Christina Zakas

Practice/Research/Teaching Professors
Patricia A Estes

Emeritus Faculty
Henry Van Amerson
William Reid Atchley
James W. Brown
### Functional Genomics (MR)

#### Degree Requirements

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Students will select an additional nine credit hours of Functional Genomics Category I Electives in conjunction with the academic committee.

Total Hours: 30

---

1 Functional Genomic Category I Electives cannot be chosen from ST 590, CSC 530, ST 512, ST 501, or ST 502. However, these courses can be taken as additional electives beyond the minimum 30 credit requirement.
Assistant Professors
Caitlin S. Heil
Ruben Rellan Alvarez
Benjamin John Callahan
Ilenys Muniz Perez Diaz
Manuel Kleiner
Kurt Marsden
David Alan Rasmussen
Christina Zakas

Practice/Research/Teaching Professors
Patricia A Estes

Emeritus Faculty
Henry Van Amerson
William Reid Atchley
James W. Brown
Vincent L. C. Chiang
Steven D. Clouse
Stephanie E. Curtis
Barry Goldfarb
Cynthia L. Hemenway
Todd Robert Klaenhammer
David H. Ley
James W. Moyer
Paul E. Orndorff
Ron Ross Sederoff
Wayne Tompkins
Paul L Wollenzien

Adjunct Faculty
Robert R. Anholt
Trudy F. MacKay

Functional Genomics (MS)
Degree Requirements

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Functional Genomics Core Courses 18

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Students will select an additional nine credit hours of Functional Genomics Category I Electives in conjunction with the academic committee.

Thesis Research Courses 6

“Thesis Research Courses” will be determined in conjunction with the academic committee.

Total Hours 36

1 Functional Genomic Category I Electives cannot be chosen from ST 590, CSC 530, ST 512, ST 501, or ST 502. However, these courses can be taken as additional electives beyond the minimum 36 credit requirement.

Faculty

Full Professors

Kenneth B. Adler
Jose Miguel Alonso
Prema Arasu
Christopher M. Ashwell
David M. Bird
Russell J. Borski
Rebecca S. Boston
Matthew Breen
Edward Bealmear Breitschwerdt
Dennis T. Brown
James W. Brown
Ignazio Carbone
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Functional Genomics (PhD)
Degree Requirements

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Functional Genomics Category I Electives will be determined in conjunction with the academic committee.

Research and Additional Electives

“Research and Additional Electives” will be determined in conjunction with the academic committee.

Total Hours 72

1 PP 810 Special Topics: Genomics Journal Club must be taken multiple times to meet the required core hours.
Functional Genomic Category I Electives cannot be chosen from ST 590, CSC 530, ST 512, ST 501, or ST 502. However, these courses can be taken as additional electives beyond the minimum 36 credit requirement.

Faculty

Full Professors
Kenneth B. Adler
Jose Miguel Alonso
Prema Arasu
Christopher M. Ashwell
David M. Bird
Russell J. Borski
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Matthew Breen
Edward Bealmear Breitschwerdt
Dennis T. Brown
James W. Brown
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Charles H. Opperman
James N. Petitte
Robert M. Petters
Jorge A. Piedrahita
Brian J. Reich
Jean B. Ristaino
Maria C. Sagui
Heike Inge Ada Sederoff
Barbara Sherry
Robert Charles Smart
William F. Thompson
Ross W. Whetten
Brian M. Wiegmann
Qiuyun Xiang
Deyu Xie
Jeffrey A. Yoder

Associate Professors
Nicolas E. Buchler
Michael B. Goshe
Steffen Heber
David S. Lalush
Flora Meilleur
Jonathan W. Olson
Lina Quesada
Plan Requirements

- 9 (MS student) or 12 (PhD student) credit hours

Faculty

Full Professors
Kenneth B. Adler
Jose Miguel Alonso
Prema Arasu
Christopher M. Ashwell
David M. Bird
Russell J. Borski
Rebecca S. Boston
Matthew Breen
Edward Bealmeare Breitschwerdt
Dennis T. Brown
James W. Brown
Ignazio Carbone
Margaret E. Daub
Gregg A. Dean
Ralph A. Dean
Ralph E. Dewey
Charlotte E. Farin
Robert Graham Franks
Frederick J. Fuller
John E. Gadsby
John R. Godwin
Major M. Goodman
Amy Michele Grunden
Linda Kay Hanley-Bowdoin
Jason M. Haugh
James B. Holland
Jonathan M. Horowitz
Sophia Kathariou
Robert M. Kelly
Matthew D. Koci
Bailian Li

Functional Genomics (Minor)
Jonathan S. Lindsey
Hsiao-Ching Liu
Steven Lommel
James W. Mahaffey
Earl S. Maxwell
Steven Edward McKeand
Melissa Schuster Merrill
Eric S. Miller
Paul Edward Mozdziak
David C. Muddiman
Jack Odle
Charles H. Opperman
James N. Petitte
Robert M. Petters
Jorge A. Piedrahita
Brian J. Reich
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Brian M. Wiegmann
Qiuyun Xiang
Deyu Xie
Jeffrey A. Yoder

Marcelo Rodriguez-Puebla
Michael L. Sikes

Assistant Professors
Caitlin S. Heil
Ruben Rellan Alvarez
Benjamin John Callahan
Ilenys Muniz Perez Diaz
Manuel Kleiner
Kurt Marsden
David Alan Rasmussen
Christina Zakas

Practice/Research/Teaching Professors
Patricia A Estes

Emeritus Faculty
Henry Van Amerson
William Reid Atchley
James W. Brown
Vincent L. C. Chiang
Steven D. Clouse
Stephanie E. Curtis
Barry Goldfarb
Cynthia L. Hemenway
Todd Robert Klaenhammer
David H. Ley
James W. Moyer
Paul E. Omdorff
Ron Ross Sederoff
Wayne Tompkins
Paul L Wollenzien

Adjunct Faculty
Robert R. Anholt
Trudy F. MacKay

Associate Professors
Nicolas E. Buchler
Michael B. Goshe
Steffen Heber
David S. Lalush
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Jonathan W. Olson
Lina Quesada
Genetics

The Genetics Graduate Program is a University wide program. Current faculty are in 14 Departments and four Colleges. The Genetics Program provides a well-balanced program of graduate course work and research training. The faculty conducts basic research in all areas of genetics, including molecular, cellular and developmental genetics; behavioral genetics, biomedical genetics, evolutionary, population and quantitative genetics, statistical genetics, and bioinformatics. Faculty research utilizes both traditional model organisms (fruit flies, mice and Arabidopsis) and non-traditional systems (cats, cockroaches, dairy cattle, dogs, maize, pigs, pine trees and more). Interdisciplinary research is encouraged.

Admission Requirements

Applicants may come from a number of undergraduate programs that include biological, agricultural, physical and mathematical science training. All applications are screened by an admissions committee, and the best qualified applicants will be accepted up to the number of spaces that are available for new students. The program uses the requirements set by the Graduate School to evaluate applications (GRE, unofficial transcripts from each previously attended college or university, three letters of recommendation, personal statement, and proof of English proficiency for non-US citizens). Competitive applicants will include research and other relevant experience as well as their interest and fit for the program in their personal statement.

Master's Degree Requirements

The M.S. degree requires a minimum of 30 credit hours, of which 14 hours are core course requirements, three hours are additional elective graduate courses with substantial genetics content, and three hours are other elective graduate courses. M.S. students majoring in Genetics are required to complete dissertation research with three credit hours of Master's Supervised Research, six credits of Master's Thesis Research, one credit of Master's Thesis Prep, and one credit of Master's Examination. M.S. students are also required to teach one semester of undergraduate courses and may enroll in three credits of Master's Supervised Teaching. 12 hours of required courses are required for Genetics minors. The Master's of Genetics requires a minimum of 31 credit hours, of which 17 hours are core course requirements, six hours are additional elective genetics courses and eight hours are elective graduate courses.

Doctoral Degree Requirements

A total of 18 hours of seven core courses and 12 hours of elective graduate courses, nine of which have substantial genetics content, is required of all majors. Ph.D. students majoring in Genetics are required to complete dissertation research with three credit hours of Doctoral Supervised Research and a combination of Doctoral Dissertation Research, Doctoral Preliminary Examination, and Doctoral Dissertation Prep to total 39 hours. Students are also required to and teach two semesters of undergraduate courses and may enroll in six credits of Doctoral Supervised Teaching to be used toward the remaining 39 credit hours. 12 hours of required courses are required for Genetics minors.

Student Financial Support

Genetics graduate students are supported on Research and Teaching Assistantships (RAs and TAs). Specific pay varies depending on the assistantship, and students are paid bi-weekly. More information will be provided at the time of acceptance into the program.

Other Relevant Information

All M. S. and Ph. D. students rotate through three laboratories during their first semester. At the end of the semester, they choose a laboratory for their research activities consistent with their interests and available research projects. Provisions are available for a co-major and collaborative research in more than one laboratory.

Degrees

- Genetics (MR) (p. 618)
- Genetics (MS) (p. 620)
- Genetics (PhD) (p. 622)
- Genetics (Minor) (p. 624)

Faculty

Full Professors

Jose Miguel Alonso
Peter J. Balint-Kurti
Rodolphe Barrangou
David M. Bird
Adam Joseph Birkenheuer
Matthew Breen
Ignazio Carbone
Ralph A. Dean
Ralph E. Dewey
Robert Graham Franks
Troy Ghashghaei
John R. Godwin
Major M. Goodman
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Candace Hope Haigler
Linda Kay Hanley-Bowdoin
Christine Veronica Hawkes
James B. Holland
Fikret Isik
Ramsey S. Lewis
Hsiao-Ching Liu
Steven Lommel
James W. Mahaffey
Christian Maltecca
Carolyn Jane Mattingly
Kathryn Montgomery Meurs
Spencer V. Muse
Natasha J. Olby
Charles H. Opperman
Emilie Francesca Rissman
Jean B. Ristaino
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Maxwell J. Scott
Heike Inge Ada Sederoff
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Zhaobang Zeng

Nanette M. Nascone-Yoder
Dahlia M. Nielsen
Xinxia Peng
Marcella Pierce
Antonio Planchart
David Michael Reif
Michael Hay Reiskind
Reade Bruce Roberts
Michael L. Sikes
Rosangela Sozzani
Anna N. Stepanova
Yihui Zhou

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Benjamin John Callahan
Michael Anthony Cowley
Colleen Jennifer Doherty
Amanda Marie Hulse
Albert Jun Qi Keung
Manuel Kleiner
Caroline Laplante
Wusheng Liu
Anna Michelle Locke
Elizabeth Lucas
Kurt Marsden
Santosh Kumar Mishra
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Benjamin J. Reading
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Laurianne Chantal Van Landeghem
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Susana Rita Milla-Lewis
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Dale F. Matzinger
Wendell Herbert McKenzie
John G. Scandalios
Henry E. Schaffer
Ron Ross Sederoff
Charles William Stuber
Earl A. Wernsman

Adjunct professors
Robert R. Anholt
Trudy F. MacKay
Alison Anne Motsinger-Reif
Nadia Singh

Genetics (MR)

Degree Requirements

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<tr>
<td>GN 701</td>
<td>Molecular Genetics</td>
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<td>GN 702</td>
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<td>Population and Quantitative Genetics</td>
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<td>GN 850</td>
<td>Professionalism and Ethics</td>
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<td>ST 511</td>
<td>Statistical Methods For Researchers I</td>
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<td>BCH 451</td>
<td>Principles of Biochemistry</td>
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<td>GN 721</td>
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<td>GN 735</td>
<td>Functional Genomics</td>
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<td>Quantitative Genetics Theory and Methods</td>
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<td>Microbial Genetics &amp; Genomics</td>
<td>3</td>
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<tr>
<td>GN 761</td>
<td>Advanced Molecular Biology Of the Cell</td>
<td>3</td>
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<td>GN 768</td>
<td>Nucleic Acids: Structure and Function</td>
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<td>GN 810</td>
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<td>GN 820</td>
<td>Special Problems</td>
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<td>ST 590</td>
<td>Special Topics (Bioinformatics I)</td>
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<td>ST 590</td>
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<td>PB 780</td>
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<td>PB 824</td>
<td>Topical Problems (Topics in Plant Molecular Genetics)</td>
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<td>Core Technologies in Molecular and Cellular Biology</td>
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<td>BIT 815</td>
<td>Advanced Special Topics</td>
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</tbody>
</table>

Other Electives

See "Elective Courses" listed below

Other Electives

"Other Electives" are approved in conjunction with the academic committee

Total Hours 31

1 Only three hours of these courses may be counted toward the primary elective requirement.
2 Other courses that do not appear on this list may be counted if they have substantial genetics content. Please consult with the Director of Graduate Programs if you would like to count a course as an elective that is not on this list.

Elective Courses

Faculty

Full Professors
Jose Miguel Alonso
Peter J. Balint-Kurti
Rodolphe Barrangou
David M. Bird
Adam Joseph Birkenheuer
Matthew Breen
Ignazio Carbone
Ralph A. Dean
Ralph E. Dewey
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Steffen Heber
Vasu Kuraparthry
Randall Brian Langerhans
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Marce D. Lorenzen
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Susana Rita Milla-Lewis
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Xinxia Peng
Marcela Pierce
Antonio Planchart
David Michael Reif
Michael Hay Reiskind
Reade Bruce Roberts
Michael L. Sikes
Rosangela Sozzani
Anna N. Stepanova
Yihui Zhou
Genetics (MS)

Ruben Rellan Alvarez
Adriana San Miguel Delgadillo
Caitlin Suzanne Smukowski Heil
Casey Michelle Theriot
Laurianne Chantal Van Landeghem
Christina Zakas

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Stephanie E. Curtis
Eugene Eisen
Charles S. Levings III
Todd Robert Klaenhammer
Wesley Edwin Kloos
Dale F. Matzinger
Wendell Herbert McKenzie
John G. Scandalios
Henry E. Schaffer
Ron Ross Sederoff
Charles William Stuber
Earl A. Wernsman

Adjunct professors
Robert R. Anholt
Trudy F. MacKay
Alison Anne Motsinger-Reif
Nadia Singh

Genetics (MS)

Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>GN 702</td>
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<tr>
<td>GN 685</td>
<td>Master's Supervised Teaching</td>
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</table>

Elective Course 1, 2

See "Elective Courses" listed below

Other Elective

"Other Elective" is determined in conjunction with the academic committee

Research Course

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>GN 695</td>
<td>Master's Thesis Research</td>
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</table>

Total Hours 32

1 Only three hours of these courses may be counted toward the primary elective requirement.
2 Other courses that do not appear on this list may be counted if they have substantial genetics content. Please consult with the Director of Graduate Programs if you would like to count a course as an elective that is not on this list.

Elective Courses

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<td>GN 713</td>
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<td>Quantitative Genetics In Plant Breeding</td>
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<td>GN 810</td>
<td>Special Topics in Genetics</td>
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<td>GN 820</td>
<td>Special Problems</td>
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</table>

Faculty

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Assistant Professors
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Amanda Marie Hulse
# Genetics (PhD)

## Degree Requirements

### Core Courses

<table>
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### Teaching Course

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### Elective Courses

Select at least three courses below:

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<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
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<td>Quantitative Genetics and Breeding</td>
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<td>Microbial Genetics &amp; Genomics</td>
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<td>GN 761</td>
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<td>Nucleic Acids: Structure and Function</td>
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<td>Special Topics in Genetics</td>
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<td>GN 820</td>
<td>Special Problems (Professional Development)</td>
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<td>ST 590</td>
<td>Special Topics (Bioinformatics I)</td>
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---

1. GN 810 Special Topics in Genetics is to be repeated twice to meet the 2 credit hour requirement.

2. Only three hours of these courses may be counted toward the primary elective requirement.

3. Other courses that do not appear on this list may be counted if they have substantial genetics content. Please consult with the Director of Graduate Programs if you would like to count a course as an elective that is not on this list.
Faculty

Full Professors

Jose Miguel Alonso
Peter J. Balint-Kurti
Rodolphe Barrangou
David M. Bird
Adam Joseph Birkenheuer
Matthew Breen
Ignazio Carbone
Ralph A. Dean
Ralph E. Dewey
Robert Graham Franks
Troy Ghashghaei
John R. Godwin
Major M. Goodman
Fred L. Gould
Candace Hope Haigler
Linda Kay Hanley-Bowdoin
Christine Veronica Hawkes
James B. Holland
Fikret Isik
Ramsey S. Lewis
Hsiao-Ching Liu
Steven Lommel
James W. Mahaffey
Christian Maltecca
Carolyn Jane Mattingly
Kathryn Montgomery Meurs
Spencer V. Muse
Natasha J. Olby
Charles H. Opperman
Emilie Francesca Rissman
Jean B. Ristaino
Coby J. Schal
Maxwell J. Scott
Heike Inge Ada Sederoff
Seth M. Sullivan
William F. Thompson
Jeffrey L. Thorne
Jung-Ying Tzeng
Keith R. Weninger
Ross W. Whetten
Brian M. Wiegmann
Qiuyun Xiang
Deyu Xie
Jeffrey A. Yoder
Zhaobang Zeng

Associate Professors

David Lawrence Aylor
Chase Beisel
Nicolas Emile Buchler
Gavin Clay Conant
Steffen Heber
Vasu Kuraparthi
Randall Brian Langerhans
Terri A. Long
Marce D. Lorenzen
John Edward Meitzen
Susana Rita Milla-Lewis
Natette M. Nascone-Yoder
Dahlia M. Nielsen
Xinxia Peng
Marcela Pierce
Antonio Pianchard
David Michael Reif
Michael Hay Reiskind
Reade Bruce Roberts
Michael L. Sikes
Rosangela Sozzani
Anna N. Stepanova
Yihui Zhou

### Assistant Professors

Hamid Ashrafi
Benjamin John Callahan
Michael Anthony Cowley
Colleen Jennifer Doherty
Amanda Marie Hulse
Albert Jun Qi Keung
Manuel Kleiner
Caroline Laplante
Wusheng Liu
Anna Michelle Locke
Elizabeth Lucas
Kurt Marsden
Santosh Kumar Mishra
Casey C. Nestor
Benjamin J. Reading
Ruben Reian Alvarez
Adriana San Miguel Delgadillo
Caitlin Suzanne Smukowski Heil
Casey Michelle Theriot
Laurianne Chantal Van Landeghem
Christina Zakas

### Emeritus Professors

William Reid Atchley
Stephanie E. Curtis
Eugene Eisen
Charles S. Levings III
Todd Robert Klaenhammer

Wesley Edwin Kloos
Dale F. Matzinger
Wendell Herbert McKenzie
John G. Scandalios
Henry E. Schaffer
Ron Ross Sederoff
Charles William Stuber
Earl A. Wernsman

### Adjunct professors

Robert R. Anholt
Trudy F. MacKay
Alison Anne Motsinger-Reif
Nadia Singh

### Genetics (Minor)

#### Plan Requirements

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</table>

Total Hours: 12

### Faculty

#### Full Professors

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Operations Research

Operations Research (OR) is a graduate program of an interdisciplinary nature, governed by an administrative board and the program committee, and administered through the office of the program director.

Admission Requirements
Applications are accepted from undergraduate majors in all technical disciplines. Applicants should have had at least four math courses beyond calculus (e.g., courses in differential equations, linear algebra, probability and statistics, and mathematical analysis). Knowledge of a computer programming language is recommended, but not required. GRE scores are required of all new applicants.

Master’s Degree Requirements
The Master of Operations Research degree is a terminal graduate degree for students who seek careers as OR practitioners in either the private or public sector. The M.S. degree is designed to prepare students for careers in research and development.

Doctoral Degree Requirements
The Ph.D. degree is intended for students to be research scientists in industry or teachers and researchers in academia. This degree requires a minimum of 72 hours of graduate credit beyond the bachelor’s degree, including coursework in major and minor areas of concentration together with credit for doctoral research and dissertation preparation. A departmental written qualifying examination is required. For students who have completed a Master’s degree from another institution prior to joining the Ph.D. program, a minimum of 54 hours of additional graduate credit are required. Please consult the Operations Research website (http://www.or.ncsu.edu/) for more details of degree requirements.

Student Financial Support
Both teaching and research assistantships are available to qualified applicants. Award priority is given to Ph.D. then M.S. applicants. Outstanding students who are U.S. citizens and who shall be enrolled in the NC State Graduate School for the first time are eligible for the Engineering Dean’s Graduate Fellowship Program.

Degrees
• Operations Research (MR) (p. 628)
• Operations Research (MS) (p. 629)
• Operations Research (PhD) (p. 631)
• Operations Research (Minor) (p. 632)

Full Professors
John W. Baugh
Rada Yuryevna Chirkova
Do Young Eun
Shu-Cherng Fang
Yahya Fathi
Subhashis Ghoshal
Robert B. Handfield
Robert E. Hartwig
Christopher Graham Healey
Hans Sebastian Heese
Ilse Ipsen
Kazufumi Ito
Julie S. Ivy
Ting Yu

Operations Research (MR)

Degree Requirements

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<td>OR 506</td>
<td>Algorithmic Methods in Nonlinear Programming</td>
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<td>OR 709</td>
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<tr>
<td>OR 761</td>
<td>Queues and Stochastic Service Systems</td>
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¹ OR 505, OR 506, and OR 709 cannot be double counted toward "Requirement C" courses if already used toward "Requirement B" courses.

² "Elective Courses" cannot be double counted if already used to fulfill requirements "A-C" courses.

Full Professors

John W. Baugh

Rada Yuryevna Chirkova

Do Young Eun

Shu-Cherng Fang

Yahya Fathi

Subhashis Ghosal

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Robert E. Hartwig

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Julie LeAnne Swann

Hien T. Tran

Yannis Viniotis

Mladen Alan Vouk
Emeritus Faculty
Peter Bloomfield
Stephen L. Campbell
Thom Hodgson

Adjunct Faculty
Brian Denton
Mihail Devetsikiotis
Patricia L. Hersh
Simon M. Hsiang
Anderson Rodrigo de Queiroz
Ting Yu

Operations Research (MS)

Degree Requirements

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</tbody>
</table>
Elective Courses

“Elective Courses” that will be applied to reach 30 credit hours will be determined in conjunction with the academic committee.

Total Hours

1. OR 505, OR 506, and OR 709 cannot be double counted toward “Requirement C” courses if already used toward “Requirement B” courses.

2. “Elective Courses” cannot be double counted if already used to fulfill requirements “A-C” courses

Full Professors

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William Michael Rand
Thomas W. Reiland
Charles Eugene Smith
Hong Wan
Donald P. Warsing

Assistant Professors

Leila Hajibabai Dizaji
Xiaolei Fang
Jordan Kern
Timothy Charles Kraft
## Operations Research (PhD)

### Degree Requirements

<table>
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<td>OR 709</td>
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<td><strong>Requirement C Courses</strong></td>
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<td>Select four of the following:</td>
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² "Elective Courses" cannot be double counted if already used to fulfill requirements "A-C" courses.

### Full Professors

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Kazufumi Ito
Julie S. Ivy
Jeffrey A. Joines
Carl Timothy Kelley
Russell E. King
Zhilin Li
George F. List
Min Liu
Ning Lu
Louis A. Martin-Vega
Maria A. Mayorga
Negash G. Medhin
Arne Nilsson
Tao Pang
Harry G. Perros
Ranji S. Ranjithan
Michael A. Rappa
Joseph P. Roise
George N. Rouskas
Nagiza F. Samatova
Carla D. Savage
Munindar P. Singh
Ralph C. Smith
Matthias F.M. Stallmann
Julie LeAnne Swann
Hien T. Tran
Yannis Viniotis
Miaden Alan Vouk
Wenye Wang
Fen Wu
Zhaobang Zeng
Dmitry V. Zenkov

**Associate Professors**
Jacob James Adams
Kristin Anne Barletta
Joseph F. DeCarolis
Min Jeong Kang
Michael G. Kay
Eda Kemahlioglu-Ziya
Yunan Liu
Osman Yalin Ozaltin
William Michael Rand
Thomas W. Reiland
Charles Eugene Smith
Hong Wan
Donald P. Warsing

**Assistant Professors**
Leila Hajibabai Dizaji
Xiaolei Fang
Jordan Kern
Timothy Charles Kraft
David Papp
Sara Shashaani
Mengmeng Zhu

**Practice/Research/Teaching Professors**
Billy L. Edge
Daniela Sofia Jones
David Lee Lubkeman
Brandon Mark McConnell
Javad Taheri

**Emeritus Faculty**
Peter Bloomfield
Stephen L. Campbell
Thom Hodgson

**Adjunct Faculty**
Brian Denton
Mihail Devetsikiotis
Patricia L. Hersh
Simon M. Hsiang
Anderson Rodrigo de Queiroz
Ting Yu

**Operations Research (Minor)**

**Plan Requirements**
- 9 (MS student) or 12 (PhD student) credit hours
Full Professors
John W. Baugh
Rada Yuryevna Chirkova
Do Young Eun
Shu-Cherng Fang
Yahya Fathi
Subhashish Ghoshal
Robert B. Handfield
Robert E. Hartwig
Christopher Graham Healey
Hans Sebastian Heese
Ilse Ipsen
Kazufumi Ito
Julie S. Ivy
Jeffrey A. Joines
Carl Timothy Kelley
Russell E. King
Zhilin Li
George F. List
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Michael G. Kay
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Yunan Liu
Osman Yalin OzaltIn
William Michael Rand
Thomas W. Reiland
Charles Eugene Smith
Hong Wan
Donald P. Warsing

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Xiaolei Fang
Jordan Kern
Timothy Charles Kraft
David Papp
Sara Shashaani
Mengmeng Zhu

Practice/Research/Teaching Professors
Billy L. Edge
Daniela Sofia Jones
David Lee Lubkeman
Interdisciplinary Minors

Minors

- Bioinformatics (Minor) (http://catalog.ncsu.edu/graduate/interdisciplinary/bioinformatics/bioinformatics-minor/)
- Biotechnology (Minor) (p. 634)
- Ecology (Minor) (p. 635)
- Environmental Remote Sensing & Image Analysis (Minor) (p. 635)
- Food Safety (Minor) (p. 635)
- Functional Genomics (Minor) (p. 614)
- Genetics (Minor) (p. 624)
- Geographic Information Systems (Minor) (p. 636)
- Interdisciplinary (Minor) (p. 637)
- Operations Research (Minor) (p. 632)
- Water Resources (Minor) (p. 637)
- Women's and Gender Studies (Minor) (p. 638)

Biotechnology (Minor)

M.S. and Ph.D. minors in biotechnology are available to students who successfully complete at least eight credit hours in selected laboratory core courses and conduct their graduate thesis research in an area of biotechnology. At least one member of the student's thesis committee must be a member of the Biotechnology faculty (http://biotech.ncsu.edu/faculty/). Research in biotechnology is focused in three main areas: recombinant DNA technology, bioprocessing/bioanalytical techniques, and in vitro culture techniques. The multidisciplinary nature of biotechnology means that a wide range of research topics and techniques are applicable. For more information contact Dr. Robert Kelly (rmkelly@ncsu.edu).

Students wishing to pursue graduate studies leading to either a M.S. or Ph.D. minor in biotechnology must enroll and conduct their research in a participating department. For specific information about enrollment requirements, contact the participating departments (http://www.grad.ncsu.edu/catalog/default.asp#DEGREES) of interest to you directly. For general information about graduate education at NCSU contact the Graduate School (http://www.ncsu.edu/grad/), 1020 Main Campus Drive, Box 7102, NCSU, Raleigh, NC 27695.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
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<tbody>
<tr>
<td>Required Course</td>
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</tr>
<tr>
<td>BIT 510</td>
<td>Core Technologies in Molecular and Cellular Biology</td>
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<tr>
<td>Elective Courses</td>
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<td>Select two of the following:</td>
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<tr>
<td>BIT 564</td>
<td>Protein Purification</td>
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<tr>
<td>BIT 565</td>
<td>Real-time PCR Techniques</td>
<td></td>
</tr>
<tr>
<td>BIT 566</td>
<td>Animal Cell Culture Techniques</td>
<td></td>
</tr>
<tr>
<td>BIT 567</td>
<td>PCR and DNA Fingerprinting</td>
<td></td>
</tr>
<tr>
<td>BIT 568</td>
<td>Genome Mapping</td>
<td></td>
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<tr>
<td>BIT 571</td>
<td>RNA Interference and Model Organisms</td>
<td></td>
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<tr>
<td>BIT 573</td>
<td>Protein Interactions</td>
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<tr>
<td>BIT 574</td>
<td>Plant Genetic Engineering</td>
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</tr>
<tr>
<td>BIT 577</td>
<td>Metagenomics</td>
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</tr>
<tr>
<td>BIT 578</td>
<td>Mapping the Brain</td>
<td></td>
</tr>
<tr>
<td>BIT 579</td>
<td>High-Throughput Discovery</td>
<td></td>
</tr>
<tr>
<td>BIT 580</td>
<td>Yeast Metabolic Engineering</td>
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</tr>
<tr>
<td>BIT 581</td>
<td>Plant Transformation</td>
<td></td>
</tr>
<tr>
<td>BIT 815</td>
<td>Advanced Special Topics (Professional Development)</td>
<td></td>
</tr>
<tr>
<td>BIT 815</td>
<td>Advanced Special Topics (Research Ethics)</td>
<td></td>
</tr>
<tr>
<td>BIT 815</td>
<td>Advanced Special Topics (Capstone Biotechnology)</td>
<td></td>
</tr>
</tbody>
</table>

Additional courses will be determined in conjunction with the academic committee

Total Hours 8

1 Students may place out of BIT 510 if they have had either a similar course as an undergraduate or if they have substantial practical experience and conceptual knowledge of the material covered. The approval to place out of BIT 510 is made by the Academic Advisor of the Biotechnology Program, in conjunction with consultation with the student's thesis advisor. If placing out of BIT 510, the student will instead take one additional 2-credit BIT lab course for a total of three (and will complete the minor requirements with 6 credits of coursework rather than 8).

Full Professor

Robert M. Kelly

Practice/Research/Teaching Professors

Stefanie Chen
Carlos C. Goller
Melissa Srougi
Ecology (Minor)

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td>Required Courses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AEC 502 Introduction to Biological Research</td>
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<tr>
<td></td>
<td>AEC 503 Foundations of Ecology</td>
<td></td>
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<tr>
<td></td>
<td>Elective Courses</td>
<td>5-8</td>
</tr>
<tr>
<td></td>
<td>Select five credit hours (MS) or eight credit hours (PhD) in conjunction with the academic committee</td>
<td></td>
</tr>
<tr>
<td>Total Hours</td>
<td>9-12</td>
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</table>

1 Courses must be outside the student's major discipline

Additional Requirements

- Must maintain an average of 3.0 (B) for courses taken to complete the Ecology minor.
- A graduate faculty member who conducts research in Ecology must serve on the students graduate advisory committee. This committee member should be chosen in consultation with the Ecology minor DGP.*
- The student must obtain approval from the Ecology minor DGP to enroll in the minor.
- If the student is doing a non-thesis degree program, the student must obtain approval from the Ecology minor DGP for their minor program of study (Graduate Student Plan of Work).

Environmental Remote Sensing & Image Analysis (Minor)

This minor provides graduate students the opportunity to develop a recognized academic credential in remote sensing and image analysis in conjunction with their major program of graduate study. Twelve credit hours, 6 credit hours of required courses and 6 credit hours of elective courses, is required to complete the minor.

Other Requirements: A GIST graduate faculty member must be on the student’s graduate committee. A list of currently approved faculty members can be provided to students upon request. If no graduate committee is required by the student’s program, the student must obtain approval of his or her minor program. Students enrolled in Option B Masters programs are not eligible to declare a minor. Certificate coursework and Minor coursework must be completely independent.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td>Core Courses</td>
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<tr>
<td></td>
<td>GIS 512 Introduction to Environmental Remote Sensing</td>
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<tr>
<td></td>
<td>or GIS 712 Environmental Earth Observation and Remote Sensing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ST 533 Applied Spatial Statistics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>or ECE 514 Random Processes</td>
<td></td>
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<tr>
<td></td>
<td>Elective Courses</td>
<td>6</td>
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<tr>
<td></td>
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<tr>
<td></td>
<td>GIS 512 Introduction to Environmental Remote Sensing</td>
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</tbody>
</table>

1 Additional courses may be decided in conjunction with the academic committee.

Faculty

Full Professors

Ross Meentemeyer
Helena Mitasova
Stacy Nelson
Gary Roberson
Sandra Yuter

Associate Professors

Mirela Tulbure
Jeffrey White

Assistant Professors

Josh Gray

Practice/Research/Teaching Professors

Perver Baran
Stacy Supak

Emeritus Faculty

Hugh Devine
Siamak Khorram

Food Safety (Minor)
### Geographic Information Systems (Minor)

The Geographic Information Systems (GIS) minor provides an academic credential for students who want to develop some GIS application skills while pursuing a graduate degree in another discipline. It is designed for students who wish to master the basics of GIS analysis and to develop more advanced skills in a particular application area.

Other Requirements: A GIST graduate faculty member must be on the student’s graduate committee. A list of currently approved faculty members can be provided to students upon request. If no graduate committee is required by the student’s program, the student must obtain approval of his or her minor program. Students enrolled in Option B Masters programs are not eligible to declare a minor. Certificate coursework and Minor coursework must be completely independent.

### Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td><strong>Required Courses</strong></td>
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</tr>
<tr>
<td>FSA 520</td>
<td>Pre-Harvest Food Safety</td>
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</tr>
<tr>
<td>FSA 530</td>
<td>Post-Harvest Food Safety</td>
<td></td>
</tr>
<tr>
<td>FSA 540</td>
<td>Food Safety and Public Health</td>
<td></td>
</tr>
<tr>
<td>FSA 580</td>
<td>Professional Development and Ethics in Food Safety</td>
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<td><strong>Total Hours</strong></td>
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### Elective Courses

Select three credits from the following courses:

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>GIS 512</td>
<td>Introduction to Environmental Remote Sensing</td>
<td>3</td>
</tr>
<tr>
<td>GIS 515</td>
<td>Cartographic Design</td>
<td>2</td>
</tr>
<tr>
<td>GIS/LAR 517</td>
<td>GIS Applications in Landscape Architecture and Environmental Planning</td>
<td>3</td>
</tr>
<tr>
<td>GIS 520</td>
<td>Spatial Problem Solving</td>
<td></td>
</tr>
<tr>
<td>GIS 521</td>
<td>Surface Water Hydrology with GIS</td>
<td></td>
</tr>
<tr>
<td>GIS 530</td>
<td>Spatial Data Foundations</td>
<td></td>
</tr>
<tr>
<td>GIS 535</td>
<td>Web and Mobile GIS Protocols</td>
<td></td>
</tr>
<tr>
<td>GIS 595</td>
<td>Special Topics in Geospatial Information Science</td>
<td>1-6</td>
</tr>
<tr>
<td>GIS/MEA 582</td>
<td>Geospatial Modeling</td>
<td>3</td>
</tr>
<tr>
<td>GIS 584</td>
<td>Mapping and Analysis Using UAS</td>
<td>3</td>
</tr>
<tr>
<td>GIS 609</td>
<td>Geospatial Forum</td>
<td>1</td>
</tr>
<tr>
<td>GIS 610</td>
<td>Special Topics in Geospatial Information Science</td>
<td>1-6</td>
</tr>
</tbody>
</table>

### Faculty

#### Full Professors

- Yu-Fai Leung
- Ross Meentemeyer
- Helena Mitasova
- Stacy Nelson
- Gary Roberson
- Sandra Yuter

#### Associate Professors

- Mirela Tulbure
- Raju Vatsavai
- Jeffrey White

#### Assistant Professors

- Josh Gray
- Jelena Vukomanovic

#### Practice/Research/Teaching Professors

- Perver Baran
- Eric Money
- Stacy Supak
- Laura Tateosian
- Vaishnavi Thakar
Emeritus Faculty
Heather Cheshire
Hugh Devine
Siamak Khorram

Interdisciplinary (Minor)

Plan Requirements
The interdisciplinary minor requires two or more areas of coursework to be represented with a faculty member representing one of the areas of coursework. Students who are interested in an interdisciplinary minor should contact their Directors of Graduate Programs for more information.

Water Resources (Minor)
The interdisciplinary, interdepartmental graduate minor in water resources is designed for students majoring in the many disciplines of natural resources, science, engineering, technology, and social sciences that are relevant to water resources. The minor exposes students to water resources courses and faculty members within and outside their major fields of study.

The graduate minor in water resources (WR) requires successful completion (“B-” or better in each individual WR course, GPA of 3.0 or better across all WR courses counted toward the minor) of at least 9 credits of WR courses chosen from the lists below. At least 3 of the 9 credits must be from outside the student’s major department. For M.S. students (not Ph.D. students), up to 3 credits at the 400-level may be included if these credits are from outside the student’s major department. Students earning an M.S. before enrolling in a Ph.D. program can be counted toward a WR minor in the subsequent Ph.D. program. However, WR courses taken during the M.S. program may count toward a WR minor in the subsequent Ph.D. program if the M.S. program did not include a WR minor.

Plan Requirements

- At least 3 (MS) or 6 (PhD) credit hours must be from outside major

<table>
<thead>
<tr>
<th>Code</th>
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<tr>
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<td>Required Courses</td>
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<td></td>
<td>See &quot;Focus Areas&quot; listed below</td>
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<tr>
<td></td>
<td>Total Hours</td>
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Minor Focus Areas

Hydrological and Meteorological Aspects of Water Resources

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Select three of the following courses:</td>
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</tr>
<tr>
<td>BAE 502</td>
<td>Instrumentation for Hydrologic Applications</td>
<td>3</td>
</tr>
<tr>
<td>BAE 576</td>
<td>Watershed Monitoring and Assessment</td>
<td>3</td>
</tr>
<tr>
<td>BAE 577</td>
<td>Wetlands Design and Restoration</td>
<td>3</td>
</tr>
<tr>
<td>BAE 581</td>
<td>Open Channel Hydraulics for Natural Systems</td>
<td>3</td>
</tr>
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<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>BAE 583</td>
<td>Stream Corridor 3 Es: Ecohyadraulics, Engineering and Ethics</td>
<td>3</td>
</tr>
<tr>
<td>BAE 584</td>
<td>Introduction to Fluvial Geomorphology</td>
<td>3</td>
</tr>
<tr>
<td>BAE/SSC 771</td>
<td>Theory Of Drainage--Saturated Flow</td>
<td>3</td>
</tr>
<tr>
<td>CE 584</td>
<td>Hydraulics Of Ground Water</td>
<td>3</td>
</tr>
<tr>
<td>CE 586</td>
<td>Engineering Hydrology</td>
<td>3</td>
</tr>
<tr>
<td>CE 607</td>
<td>Water Resource and Environmental Engineering Seminar</td>
<td>1</td>
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<tr>
<td>FOR 420/520/ NR 420/520</td>
<td>Watershed and Wetlands Hydrology</td>
<td>4</td>
</tr>
<tr>
<td>MEA 455</td>
<td>Micrometeorology</td>
<td>3</td>
</tr>
<tr>
<td>MEA 481</td>
<td>Geomorphology: Earth's Dynamic Surface</td>
<td>3</td>
</tr>
<tr>
<td>MEA 485</td>
<td>Introduction to Hydrogeology</td>
<td>3</td>
</tr>
<tr>
<td>MEA 585</td>
<td>Physical Hydrogeology</td>
<td>3</td>
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<tr>
<td>MEA 715</td>
<td>Dynamics of Mesoscale Precipitation System</td>
<td>3</td>
</tr>
<tr>
<td>SSC 470/570</td>
<td>Wetland Soils</td>
<td>3</td>
</tr>
<tr>
<td>SSC 511</td>
<td>Soil Physics</td>
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</table>

Water Quality Aspects of Water Resources

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<td>Select three of the following courses:</td>
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</tr>
<tr>
<td>BAE 473</td>
<td>Introduction to Hydrologic and Water Quality Modeling</td>
<td>3</td>
</tr>
<tr>
<td>BAE/SSC 573</td>
<td>Introduction to Hydrologic and Water Quality Modeling</td>
<td>3</td>
</tr>
<tr>
<td>MEA 760</td>
<td>Biogeochemistry</td>
<td>3</td>
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<tr>
<td>MEA 763</td>
<td>Isotope Geochemistry</td>
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<tr>
<td>MEA 785</td>
<td>Chemical Hydrogeology</td>
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</tr>
<tr>
<td>SSC 442</td>
<td>Soil and Environmental Biogeochemistry</td>
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<tr>
<td>SSC 521</td>
<td>Soil Chemistry</td>
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Biological and Ecological Aspects of Water Resources

<table>
<thead>
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</thead>
<tbody>
<tr>
<td></td>
<td>Select three of the following courses:</td>
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</tr>
<tr>
<td>BAE 472/572</td>
<td>Irrigation and Drainage</td>
<td>3</td>
</tr>
<tr>
<td>BAE 574</td>
<td>DRAINMOD: Theory and Application</td>
<td>3</td>
</tr>
<tr>
<td>BAE 575</td>
<td>Design of Structural Stormwater Best Management Practices</td>
<td>3</td>
</tr>
<tr>
<td>BAE 578</td>
<td>Agricultural Waste Management</td>
<td>3</td>
</tr>
<tr>
<td>BAE 580</td>
<td>Introduction to Land and Water Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CE 484</td>
<td>Water Supply and Waste Water Systems</td>
<td>3</td>
</tr>
<tr>
<td>CE 571</td>
<td>Physical Principles of Environmental Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CE 574</td>
<td>Chemical Principles of Environmental Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CHE 575</td>
<td>Advances in Pollution Prevention: Environmental Management for the Future</td>
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</tr>
<tr>
<td>CS/HS/SSC/TOX 725</td>
<td>Pesticide Chemistry</td>
<td>1</td>
</tr>
<tr>
<td>CS/HS/SSC/TOX 727</td>
<td>Pesticide Behavior and Fate In the Environment</td>
<td>2</td>
</tr>
<tr>
<td>NR 521</td>
<td>Wetland Assessment, Delineation and Regulation</td>
<td>3</td>
</tr>
<tr>
<td>SSC 562</td>
<td>Environmental Applications Of Soil Science</td>
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</table>
Legal, Institutional, and Economic Aspects of Water Resources

Select three of the following courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>ECG 515</td>
<td>Environmental and Resource Policy</td>
<td>3</td>
</tr>
<tr>
<td>ET 460</td>
<td>Practice of Environmental Technology</td>
<td>3</td>
</tr>
<tr>
<td>LAR 430</td>
<td>Site Planning</td>
<td>3</td>
</tr>
<tr>
<td>NR 460</td>
<td>Renewable Natural Resource Management and Policy</td>
<td>3</td>
</tr>
<tr>
<td>NR 571</td>
<td>Current Issues in Natural Resource Policy</td>
<td>3</td>
</tr>
<tr>
<td>NR 484</td>
<td>Environmental Impact Assessment</td>
<td>4</td>
</tr>
<tr>
<td>PA 550</td>
<td>Environmental Policy</td>
<td>3</td>
</tr>
</tbody>
</table>

Women's and Gender Studies (Minor)

The minor provides graduate students in the humanities, social sciences and sciences with the theories and methodologies to study women and gender relations. The minor is intended to support and further students' research in their own field.

- Nine hours of graduate credit are required with a B or better in each course.
- No more than three hours of coursework may overlap between the major department coursework requirement and the Women's and Gender Studies minor. Students may choose from the courses listed on the website and/or a list of approved special topics courses.
- Because the Minor is an interdisciplinary one, at least one of the courses needs to be in a field different from that of the graduate program in which the student is enrolled.
- All courses must be taught by the Women's and Gender Studies Affiliated Faculty.
- An Affiliated Faculty member (not in the field of the degree graduate program) must sit on the master's or dissertation committee.

Plan Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>WGS/ANT 544</td>
<td>Cross-Cultural Perspectives on Women</td>
<td>9</td>
</tr>
<tr>
<td>WGS/ECD 540</td>
<td>Gender Issues in Counseling</td>
<td></td>
</tr>
<tr>
<td>WGS/HI 547</td>
<td>Women in America: From Contact to the Civil War</td>
<td>540</td>
</tr>
<tr>
<td>WGS/HI 548</td>
<td>American Women in the Twentieth Century</td>
<td></td>
</tr>
<tr>
<td>WGS/REL 573</td>
<td>Religion, Gender, and Reproductive Technologies</td>
<td>653</td>
</tr>
<tr>
<td>WGS/PSY 706</td>
<td>Psychology of Gender</td>
<td></td>
</tr>
<tr>
<td>WGS/SOC 737</td>
<td>Sociology Of Gender</td>
<td>737</td>
</tr>
<tr>
<td>SOC 739</td>
<td>Social Psychology Of Inequality</td>
<td></td>
</tr>
<tr>
<td>Total Hours</td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

Faculty

**Associate professor**

Karey Harwood

NC State Graduate Handbook

The Graduate Handbook provides an overview of Graduate School functions and resources, as well as the rules, regulations, and procedures administered by the Graduate School.

It is the responsibility of all graduate students to know and understand their degree requirements. Students are responsible for the fulfillment of those requirements.

NC State also lists official policies, regulations and rules (PRRs) on the university’s PRR website (https://policies.ncsu.edu/). Links to pertinent PRRs are found in the Graduate Handbook sections that contain PRR information.

Graduate Administration

- 1.1 Graduate School Responsibilities (p. 639)
- 1.2 Graduate Student Responsibilities (p. 639)
- 1.3 Graduate Faculty (p. 639)
- 1.4 Directors of Graduate Programs (p. 640)
- 1.5 Graduate Services Coordinators (p. 641)
- 1.6 Graduate School Representatives (p. 641)
- 1.7 Administrative Board of the Graduate School (p. 642)
- 1.8 Common Administrative Board Actions (p. 642)

Applications and Admissions

- 2.1 Applications (p. 643)
- 2.2 Application Deadlines (p. 644)
- 2.3 Graduate School Admissions (p. 644)
- 2.4 Medical History and Immunization Requirements (p. 647)

Graduate Degrees: Policies and Procedures

- 3.1 Graduate School Minimum Requirements (p. 648)
- 3.2 Advisory Committees (p. 651)
- 3.3 Graduate Plan of Work (p. 652)
- 3.4 Time Limits (p. 653)
- 3.5 Comprehensive Examinations (p. 653)
- 3.6 Theses and Dissertations (p. 655)
- 3.7 Master's Degree: Summary of Procedures (p. 656)
- 3.8 Doctoral Degree: Summary of Requirements (p. 657)
- 3.9 Change in Degree Level or Program (p. 657)
- 3.10 Dual Master's Degrees (p. 658)
- 3.11 Master's degrees while in Doctoral Status (p. 658)
- 3.11a Co-Majors and Minors (p. 659)
- 3.12 Accelerated Bachelor's/Master's Programs (p. 659)
- 3.13 Graduate Certificate Programs (p. 660)
- 3.14 Minimum Enrollment Requirements (p. 661)
- 3.15 Course Registration (p. 662)
- 3.16 Withdrawal from the University (p. 663)

Special topics courses in a variety of disciplines are offered each semester and may be taken with the approval of the Women's and Gender Studies Director.
The Graduate Handbook defines the minimum requirements in place at that time or any subsequent versions, and students who readmit must use an entire set of requirements; they may not piece together a set of requirements approved during their continuous enrollment. Students must adhere to either the requirements in place at the time they matriculate at NC State or any subsequent versions of the requirements of their specific programs.

Students are expected to adhere to either the requirements in place at the time they matriculate at NC State or any subsequent versions of the requirements approved during their continuous enrollment. Students must use an entire set of requirements; they may not piece together a set of requirements from various versions. If a student is readmitted, they must use the requirements in place at that time or any subsequent versions, but they cannot choose requirements from their previous enrolled status.

Individual program requirements may be found in the Graduate Catalog (p. 63) and should be available through the department office or its website.

All students must also abide by standards of conduct established by NC State. The Graduate Handbook section on Codes of Conduct provides web links to Policies, Procedures, and Rules (https://policies.ncsu.edu/).

### 1.3 Graduate Faculty

Faculty participation in graduate education is a critical element of university life. The engagement with students as advisors and mentors plays a critical role in developing future researchers and instilling in them the qualities required for degree completion. Membership in the graduate faculty is a privilege.

#### A. Graduate Faculty

- All full-time tenured and tenure-earning faculty will be granted Graduate Faculty status based on a majority vote of a department’s graduate faculty at the time of hire. Emeritus faculty and those on phased retirement retain their Graduate Faculty status.
- Full-time faculty in non-tenure positions (e.g., clinical, extension, practicum, research, teaching, professor of practice, and federal contractual employees, such as USDA, DOI, U.S. Forest Service) may be granted Graduate Faculty status upon a majority vote of the graduate faculty in the department/program in which they are employed.
- Graduate faculty at another university who are in a joint department/program with one at NC State are considered graduate faculty at NC State.
- If a chair of an advisory committee leaves NC State for another position, s/he may continue as chair for one more year. After that period, s/he can only co-chair with another member of the Graduate Faculty.

#### B. Affiliate Graduate Faculty

- All non-tenure-line faculty who are on temporary appointments or are not paid by the university and who are expected to serve on master’s or doctoral advisory committees and/or teach graduate courses will be granted Affiliate Graduate Faculty status by departmental vote (see Section E). Such faculty include those who are adjunct, visiting, and interinstitutional (Duke and UNC-Chapel Hill). Faculty at other universities or others seeking Affiliate Graduate Faculty status require a majority vote of approval by the graduate faculty in the department/program they are to be affiliated with.

#### C. External members and technical consultants

- Affiliate Graduate Faculty status is not required for the participation of external members of committees and technical consultants (see 3.2 Advisory Committees (p. 651) for definitions and credentials of these roles).

#### D. Responsibilities of Graduate Faculty

The responsibilities associated with membership in the Graduate Faculty include:

- teaching courses at the graduate level (i.e., courses at the 500-900 levels)
1.4 Directors of Graduate Programs

Appointment Process

Each department offering graduate study is required to appoint a Director of Graduate Programs (https://grad.ncsu.edu/about/people/dgp/) (DGP) from among its Graduate Faculty. The Department Head, or Dean in the case of interdisciplinary programs, submits this designation in writing to the Graduate Dean. The Director of Graduate Programs plays a critical role in overseeing graduate education at the department/program level in variety of arenas as outlined below.

Responsibilities

Communication

• Handles all correspondence between the graduate program and the Graduate School and between the Graduate School and the program;
• Transmits information from the Graduate School to students;
• Submits requests for scheduling preliminary and final oral examinations and graduation checkouts;
• Communicates with the Office of International Services (OIS) and serves as a critical academic authority for matters that may affect students’ visa status.

Oversight

• Conducts the daily administration of departmental graduate programs;
• Recommends admission or denial of graduate applicants;
• Approves students’ Graduate Plans of Work after approval by the student’s Graduate Committee; submits plans to the Graduate School.

Interaction with Students

• Plays a lead role in recruiting graduate students;
• Conducts orientation of new graduate students;
• Serves as the program’s point of contact for concerns that students may have;
• Assigns graduate students to assistantships.

Advising

• Advises students requesting admission to the graduate program;
• Serves as temporary advisor to new graduate students, providing them information and advice including but not limited to course selection and scheduling, faculty interests, procedural matters, and University resources;
• Monitors graduate students’ progress and graduation credits;
• Assists new students in selecting a major advisor;
• Advises students on various aspects of program progress and completion as needed.

Fellowship Support

• Assists the Graduate School in developing fellowship proposals, including recruitment of graduate faculty to draft proposals and participate in proposed fellowship project;
• Nominates eligible students for individual fellowships and transmits their applications to the Graduate School;

E. Application for Graduate Faculty and Affiliate Graduate Faculty status

• Because new tenured or tenure-track faculty become members of the graduate faculty at the time of hire, there is no separate application process for membership in the Graduate Faculty. To ensure that Graduate Faculty status is granted, the Graduate Faculty Nomination form must be submitted to the Graduate School for processing.
• Before members of the Graduate Faculty can serve in another department/program, however, their membership generally should be voted on by the Graduate Faculty in that department/program. It may be approved by the given program’s DGP in consultation with the program’s faculty.
• For non-tenure-line faculty seeking Affiliate Graduate Faculty status, the department head or DGP forwards the Graduate Nomination Form along with a current CV to the Graduate School. As part of that process, members of the Graduate Faculty of the appropriate department/program vote and those results must be included on the Affiliate Graduate Faculty Nomination Form.

F. Requirements to Teach Graduate Courses at NC State

The Request to Teach Graduate Courses form should be completed and submitted to the Graduate School for instructors who are not members of the Graduate Faculty. For instructors who do not have a terminal degree in the discipline in which they will be teaching, a thorough justification outlining their alternative credentials is required for approval by the Graduate School.

G. Removal of Graduate Faculty/Affiliate Graduate Faculty Members

• Members of the Graduate Faculty of a specific department or program may initiate removal of a current Graduate Faculty member based on the failure to carry out the responsibilities (see Section D) or for other good cause. The department must vote on this recommendation and consult with the college dean, and if it is decided that a faculty member should be removed from the Graduate Faculty, the head or DGP (in the case of non-departmental programs) makes this recommendation in the form of a memo to the Dean of the Graduate School. The memo should include the vote of the members of the department’s/program’s Graduate Faculty. The dean of the Graduate School is then authorized to remove the person from the Graduate Faculty.
• If the member has Graduate Faculty status in more than one department/program, the status would be maintained unless all relevant entities voted to remove the member.
• Supports the Graduate School in managing fellowship awards to the program's graduate students.

**Program Development and Evaluation**

• Initiates program-related proposals to the Administrative Board of the Graduate School (Admin Board), either informally through contact with Graduate Deans or formally through written proposals to be considered at Admin Board meetings; seeks approval of College Graduate Studies Committee and College Associate Dean for Academic Affairs prior to submitting to Admin Board;

• Assists the Graduate School in conducting the annual and 8-year (or shorter as required by accrediting bodies) reviews of the graduate program, by initiating the self-study process upon notification by the Graduate School.

**1.5 Graduate Services Coordinators**

The Graduate Services Coordinators (https://grad.ncsu.edu/about/people/gsc/) serves as the principal administrative liaisons between the student, the Graduate Program Director, the graduate program, and the Graduate School. In this capacity, the Graduate Services Coordinator:

1. Processes admissions applications, collects all supplemental documents required by individual programs, and submits the materials and recommendations to the Graduate School;

2. Prompts students to meet critical Graduate School milestones to promote retention and timely completion, including preparing Plans of Work, appointing advisory committees, adding and dropping courses, maintaining continuous registration, monitoring graduation applications, and requesting the scheduling of oral exams;

3. Assists students and Director of Graduate Programs in preparing and submitting various forms and documents that require Graduate School approval. These include, but are not limited to, requests for leaves of absence, Graduate Plans of Work, committee appointments, requests for preliminary and final oral exams, grade changes, transfer requests, and reinstatements;

4. Develops proficiency in using the Student Information System (SIS), the Graduate School Information System databases, and other information systems to facilitate all graduate-student-related correspondence with the Graduate School.

**1.6 Graduate School Representatives**

The Graduate School Representative has a unique role on the doctoral examination committee. The Representative protects the interests of the student, the advisory committee, and the Graduate School. The Graduate School Representative is also an "unbiased person" to whom the Dean may turn for judgment and counsel. [Recommended by the Administrative Board of the Graduate School and approved by the Dean of the Graduate School on 10/27/86.]

**A. Appointment Process**

If a doctoral graduate committee has no representation outside of the student's graduate program, a Graduate School Representative is required. Co-chairs can never be considered unbiased, even if they are from outside the student’s graduate program, and would therefore never be able to substitute for the Graduate School Representative.

The Dean of the Graduate School chooses Representatives at random from the Graduate Faculty. Each member of the Graduate Faculty is expected to serve in this capacity. The Dean appoints the Graduate School Representative after the doctoral student’s Plan of Graduate Work is approved. An effort is also made to make no more than two such assignments to a faculty member at any one time. It is the responsibility of the student to schedule preliminary and final examinations that are satisfactory to the Graduate School Representative and to provide the Representative with a copy of the dissertation one week before the final oral.

**B. Responsibilities**

The primary responsibility of the Graduate School Representative is that of an observer. Consequently, the Representative should be invited to participate in both the preliminary and final oral examinations, but should never take a dominant role in the exams. The Representative is expected to contribute to the scholarly atmosphere of the examination. Moreover, the experiences of faculty members who serve as Graduate School Representatives should improve the overall quality of graduate education.

The Graduate School Representative also signs the official examination form and may include comments. The Representative expected to express concerns (if they exist) and encouraged to note any exceptional strengths of the examination. The Graduate School Representative should:

1. Sign the form without comment;

2. Sign the form and note any specific comments; or

3. Sign the form and note that a letter to the Graduate School Dean will follow (with copies to the committee).

The Representative may wish to comment on:

1. the appropriateness of the committee;

2. the adequacy of the Plan of Graduate Work;

3. the appropriateness of the examination questions and procedures;

4. the quality of the student’s performance; and/or

5. reservations about the dissertation.

A signature with no comments indicates that the Representative believes that the examination was properly conducted and does not take exception to the findings of the committee. The signature does not imply the Representative’s approval of the substance of the examination or dissertation. In the event the Graduate School Representative indicates any substantive reservation, the Dean of the Graduate School will investigate and decide the course of action.

**Note:** Serving as a Graduate School Representative is a requirement of Graduate Faculty status. Exceptions are made only on an individual basis and in cases of emergency.
1.7 Administrative Board of the Graduate School

A. Mission

The Administrative Board of the Graduate School advises the Dean of the Graduate School on all matters pertaining to graduate education at NC State.

B. Membership

Voting Members

The Administrative Board is comprised of 23 voting members. The voting members consist of elected as well as appointed members and represent all colleges, interdisciplinary graduate programs, the Faculty Senate and the Graduate Student Association (GSA). Each college is represented by two Graduate Faculty members. One representative is elected by the college’s Graduate Faculty as coordinated by the Associate Dean or college designee responsible for graduate education. The second representative is appointed by the College Dean. The interdisciplinary member is appointed by the Dean of the Graduate School. Board members representing the Faculty Senate and GSA are appointed annually by the Chair/President of those organizations.

Terms of elected members and interdisciplinary representative are three years starting on July 1, and these members may serve for two consecutive terms, although they may serve subsequent terms following a hiatus. The terms for each college’s representatives should be staggered so that both members do not exit the Board simultaneously. Although the expectation is that members will complete their entire term, if that is not possible, then a replacement may be identified by the respective college or unit to complete the remainder of the term. The Board’s Coordinator will notify university units in April of a Board member’s ending term. The unit should provide the name of the new Board member to the Administrative Board Coordinator no later than May 15.

Non-Voting Members

Non-voting members represent and provide insight from other important university offices including one representative from the Distance Education and Learning Technology Applications (DELTA), the Southeastern SACS Liaison, and Registration and Records. The Graduate School is also represented by non-voting members to provide insight about Graduate School administration and policies.

The current list of Board members and their contact information can be found at https://grad.ncsu.edu/about/people/admin-board/ (https://grad.ncsu.edu/about/people/admin-board/).

C. Meetings

The Administrative Board is chaired by the Dean of the Graduate School and meets biweekly during the academic year.

Agendas and minutes from previous meetings will be posted to the Graduate School website (https://grad.ncsu.edu/about/people/admin-board/minutes/ (https://grad.ncsu.edu/about/people/admin-board/minutes/)) at least one week prior to each meeting.

A quorum (12 voting members) must be present to hold a meeting of the Administrative Board. If a quorum is not met, the meeting and all agenda items will be postponed until the next scheduled meeting.

Given the nine-month appointments of many faculty members, board members are expected to be available from August 1 through May 15 to review action items for the academic year, but are generally not expected to review items over the summer.

1.8 Common Administrative Board Actions

A. Course Actions

The Board reviews and recommends for approval course actions for the creation, deactivation, and revision of all graduate and professional (#500-level) courses. These course proposals may be submitted at any time. However, if the desired effective term for a new course is the immediately following semester, the Administrative Board Coordinator must receive proposals by the following deadlines:

<table>
<thead>
<tr>
<th>Date Due to Administrative Board</th>
<th>Desired Effective Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 1</td>
<td>Summer</td>
</tr>
<tr>
<td>March 15</td>
<td>Fall</td>
</tr>
<tr>
<td>September 15</td>
<td>Spring</td>
</tr>
</tbody>
</table>

B. Program Actions

The Board reviews and recommends the following program actions:

- new graduate degree programs, concentrations, and certificates
- discontinuation of degree programs, concentrations, or certificates
- revision of degree program curriculum requirements
- changes to the title or in the CIP code of an existing degree program or concentration

C. Workflow

All items reviewed by the Administrative Board follow the following steps (for a more comprehensive listing of the steps see https://grad.ncsu.edu/faculty-and-staff/program-development/ (https://grad.ncsu.edu/faculty-and-staff/program-development/)):

1. Proposals are initiated in the program/department;
2. Upon program/department approval, the proposals are routed through the college for review by the respective Graduate Studies Committee and the college dean; interdisciplinary programs may require the approval of multiple colleges;
3. Upon college dean approval, the proposals are sent to the Administrative Board Coordinator in the Graduate School;
4. Proposals are reviewed by the Assistant Dean for Program Development;
5. Proposals are reviewed by three Administrative Board voting members;
6. Proposals are placed on the meeting agenda for review and vote by the full Board;
7. After Board recommendation and Graduate Dean approval, no additional approvals are required for curriculum revisions and concentrations. Course actions are sent to Registration & Records for implementation and program actions are sent to the Provost’s
office to continue through the university and, where applicable, UNC system routing processes.

Note: at any point in this process, the proposal may be sent back to the instructor, program, or department for revision.

D. Graduate Policies
Reviews, revises, and recommends for approval revisions to graduate policies contained within the Graduate Handbook.

E. Memoranda of Agreement/ Understanding
Reviews and recommends degree-related agreements, including both domestic and foreign, that pertain to the graduate academics. The routing for these memoranda is identical to that for new programs (see above).

F. Extensions to Time Limits beyond Two Years
Although the Graduate School recommends extensions to the time limits of up to two years, for extensions exceeding these limits, students accompanied by their major professor and DGP must present the rationale for a continued extension to the Administrative Board. The Board will determine whether or not a further extension should be granted.

G. Degree Conferral
Each semester recommends the conferral of graduate degrees for both master’s and doctoral degrees, with the exception of the Doctor of Veterinary Medicine.

H. Posthumous Degrees
Posthumous degrees may be requested for graduate students who are close to completing their degree requirements (see 3.20 – Graduation for additional details (p. 651)).

2.1 Applications
A. Receiving the Application
All applicants to graduate programs and/or certificates must submit the online NC State University Graduate School Application Form (https://grad.ncsu.edu/apply/), including a statement of purpose and the North Carolina Residency Form (if necessary for tuition purposes). Recommenders identified by the applicant during the online application process also submit references online. An unofficial transcript from each college or university previously attended should be uploaded. The Graduate School encourages applicants to pay all application fees by credit card.

Required Documents
Applications for degree-seeking graduate students are not complete until the Graduate School receives a non-refundable application fee and the following documents (for Certificate applications see Section x.x).

- An unofficial transcript from all colleges and universities where they have or will obtain a degree; (Note: Applicants currently attending or who have previously attended NC State are not required to provide an NC State transcript.)

- Three recommendations from people who know the prospective student’s academic record and potential for graduate study;
- Online North Carolina Residency Form if claiming NC residence for tuition purposes submitted within one (1) week of application submission;
- Additional program requirements, such as official GRE or other standardized test scores, statements of purpose, portfolios or other work samples (documentation of these additional programmatic requirements can be linked to through the Fields of Graduate Instruction website); and
- Where applicable, official TOEFL or IELTS scores. All supporting documents should be uploaded to the application prior to submission, and cannot be updated after submission. Other than official transcripts, paper documents should not be mailed to the Graduate School.

Transcript Requirements
Legible, unofficial copies of transcripts should be uploaded to the application for review purposes. Upon recommendation of admission, the University requires that official transcripts that document all prior conferred/awarded degrees be on file in the student’s permanent record at NC State. The transcript(s) must include a statement of any degree(s) awarded. At the time of application, some students are enrolled in a degree program and can only provide an incomplete official transcript at the time an admission decision is reached. The official, complete transcript(s), including statements of all degrees awarded, must be submitted to the Graduate School no later than the last day of classes of the first semester they are enrolled. An initial hold will be placed on a student’s registration if they fail to supply the transcripts with possible termination should they not be provided.

Deadlines for Applications
The Graduate School must receive the application and all supporting documents no later than the deadlines specified by the Graduate School and/or the program; numerous programs have earlier deadlines than those established by the Graduate School. Applicants are responsible for meeting any earlier deadline established by a graduate program to which the prospective student is applying (see the Fields of Graduate Instruction website for links to program deadlines).

Conditions of Admission
Final acceptance at NC State is contingent upon completion and official documentation of any degree (bachelor’s or master’s) listed in an applicant’s application. It is the applicant’s responsibility to maintain a level of academic performance that meets university and program admission standards. Poor performance during the last semester(s) could jeopardize an applicant’s admission. Likewise, students currently enrolled in Post Baccalaureate Studies (PBS) or who request an admissions deferral and take PBS coursework must also maintain a level of academic performance that meets the university’s and program’s admission standards. Failure to comply with these conditions could, at the discretion of the program and/or Graduate School, be grounds for changing the admission status.

Length of Application Validity
An application is valid for 12 months from the date it was submitted by the applicant.
Number of Programs for Which Applicant Can Be Considered

An application is only valid for admission consideration by one graduate program. If an applicant wants to be considered for admission to additional programs, they must re-apply and pay an additional application fee for each program they apply to.

B. Waiving the Application Fee

Under exceptional circumstances, the Graduate School may waive the application fee. (https://ncsu.service-now.com/gradschool?id=kb_article&sys_id=5eab88dbdbce4f40de08f1a51d9619cf/)

C. Processing Applications

All Applications

Applicants must ensure that all of the required materials are submitted. When the Graduate School receives a completed application and the application fee, an admission record is created for the applicant and their application is made available to the program of interest. The DGP and the graduate program review the completed files of all applicants in accordance with the Graduate School’s guidelines for final admission or denial decisions. The DGPs then submit their recommendations to the Graduate School.

The Graduate School reviews the departmental recommendations and, in cases where the Graduate School concurs with an admission decision, requests official transcripts. Once the official transcripts are received and verified, the Graduate School posts the final admission decision. When the Graduate School denies a program’s recommendation for admission, the program has the option of supplying further justification to the Graduate School. However, the Graduate School has the final decision.

International Applications

Before international applicants’ admission status can be finalized, they will need to submit a completed Certificate of Financial Responsibility (CFR) and/or a Visa Clearance Form (VCF), depending upon their visa status, directly to the Graduate School. Once the CFR and/or VCF are approved, applicants must accept the offer of admission before a Certificate of Eligibility (Form I-20 or DS-2019) will be created (see Section x.x for detailed information on International Applications).

D. Reapplication

Students denied admission into a graduate program may be reconsidered for admission at a later time upon submission of a new application and supporting materials.

2.2 Application Deadlines

A. U.S. Applicants and Permanent Residents

The following dates are Graduate School application deadlines. Many programs have earlier deadlines (see URL). Applicants should submit applications and all supporting documents on or before the Graduate School or program deadline, whichever is earlier.

<table>
<thead>
<tr>
<th>Semester</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>June 25</td>
</tr>
<tr>
<td>Spring</td>
<td>November 25</td>
</tr>
<tr>
<td>Summer I</td>
<td>March 25</td>
</tr>
<tr>
<td>Summer II</td>
<td>May 10</td>
</tr>
</tbody>
</table>

B. International Applicants

The following dates are Graduate School application deadlines for international applicants. Many programs have earlier deadlines (see URL). International applicants should submit applications and all supporting documents on or before the Graduate School or program deadline, whichever is earlier.

<table>
<thead>
<tr>
<th>Semester</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>March 1</td>
</tr>
<tr>
<td>Spring</td>
<td>July 15</td>
</tr>
<tr>
<td>Summer I</td>
<td>December 15</td>
</tr>
<tr>
<td>Summer II</td>
<td>December 15</td>
</tr>
</tbody>
</table>

C. Late Applications

1. Departments are under no obligation to review or consider any applications received past their program deadlines.
2. Should departments wish to consider late applications, they may do so without requesting special waivers from the Graduate School.

2.3 Graduate School Admissions

A. Types of Admission

The criteria used for admissions decisions vary by program, reflect an evaluation of the applicant’s potential for graduate work, and consider the ability of a program to accommodate additional students. Departmental admissions committees consider requests for admission and forward their recommendations to the Graduate School. However, Graduate School regulations govern the criteria for the classification of graduate student status. Programs should first determine the appropriate status of the student before forwarding their admission recommendations to the Dean of the Graduate School.

There are three types of admission to graduate study at NC State:

- Full-graduate standing
- Provisional
- Graduate-unclassified

B. Full Graduate Standing

To be considered for admission in full graduate standing, applicants must have:

- (a) a four-year bachelor’s degree (or equivalent) from a regionally accredited college or university. Exceptions to standard accreditation may be granted for applicants with international degrees, including
applicants with three-year degrees from institutions in Europe participating in the Bologna Process.

- (b) a GPA of at least 3.00 (on a 4.00 scale) in their undergraduate degrees.

C. Provisional Admission

Students may be granted provisional status when they do not fully meet all the necessary requirements for admission to the Graduate School, but their circumstances warrant provisional admission.

1. Students with related bachelor’s degree and overall bachelor’s GPAs that fall below 3.00 on a four (4)-point scale) Provisional admission may be granted to students with related bachelor’s degrees from regionally accredited institutions whose GPAs fall below 3.00 standards for admission to full graduate standing when:
   a. unavoidable, extenuating circumstances affected their undergraduate averages, or
   b. progressive improvement in their undergraduate work warrants provisional admission. Students can attain full-graduate standing after completing nine or more graduate credit hours with a minimum 3.00 GPA. Courses taken for S/U grade cannot be used as part of the minimum. A graduate student is not eligible for appointment to an assistantship or fellowship while on provisional status.

2. Students with non-related bachelor’s degrees (from accredited institutions) The Graduate School may grant provisional admission to applicants with bachelor’s degrees from accredited institutions who lack undergraduate work considered essential for graduate study in a major field. The Graduate School grants full-graduate standing when the deficiencies responsible for the provisional status are corrected through additional coursework. The student must also maintain a satisfactory academic record (3.000 GPA) on all coursework taken in a graduate classification. The graduate program must also recommend that full graduate standing be granted to the student seeking admission.

D. Graduate-Unclassified Status

The Graduate-Unclassified status is a temporary classification for students, such as foreign visitors (see Section 2.4), who are not candidates for degrees. Students may take courses for graduate credit but may not apply more than 12 credits to any program leading to an advanced degree at NC State.

Unclassified graduate students must meet the same admissions requirements that apply to graduate students in full standing. Individuals interested in applying for admission as Graduate-Unclassified Students should contact the graduate program of interest.

E. Eligibility for Student Status in a Graduate Program

Students who graduate from a degree program can no longer register as students in that program unless they are formally admitted to a new graduate classification (e.g., from a master’s to a doctoral degree). Students with specific educational goals not encompassed by traditional degree programs may request admission in the “Graduate-Unclassified Status” or register in the “Post-Baccalaureate Studies” program through Registration and Records (https://registrar.ncsu.edu/).

F. Process of Admission or Denial

Using the online DGP Decision Recommendation form, the Director of Graduate Programs (DGP) indicates via a checkbox on the form that all information is accurate (including GPA information) and that the decision recommendation is ready for communication to the applicant.

After reviewing the applicant’s file and, if necessary, consulting with the appropriate DGP, the Graduate School notifies the applicant of acceptance or denial of admission. The DGP and the applicant will have access to this letter via the online system. DGPs should only notify an applicant regarding admission after the official notification of admission is posted online by the Graduate School. A template departmental admission letter is available for that use.

G. Advanced Enrollment Deposits

1. Some graduate programs require a deposit for newly admitted masters and doctoral students to enroll. Admitted students must confirm their intent to enroll via the link in their online decision letter by filling out the enrollment form and paying their enrollment deposit. Payment options include credit card and check. The non-refundable deposit will be credited toward tuition for the student’s admit term; there is also a processing charge. The deadline to submit the enrollment deposit will be June 15 for Fall and Summer terms/sessions, and November 15 for Spring, or within two weeks of an admission decision rendered after these deadlines.

2. Advanced enrollment deposits are term specific. Should a student receive approval for deferment of their admission to a future term after having paid the advanced enrollment deposit, they must request a deferral of their enrollment deposit by notifying the Graduate School by September 1 of the year in which they were originally admitted. Failure to request a deposit deferral by the due date will result in forfeiture and a new deposit will be required for the future term. Exceptions cannot be granted to this policy.

3. Sponsored students (research assistants, teaching assistants and fellows) are required to pay the enrollment deposit. When tuition awards are posted to these students’ financial accounts, the amount of the advanced enrollment deposit will go toward student fees. If student fees are covered under the sponsorship, then the deposit amount will be refunded by the University Cashier’s office.

H. Exceptions to Standard Admission

1. Doctoral applicants with previous doctoral degrees. An individual who has a doctoral degree will be denied admission to a doctoral program at NC State. The Dean of the Graduate School may make exceptions based upon departmental recommendations.

2. Applicants to graduate programs without bachelor’s degrees but with professional degrees. The Graduate School may consider an applicant who does not possess a bachelor’s degree, but who has earned a D.D.S., D.V.M., J.D., PharmD, or M.D. degree from a regionally accredited institution for admission to a graduate program.

3. Applicants who have a previous Master’s degree in the program to which they are seeking admission. The Graduate School will not admit or transfer a student to a Master’s program if the student already holds a Master’s degree in the same discipline. Exceptions may be considered if a statement of justification is provided by the DGP and is then approved by the Dean of the Graduate School.
I. Date of Admission

1. Deferral of Admission. Registration is automatically canceled when students do not enroll for the semester or summer session for which they received admission. Any applicant wishing to defer the admission date must submit a written request to the graduate program. Both the graduate program and the Graduate School must approve the request. The maximum time that a student may be granted a deferral is one year.

2. Ineligibility for leave of absence prior to enrollment. Leaves of absence are available only to currently enrolled students or students already on an approved leave of absence. Students who are admitted for an upcoming semester, but are unable to register, must request a deferment in writing to their graduate program and Director of Graduate Programs.

J. Readmission

Students must reapply if they are terminated at NC State because of non-compliance with the continuous registration policy and wish to resume study in their original graduate program. The student must submit a new application and pay the application fee, submitting all materials as if applying for the first time. However, letters of recommendation and GRE scores less than five years old that are on file in the Graduate School or department may be transferred to the second application, upon request.

If the program approves the student’s request for readmission, the Director of Graduate Programs must submit both a letter of justification and an online DGP Decision Recommendation form to the Graduate School on the student’s behalf. The Graduate School makes the final decision on the student’s readmission.

K. Contractual Readmission for Master’s Students

In rare circumstances, a program may request that the Graduate School contractually readmit a student. Contractual readmission permits students, who had previously enrolled in a master’s program at NC State and obtained GPAs below a 3.00, to pursue a master’s degree in another field and have their GPAs reset. The program requesting this readmission must be different from the one in which the student was originally enrolled. Students must complete the Graduate Contractual Readmission form and this must be approved by the new program’s DGP and the Graduate School. This process will not remove the previous coursework from their NC State transcript, but it will allow the calculation of the graduate GPA to commence when they enroll in the new program. Furthermore, this process requires a break in enrollment; the coursework for the prior program must have been completed at least two years prior to the term in which the student will re-enroll.

L. International Admission Pending Receipt of Certain Documents

International students cannot be admitted until the Graduate School receives additional documentation required by both the US Citizenship and Immigration Services (https://www.uscis.gov/) (USCIS) and the Graduate School (see Section xx).

M. NC State Faculty Enrollment in Degree Programs

Any NC State faculty member, regular or special, may enroll in an NC State program to pursue an advanced degree, provided they have the prior approval of their Department Head and Dean. Annual renewal or rescinding of approval must occur by letter in the faculty member’s personnel file. The Department Head and Dean are responsible for ensuring that no conflict of commitment, conflict of interest, unethical or improper actions, or privileges are incurred in this process.

N. Post-Baccalaureate Studies (PBS) Classification

Those who wish to undertake academic work beyond the bachelor’s degree, but are not currently admitted to a graduate degree program, may enroll under the Post-Baccalaureate Studies (PBS) classification. This classification is open only to US citizens, permanent residents, and international students who are sponsored by an agency of the US government or are married to an NC State student. Registration is through Registration and Records.

Rules for Participation in PBS

The following are university minimum requirements, although home departments may have more restrictive requirements.

1. All applicants must have a bachelor’s degree from a regionally accredited institution of higher education.

2. All classes taken for credit by PBS students will be graded in the usual manner that applies for the particular course (A+ through F or S/U). All courses taken at NC State will appear on the student’s transcript.

3. Registration is limited to a maximum of two courses per semester. Individuals who are employed full-time should limit their PBS registrations to one course per semester.

4. The GPA of a graduate student who has credits in the PBS category will be based on all courses taken at the 400-800 level. If PBS courses are included in a student’s degree program, his/her degree clock for time-to-completion starts with the first course approved for inclusion in the Plan of Work.

5. If a student’s graduate degree program is terminated, he/she cannot use courses taken in PBS status after termination for credit toward the same graduate degree program.

6. The student’s advisory committee must approve all coursework accepted for degree credit. Requests for degree credit for courses completed in the PBS classification are considered after admission to a graduate degree program when the student’s Plan of Graduate Work is filed with the Graduate School.

7. The PBS classification carries with it no implication that the student will be admitted to the Graduate School in any degree classification or that courses taken will be accepted for degree credit.

8. PBS students are required to familiarize themselves with Graduate School and departmental policies and to seek further advice or clarification as needed.

O. Teaching Certificate Renewal

Public-school personnel who are primarily interested in “certification credit” may enroll in the PBS program without forwarding transcripts of previous work to the Graduate School. However, these students must be admitted in the Graduate–Unclassified status before completing their certification. The College of Education determines the applicant’s qualifications for enrollment.
P. English Proficiency Requirements for International Applicants

To be eligible for admission to graduate study at NCSU, all non-US citizen applicants (i.e., non-resident aliens and permanent residents) must demonstrate proficiency in English at a level necessary to be successful in a graduate program at NC State. This requirement can be met for most applicants in one of the following ways; however, some programs may require additional evidence of English proficiency:

1. Provide Test of English as a Foreign Language (https://www.ets.org/toefl) (TOEFL) with a total score of at least 80 on the Internet-based Test (iBT), and with minimum test scores for each section of:
   - Listening 18 points
   - Reading 18 points
   - Writing 18 points
   - Speaking 18 points – for admission, 23 points – for TA appointment where TA has direct verbal interactions with students, 26 points – for TA appointment where TA presents lectures in the class or laboratory NOTE: The current computer- and paper-based versions of the TOEFL test will be given until the iBT version is implemented in a particular location. Computer-based TOEFL scores must be 213 or higher (with at least 17 on three sections and no section score below 13). The paper-based test requires a score of 550 or higher (with scores of 50 on at least two of the three sections and no section score below 45).
2. Provide International English Language Testing System (https://www.ielts.org/) (IELTS) scores with an overall band score of at least 6.5. Minimum test scores for each section are listed below:
   - Listening 6.5
   - Reading 6.5
   - Writing 6.5
   - Speaking 6.5 – for admission, 7.0 – for TA appointment
3. be a citizen of a country where English is the official language (https://projects.ncsu.edu/grad/handbook/docs/official_language_english.htm) and the language of instruction in higher education;
4. have successfully completed at least one year of full-time study in a degree program at a regionally accredited four-year US College or university.

TOEFL or IELTS test scores must be no older than two years (24 months) prior to the beginning of the requested entry term.

2.4 International Student Admissions

The Graduate School can inform an international student of academic acceptance, but cannot grant official admission until certain critical documents are received and approved either by the International Admissions Specialist at the Graduate School or by the Office of International Services (https://internationalservices.ncsu.edu) (OIS). International students (non-resident aliens) are those who have neither United States citizenship nor permanent resident status in the United States. U.S. permanent residents will be required to show proof of valid permanent residency if recommended for admission.

Applicants who are overseas internationals, U.S. permanent residents, or international students already residing in the U.S. on a visa that allows study, must send their paperwork to the International Admissions specialist at the Graduate School. Those applicants who will need to change their visa status to F-1 or J-1 prior to enrolling must send their paperwork to OIS. The OIS staff members also provide immigration and cross-cultural assistance to students on nonimmigrant visas throughout their program at NC State.

A. Types of Admission for International Students

International graduate students are admitted to either full-time study in a specific graduate program or into the Graduate-Unclassified category as an international visitor. In addition to admission requirements listed elsewhere for graduate admission, applicants who are not U.S. citizens must complete and submit a Visa Clearance Form and/or a Certificate of Financial Responsibility (see additional sections below) before a final admission decision can be made. Criteria for international visitors are as follows:

1. International student visitors must state their educational objectives at NC State and the time expected to accomplish those objectives (normally one semester or one academic year). The educational objective may not be to seek a graduate degree at NC State.
2. They are expected to meet the same minimum academic admission requirements that apply to graduate students in full standing.
3. They are expected to meet the same TOEFL requirements that apply to international students who are admitted to Master’s and doctoral programs if they plan to take courses. If they plan to register for research only, they are not required to take the TOEFL.
4. They must be recommended by the DGP of the program in which they plan to take courses or do research.
5. Special admission status may apply for a period not to exceed one year.
6. They may hold a research assistantship but may not hold a teaching assistantship (provided their nonimmigrant status allows on-campus employment).
7. They will not be eligible for out-of-state tuition remission.
8. Those in F-1 or J-1 status must maintain full-time enrollment and all other requirements based on their particular nonimmigrant status.

B. English Proficiency Requirements

In order to be eligible for admission to the Graduate School all non-US citizen applicants (i.e., non-resident aliens and permanent residents) must demonstrate proficiency in English at a level necessary to be successful in a graduate program at NC State (see English Proficiency Requirements (p. 644)).

C. Visas

Under immigration law, international students are divided according to their immigration classification. Each visa type has its own eligibility requirements and restrictions.

1. F-1 Student – is a resident of a foreign country who plans to return to their home country and who is coming to the U.S. temporarily and solely for the purpose of attending a school previously determined by the student. An F-1 student is required to demonstrate full financial support to obtain the F-1 visa and be admitted to the U.S. as a student. There are numerous requirements and restrictions regarding enrollment, employment, travel, etc., and detailed information is available from OIS.
2. J-1 Exchange Visitor – is a classification that serves a variety of educational purposes. Under this status, students, scholars, professors, and researchers may come to the U.S. temporarily for the purpose of educational exchanges under the sponsorship of an approved organization or institution. Students often enter the U.S. in J-1 Exchange Visitor status when they are participants in sponsored activities such as the Fulbright program.

3. Other Visa Types- in addition to F-1 and J-1, there are other visa types represented among the international student population at NC State, such as H-1B, TN, O, and E visas.

International applicants already in the U.S. who wish to study at NC State must indicate on the Visa Clearance Form (see below) whether they wish to remain in their current nonimmigrant status or wish to change their status. Because processing times at the U.S. Citizenship and Immigration Services are sometimes long and there are many factors that must be taken in to consideration when deciding to change one’s status, those in dependent status (F-2) are recommended to contact an OIS advisor early in the admission process. A link to the online Visa Clearance Form is issued when the Graduate School sends the academic acceptance letter; if the applicant is a foreign national in the U.S. The applicant should complete and return this form to the appropriate office listed on the form as soon as possible to enable the Graduate School to grant official admission. To finalize an international student’s application, the Graduate School must receive a completed Certificate of Financial Responsibility (CFR) and/or a Visa Clearance Form (VCF) depending on their status. Once approved, the Graduate School or OIS will then issue Certificate of Eligibility Form I-20 for an F-1 visa or Form DS-2019 for a J-1 visa. The Certificate of Eligibility can be used as partial documentation to: apply for a visa overseas; request admission/inspection at a U.S. port of entry; and as proof of nonimmigrant status when applying for certain benefits. International applicants can check on the status of their application/admission, including when the Certificate of Eligibility was issued by going to: http://www.ncsu.edu/applygrad (http://www.ncsu.edu/applygrad/). A lawful permanent resident of the U.S. (“Green Card holder” or “resident alien”) is not required to demonstrate financial ability on the CFR and needs only to complete and submit the Visa Clearance Form.

D. Certificate of Financial Responsibility

The Certificate of Financial Responsibility (CFR) requires the candidate to provide evidence of ability to cover all expenses, including those of any accompanying dependents, for each year of study. Students must return the complete CFR to the Graduate School. Once the CFR and/or VCF are approved, the applicant will receive a Certificate of Eligibility Form I-20 (or DS-2019) and an official admission letter. Scholarship award letters are not acceptable substitutes.

E. Health Insurance Requirement

Hospitalization costs in the U.S. are high and having appropriate health insurance is a requirement for all international students at NC State in F-1 or J-1 status. All international students in F-1 or J-1 status must purchase the University student health and accident insurance plan (or opt out through the universities hard-waiver program if other acceptable health insurance has already been purchased) throughout their program of study at NC State. Those who do not maintain this required insurance will have a hold placed on their ability to register.

F. Letters of Assurance for Research Participation

The Board has determined that no international students are required to sign Letters of Assurance, such as those occasioned by the Export Control Act, as a condition of participating in research activities.

G. Full-time Status Requirement

International students in F-1 or J-1 status must carry a full course load in each regular semester to comply with the US Citizenship and Immigration Services (https://www.uscis.gov/) (USCIS) regulations. Please refer to Section 3.15 for information on determining full- and part-time status.

H. Assistantship Limitations

International students in F-1 or J-1 status may not hold assistantships or a combination of assistantships that exceed 20 hours of service work per week during Fall and Spring semester since this jeopardizes their student status with USCIS. However, these students can have appointments up to 1.0 FTE during the Summer sessions.

I. Employment

International students should consult with OIS before accepting any type of employment. Employment regulations vary by visa type.

2.5 Medical History and Immunizations Requirements

All graduate students admitted to a degree program are required by State law to submit a report of medical history and immunization documentation prior to initial registration. Both forms are available online through the HealthyPackPortal (https://healthypack.dasa.ncsu.edu/healthweb/). This report must document immunization against tetanus/diphtheria, measles, German measles, polio, and for international students from a high risk country, show results of a tuberculin skin test (must be completed at U.S facility) or TB blood test. Graduate students who have recently completed their undergraduate work at NC State must update their medical history. Student Health Services (https://healthypack.dasa.ncsu.edu/) must receive the required reports at least 30 days before registration. If the student does not meet this requirement, dismissal from school is mandatory under the law.

3.1 Graduate School Minimum Requirements

A. Master of Arts and Master of Science

All Master of Science and Master of Arts degree programs are planned with the objective of making possible a reasonable, comprehensive mastery of the subject matter in a chosen field. In most cases, the Master of Science and Master of Arts programs provide training and experience in research in order to familiarize the student with the methods, ideals and goals of independent investigation. In these cases, representative of most Master of Science and Master of Arts degree programs, a thesis is required. A small number of Master of Science and Master of Arts programs do not require a thesis.
Students in the Master of Arts or Master of Science programs follow the individual program and the Graduate School requirements that were in effect when they entered the program.

The following are minimum requirements for a degree in Master of Science or Master of Arts degree programs:

1. A minimum of 30 semester hours of graduate work in the degree program, unless the specific program requires more hours.
2. A reading knowledge of a foreign language (in a few programs; see Section 3.5 (p. 653))
3. A comprehensive written examination (in some programs)
4. A thesis (in most programs)
5. A comprehensive oral examination (except Option B programs)

Note: Requirements for ALL master’s degrees must be completed within six (6) calendar years. For further information about the time limited for degrees, see Section 3.4 (p. 653).

B. Master’s Degree in a Designated Field

A number of departments and programs offer master’s degrees in designated fields. These are professional degrees and do not require a thesis. Master’s Thesis Research (XXX 695) may not be included as part of the Plan of Work.

Requirements include the following:

1. A minimum of 30 semester hours of graduate work in the degree program (unless the specific program requires more hours).
2. A comprehensive written examination (in some programs)
3. A comprehensive oral examination (except Option B programs)

C. Option B Master’s Degree

The Option B Master’s degree requires that students adhere to the general guidelines for a Master of Arts or Master of Science degree with the following exceptions:

1. A comprehensive oral exam is not required
2. A thesis is not required
3. Master’s Thesis Research (XXX 695) may not be included as part of the Plan of Work
4. Individual departments define other requirements for their Option B program, such as additional course work or final projects
5. Option B Master’s degree programs cannot carry an officially designated minor
6. Students have a single assigned advisor rather than an advisory committee.

Changing Master’s Programs to “Option B”

Master’s degree programs that require final oral examinations may petition the Graduate School for permission to operate the program with a single advisor and to eliminate the final oral examination (Option B). Option B Master’s degree programs may not carry an officially designated minor.

Petitions need the approval of school/college-level Graduate Studies Committees and must be made for an entire degree program, rather than for individual students. The Administrative Board of the Graduate School will review each petition and make appropriate recommendations to the Dean of the Graduate School. The petition form is entitled Proposal for Changing Non-Thesis Graduate Degree Program Requirements to Option B.

D. Credit Hour Requirements for Master’s Degrees

[Recommended by the Administrative Board of the Graduate School and approved by the Dean of the Graduate School on 6/17/2009]

A minimum of 30 semester credit hours is required for all master’s degrees. Students may take more than the minimum hours required by their programs. The Graduate School does not give credit for non-credit course work (i.e. non-departmental seminars, workshops, short courses, conferences, and any “life experience” offerings). Furthermore, the Graduate School does not allow credit by examination.

The following are specific credit-hour limitations:

1. At least 18 credit hours must be graduate credits earned while the student is enrolled in the graduate program.
2. The remaining 12 credit hours or more, depending on the requirements of the specific program, may be transferred from any of the sources or any combination thereof set forth below as transfer credit.
3. At least 18 credit hours of letter-graded courses (“A,” “B,” “C”, etc.) must be included in the program. These must be NC State or inter-institutional courses.
4. No more than six credit hours of 400-level (undergraduate) courses may be included in the program, and they may not come from the major field.
5. Credit hours for the following courses may NOT be used to satisfy the 30-credit hour requirement: Non-Thesis Master’s Examination (XXX 689), Non-Thesis Master’s Continuous Registration (XXX 688 and XXX 689).
6. No more than 12 credit hours may be used to satisfy degree requirements for another master’s degree program at NC State, unless the student did not complete the other program. (See Section 3.11A, Multiple Master’s Degrees).
7. Courses at the 900 level may not be counted toward a master’s degree.

Transfer of Credits

1. Transfer of graduate credits earned at other universities. A course that was completed at another college or university may be considered for transfer to a master’s program provided that:
   a. The course is classified as a graduate course.
   b. It was completed while the student was in a graduate or post-baccalaureate classification.
   c. It was not taken as a part of a previous master’s degree program at another institution.
   d. The grade in the course is B or better. Courses with grades of B- or lower will not be allowed to transfer.
   e. The college or university is accredited by one of the following six U.S. regional accrediting agencies: the Southern Association of Colleges and Schools, the Middle States Association of Colleges and Schools, the New England Association of Colleges and Schools, the North Central Association of Colleges and Schools, the Northwest Association of Colleges and Schools, or the Western Association of Colleges and Schools.
Exceptions are allowed for transfer from international institutions if the department or program provides the Graduate School with adequate documentation that the course is relevant to the graduate degree and comparable to an equivalent course at NC State, and that the course was taught by faculty who are qualified to teach at the level of a master's degree. Where the grading system and grading culture in such institutions differ from that at NC State, students may (with the help of the Study Abroad Office) provide a letter to the Graduate School establishing the minimum average grade required for a graduate degree from that institution. That grade will be taken as the minimum grade for transfer in lieu of the “B” noted in 1(d) above.

2. Transfer of graduate credits earned while enrolled in an undergraduate program at NC State University. A course that was completed while the student was enrolled as an undergraduate at NC State University may be considered for transfer to a master's program provided that it is at the 400-level or higher, that the earned grade is B or better, that it was not counted toward fulfillment of undergraduate requirements, and that it is verified by the undergraduate coordinator and recommended by the DGP. No credit will be allowed for a course completed in an undergraduate classification at another institution. Credit hours at the 400 level are subject to the restrictions stated in subsection D.4 above. Courses with grades of B- or lower will not be allowed to transfer. (NOTE: Students admitted to the Accelerated Bachelor’s/Master’s program may use up to 12 hours of graduate credit [500 or 700 level] to satisfy requirements for both the bachelor’s and the master’s degrees.)

3. Transfer of graduate credits earned while enrolled in a previous graduate degree program at NC State University. A graduate course that was completed while the student was enrolled in a previous graduate program at NC State University may be considered for transfer to a master’s program provided that:

(a) The course was a letter-graded (“A,” “B,” “C,” etc.) 500- or 700-level course and that the grade is B or better. Courses with grades of B- or lower will not be allowed to transfer. (b) It was not taken as a part of a previous master’s degree at another institution.

4. Transfer of Post-Baccalaureate Studies (PBS) graduate credits earned at NC State University. A graduate course that was completed while the student was enrolled in PBS status at NC State University may be considered for transfer to a master’s program provided that it is at the 500 level or higher and that the grade is B or better. Courses with grades of B- or lower will not be allowed to transfer. All PBS credits that are used to satisfy requirements of a specific master's degree must be earned before the student is admitted to that degree program. A maximum of 12 credit hours taken while in PBS status may be transferred into a master’s degree program. See Section 2.3 (p. 644) for information on admission to PBS classification. If a student's graduate degree program is terminated, he/she cannot use courses taken in PBS status after termination for credit toward the same graduate degree program.

**Submitting Transfer Credit for Graduate School Approval**

When the graduate program submits the online Plan of Graduate Work through MyPack Portal, the DGP submits a letter requesting that any transfer credit be accepted as part of the student’s master’s program. An official transcript indicating the work to be transferred must accompany the letter.

**E. Doctor of Philosophy and Doctor of Education**

Doctoral students must demonstrate their ability to undertake scholarly research by writing a dissertation reporting the results of an original investigation, by passing a series of written and oral preliminary examinations in the field of specialization and related areas of knowledge, and by successfully defending the dissertation.

The following are requirements for the Doctor of Philosophy and Doctor of Education degree programs:

1. At least two (2) residence credit points secured in continuous semesters’ residence as a graduate student at the University (see Section 3.15 (p. 662) for scale).

2. Doctoral degrees at North Carolina State University require a minimum of 72 graduate credit hours beyond the bachelor’s degree.

3. Students cannot take 400-level courses or lower as part of the credit-hour requirement.

4. Students cannot use 900-level courses to satisfy the credit-hour requirement.

5. For a student who has a master’s degree from a university other than NC State, a maximum of 18 hours of relevant graduate credit from the master’s degree may be applied toward this minimum, upon the recommendation of the student’s Graduate Advisory Committee. Therefore, the minimum credit-hour requirement in this case is 54 credit hours. Students whose previous master’s was combined with a three-year bachelor’s degree from a non-Bologna institution to meet the minimum requirements for admission will not be entitled to this 18 credit allowance and will not be considered to have a previous master’s.

6. If a student completes a master’s degree at NC State and continues for a doctoral degree without a break in time, up to 36 relevant credit hours taken while in master’s status may be used to meet minimum requirements for the doctoral degree. If there is a break in time between completing the master’s (at NC State) and beginning the doctorate (at NC State), the allowance is limited to 18 hours. Either allowance may include those 400-level courses taken as an approved part of the master’s degree.

7. A graduate course that was completed while the student was enrolled in PBS status at NC State University may be considered for transfer to a doctoral program provided that it is a 500- or 700-level course and that the grade is B or better (see Section 2.3 (p. 644) for information on admission to PBS classification). Courses with grades of B- or lower will not be allowed to transfer. All PBS credits that are used to satisfy requirements of a specific doctoral degree must be earned before the student is admitted to that degree program. These courses must be evaluated and recommended by the student’s advisory committee on the basis of appropriateness and currency of the course material. In such cases, the student’s degree clock starts with the first of these courses approved for inclusion in a plan of work (POW). Final approval is given by the DGP upon submission of the POW to the Graduate School. A maximum of 12 credit hours taken while in PBS status may be transferred into a doctoral degree program.

8. Students who hold a Ph.D. are generally not admissible for a second Ph.D. unless a “special exception” is requested and granted (see Section 2.3 (p. 644) and REG 2.15.01).

9. A successful preliminary comprehensive examination (written and oral components)
10. A dissertation.
11. A successful final comprehensive oral examination (dissertation defense).

Note: Doctoral students must attain candidacy for the degree within six (6) calendar years. The time limit for completing all requirements for the Doctor of Philosophy and Doctor of Education degrees is noted in Section 3.4 (p. 653).

3.2 Advisory Committees

The primary function of the committee is to advise the student in all aspects of the educational program and to monitor and evaluate progress toward and completion of the degree. Thus, the committee must be active throughout students’ programs, beginning with helping students prepare their Plans of Work. The committee should provide an intellectually stimulating foundation for the student’s professional as well as scholarly development and should be sensitive to any difficulties in the student’s progress. The committee certifies whether the student has met NC State’s standards for a graduate degree. Advising and guiding the student on how best to fulfill the degree requirements is a critical element of this responsibility.

It is the students’ responsibility, in consultation with their graduate advisors, to select graduate advisory committees. The graduate advisor(s) serves as chair or co-chair of the committee. The Director of Graduate Programs approves and electronically submits the advisory committee names to the Graduate School for final approval as part of the Plan of Work.

A. Advisory Committee Requirement and Composition

1. Committee administrative structure
   a. Every committee shall have a chair or co-chairs.
   b. The co-chair designation implies equally shared responsibilities in guiding the student through to degree completion.

2. Master’s students
   a. For master’s students in all programs except Option B, the committee consists of a minimum of three graduate faculty members, inclusive of the committee chair. The Graduate School verifies the committee when the DGP submits the Plan of Work that includes the committee information.
   b. If a minor has not been declared, it is up to the individual program whether to require external representation on the committee.
   c. If a minor has been declared, one member of the committee must be from the minor field.
   d. In a master’s program in which the minor is classified as interdisciplinary, the minor must be represented by a committee member.
   e. Option B master’s students do not have a committee. The Graduate School will verify the appropriate major advisor when the DGP submits the students’ Plans of Work.

3. Doctoral students
   a. Doctoral committees require a minimum of four graduate faculty members
   b. If a doctoral graduate committee has no outside representation beyond the student’s graduate program by a member of the graduate faculty, a Graduate School Representative is required. This representative is not a voting committee member.
   c. If the student has declared a minor, one of the committee members must be from the minor field.
   d. The committee membership is submitted for approval as part of the Plan of Work
   e. At the time that the committee is approved, the Graduate School appoints the Graduate School Representative (see Section 1.6 (p. 641)) to serve on the doctoral committee, if required.

B. Functions, Responsibilities and Requirements of the Advisory Committee

The chair/co-chair and the other members of the advisory committee are responsible for the following aspects of the thesis or dissertation and the associated research experience:

1. approval of the subject matter and methodology of the thesis or dissertation research;
2. approval of the organization, content, and format of the thesis or dissertation according to NC State required and optional formatting guidelines as provided in the Thesis and Dissertation Guide;
3. review of and comment on drafts of various sections of the thesis or dissertation, including:
   a. the quality of data and evidence,
   b. logical reasoning, and
   c. the editorial, linguistic and bibliographic quality;
4. evaluation of the thesis or dissertation as a basis for certification that the student has fulfilled that portion of the degree requirements for which he or she is a candidate.

For non-thesis master’s degrees that require a final examination, the advisory committee is responsible for administering that exam.

C. Committee Members from Other Institutions

The selection of outside committee members will generally depend upon the student’s major interest and research. If the program recommends the appointment of a committee member who is not an NC State graduate faculty member, it should be made clear to that person that he or she will be expected to participate as a full committee member.

There are three types of non-NC State faculty who may be appointed to a graduate committee: inter-institutional faculty, external (voting) members, and technical consultants.

1. Interinstitutional Graduate Faculty
   a. Graduate Faculty from UNC-CH and Duke. A member of the graduate faculty from the University of North Carolina at Chapel Hill or Duke University may serve as one of the required committee members when appropriate. These are automatic appointments, although the members are vetted by the DGP of the program, the Associate Dean of the College involved, and the Dean of the Graduate School. Members of professional programs at these institutions, such as faculty at the School of Law or Medical School at UNC or Duke, cannot serve automatically unless their appointment at their respective institution explicitly states that they are on the graduate faculty. A Graduate Advisory Committee Appointment Form for Interinstitutional Member must be completed for faculty from these institutions. Should their appointment be for that professional school only, then they must
follow the guidelines discussed for External Members and/or Technical Consultants (see below).

b. Cooperative Doctoral Program Graduate Faculty from UNC-System Institutions. In addition to the non-degree-specific interinstitutional arrangement of NC State, UNC, UNC-G and Duke, NC State has established cooperative doctoral programs with other UNC-system institutions.

2. External Members. A faculty member from another university (who is not an interinstitutional graduate faculty member) or a professional from industry or government with credentials comparable to those required for membership on the graduate faculty, may serve as an external member, in addition to the number of committee members normally required (four for doctoral degrees and three for master’s degrees).

a. Appointment. To appoint an external member, the DGP must submit a Graduate Advisory Committee Appointment Form for External Member/Technical Consultant along with the proposed external member’s curriculum vitae.

b. Responsibilities. External members will have full voting privileges and are expected to participate in the student’s preliminary and final examinations. They will also be consulted in the development of the student’s Plan of Graduate Work and will approve the thesis or dissertation.

3. Technical Consultants. A person from industry, a governmental agency, or a university may, upon recommendation of the committee and the DGP, serve as a technical consultant along with the required committee members.

a. Appointment. To appoint a technical consultant, a Graduate Advisory Committee Appointment Form for External Member/Technical Consultant must be submitted to the Graduate School, along with a statement describing the Technical Consultant’s potential contribution to the student’s research or project.

b. Responsibilities. Technical consultants serve in an advisory capacity to students in the conduct of research for their dissertation, thesis or master’s project. Technical consultants are expected to participate in the student’s preliminary and final examinations and may sign the thesis. However, they will not vote on the outcome of the examinations.

D. Substitution of Committee Members for Exams

Under extenuating circumstances, it may be necessary for a member of a graduate advisory committee to have a substitute at committee meetings or an exam. The substitution of a committee member on an oral examination must be requested in writing by the DGP and approved by the Graduate School in advance of the examination. It is extremely important to have clear communication between committee members and substitutes so that new expectations or concerns do not arise at the time of the final oral examination.

E. Permanent Changes in Committee Members

1. Changes before Final Examinations for Master’s Students and before the Preliminary Examination of PhD Students. Should students, in consultation with their advisors, wish to change any of the committee members, they must submit a revised Plan of Graduate Work with the new members, indicating that this change has been approved by the advisor and by the DGP. Approvals of the students, the committee members, and the DGP must be included. The DGP must submit the revised Plan of Work to the Graduate School. Disagreements within committees or between students and committee members over the quality of students’ performance are not grounds for reconstituting the committee. If students believe that they have been unjustly or unfairly treated in efforts to resolve committee conflicts, they have the right to grieve this issue, according to the current University Grievance Procedures for Graduate Students.

2. Changes after the Preliminary Examination. Changes in doctoral committee membership after preliminary exams requires signatures of both outgoing and incoming committee members and the student, as well as justification for the committee change. Approval by the Graduate School is required before holding any examinations.

3.3 Graduate Plan of Work

A. Description

The Graduate Plan of Work is a document that serves both as a guide to successful degree completion and a contract between students and their programs. In this way, it serves to reduce the potential for misunderstandings about degree requirements and outlines the expected academic progress students should make. It is especially helpful when it is evaluated on at least an annual basis by students with their advisor(s), and, where applicable, their advisory committees, with any needed modifications recorded at that time. It should be viewed as a “living document” that reflects changes that may occur as students continue to develop and refine their academic programs.

B. Contents of a Graduate Plan of Work

At the time of final submission Graduate Plan of Work must include:

1. a list of the coursework to be undertaken
2. accurate information about any transfer credits to be used for the degree. Any request to include transfer credit should be submitted to the Graduate School prior to the start of the student’s graduate program or no later than before the end of the first semester
3. the thesis or dissertation topic (except in non-thesis master’s programs)
4. the name of the student’s major professor
5. the members of the student’s advisory committee

C. Formulation and Submission Process

The Graduate Plan of Work must be:

1. developed by the student in collaboration with his/her major professor and, where applicable, advisory committee
2. approved by the committee and the Director of the Graduate Program (DGP) or department head prior to submission to the Graduate School for approval
3. submitted online through MyPack Portal
4. evaluated by the Graduate School, which will inform the program as to whether or not the Graduate Plan of Work meets the Graduate School requirements. The Graduate School will deny approval of any student’s Graduate Plan of Work until all documents necessary to complete that student’s permanent file are received (e.g., signed Patent Agreement, Transfer of Credit form, if applicable). If any materials are missing, the Graduate Plan of Work will be denied with the reason for the denial communicated to the DGP and the student.
D. Timing of Submission

As the Graduate Plan of Work serves as a guide to promote successful progression through a given graduate program, it is important that various components of it be completed in a timely manner. Failure to complete the various components of the Graduate Plan of Work may result in a registration hold being placed on a student’s record.

1. All Graduate Students: Course Component of the Graduate Plan of Work
   • By the end of their first term, and preferably earlier than that, students in all graduate programs must submit at least a preliminary course schedule using “place holders” where necessary, defining the specific courses or, at a minimum, courses in a curricular area, including electives, required to fulfill the degree requirements for their respective degree programs.

2. Thesis Master’s/Doctoral Students: Committee and Other Milestone Components of the Graduate Plan of Work
   • By the completion of 18 hours, but no later than the third term of enrollment, those graduate students enrolled in master’s programs that require a thesis or in doctoral programs must submit additional elements of the Graduate Plan of Work that include the topic of their thesis/dissertation research, their committee chair(s), committee members, and estimated completion times for important milestones, such as the preliminary and final oral examinations. Students in Option B master’s programs requiring projects should also submit their topic and the name of their project advisor.

3. Submission of Final Graduate Plan of Work
   • The final version of the Graduate Plan of Work must be submitted before a master’s student’s final examination and before a doctoral student’s preliminary oral examination. For Option B students, this should be submitted prior to the completion of their Application to Graduate in their final semester.

E. Revising a Graduate Plan of Work

The expectation is that the Graduate Plan of Work will be reviewed and revised annually to reflect students’ academic trajectories as they become better defined during their academic careers. Given that an annual progress report is required (Section 3.4 (p. 653)) as part of this process, the student’s major professor and, where appropriate, advisory committee should review the Graduate Plan of Work to evaluate progress, suggest potential revisions, and provide guidance as necessary.

F. Annual Progress Evaluation

The Graduate School requires all graduate programs to complete an annual evaluation of progress toward degree for each graduate student. This evaluation process should involve the student, at least one academic advisor/committee chair, and the DGP. As part of each annual evaluation, the student’s major advisor should review the POW to evaluate progress, suggest potential revisions, and provide guidance as appropriate. Each evaluation must include the following items:

1. the student’s report of activities and achievements for the preceding year (e.g., courses, honors, milestones achieved, and professional development);
2. the student’s own evaluation of his or her progress;
3. an evaluative response to the student’s progress report by at least one faculty advisor/committee chair; and
4. a completed POW (see POW requirements).

3.4 Time Limits

A. Master’s Degrees

Students must complete all requirements for the master’s degree within six calendar years. The student’s degree clock for time to completion starts with the first course approved for inclusion in the plan of work or the date of admission to the program, whichever comes first. The time limit remains at six years even if a student was on approved leave of absence during the six-year period.

B. Doctoral Degrees

All doctoral students must complete all degree requirements within ten calendar years; for information about the time limits for completing the preliminary oral examination, see Section 3.5 (p. 653). The time limit remains at ten years even if a student was on approved leave of absence during the ten-year period. The student’s degree clock for time-to-completion starts with the first course approved for inclusion in the Plan of Work or the date of admission to the program, whichever occurred earlier. Academic colleges/schools or programs may have more restrictive requirements than the above stated University policy.

C. Time-Limit Extensions

The Graduate School may grant exception to the above time limits for a period of up to two years, which can include, but is not limited to: military obligations, family and medical circumstances, and life events. The Dean, or designee, will consider and evaluate the specific nature of the circumstances, the reasons that prompted the advisor and DGP to make the request, the impact the proposed extension would have on the validity of coursework and research, as well as a detailed timeline outlining how and when various degree requirements completed (see Time Limit Extension form (https://grad.ncsu.edu/faculty-and-staff/forms/graduate-school-forms/)).

For requests beyond two years, the Graduate School will undertake an initial review to determine if they should go forward. If a positive decision is reached, such appeals must be presented to the Administrative Board of the Graduate School by the advisor or their designee. That body will render decision as to whether or not the request should be granted.

3.5 Comprehensive Examinations

Comprehensive examinations are a critical step in degree completion in evaluating the relevant breadth of knowledge in master’s and doctoral students. Throughout the process, the chair of the candidate’s advisory committee has the obligation to maintain a scholarly atmosphere and to keep academic integrity and the student’s best interest foremost.

A. Doctoral Students

• Doctoral students schedule their oral preliminary and final examinations in consultation with their advisory committees. It is the responsibility of doctoral students to contact committee members and, where appropriate, the appointed Graduate School Representative to establish a date and time convenient to all members before officially requesting that the examination be scheduled. The Graduate School, upon approval, will send
B. Master’s Degree

1. Written examinations (Optional)
   • A degree program may require written examinations covering the subject matter of the major and minor in which the student is enrolled. When required, such examinations must be successfully completed prior to the submission of a Request for a Permit to Schedule the Master’s Oral Examination. Information concerning written examination schedules should be obtained from the student’s program.

2. Oral examinations
   • Candidates for master’s degrees (except those in Option B programs) must pass a comprehensive oral examination to demonstrate to the advisory committee that they possess a reasonable mastery of the subject matter of the major and minor fields and that this knowledge can be used with promptness and accuracy.

a. Scheduling an exam – Master’s students schedule their oral examinations in consultation with their advisory committees. To do this, students must submit a Request for a Permit to Schedule the Master’s Oral Examination to their DGP’s who approve and submit it to the Graduate School two weeks prior to the date of the examination. The two-week window does not commence until all other requirements are completed, including a final, approved Plan of Work and a Patent Agreement.

b. Format of the exam – This exam takes the form of a traditional thesis defense in those programs requiring theses. This examination may not be held until all other requirements, except completion of the coursework taken during the final semester, are satisfied. After obtaining DGP approval, a student must file a Request to Schedule Master’s Oral Examination with the Dean of the Graduate School only after the above conditions are met. For students in non-thesis, non-Option B master’s, the program determines the format of the oral exam.

c. Passing the oral examination – Within a week of completing the exam, the student’s DGP must forward a permit form (Admission to the Final Master’s Oral Examination) that displays the date that the exam was conducted, the result of the examination, and the signatures of all advisory committee members to the Graduate School. A unanimous vote of approval of the advisory committee is required for passing the oral examination.

d. Conditional pass – Students may get a conditional pass contingent upon completion of additional work to the satisfaction of the advisory committee. A formal re-examination may not be required in this case. The DGP must notify the Graduate School within a week after the exam of the conditional pass, the reasons for the conditional pass, and also when the conditions have been removed. The date upon which the Graduate School is notified of the pass establishes the student’s graduation date.

e. Failure to pass the oral examination – A student who fails the oral examination is terminated from graduate work at NC State unless the graduate advisory committee unanimously requests a re-examination. Only a single re-examination will be allowed. If the DGP or the Graduate School denies the request, the student’s program is terminated.

C. Doctoral Degree

1. Preliminary written examinations
   • Each doctoral student is required to take a preliminary examination, consisting of written and oral components, after they have completed their coursework. As indicated in Section 3.4, all doctoral students must attain candidacy for the degree within four years of starting their program or after they have completed 48 hours of coursework, whichever is later.

   a. Format of the exam. The written portion of the examination may be conducted in one of two ways.
      • If applicable, the written portion of the examination may be conducted in one of two ways.
      • The committee decides on the specific format of this exam, and each member of the advisory committee prepares a set of questions for the student’s response, and the answers to each set are returned to the appropriate faculty member for evaluation.
      • Standardized departmental examinations may be used for all students in a program. These examinations are given at specified times during the year, and scheduled dates must be announced at least a semester in advance. Where written departmental examinations of this kind are used, the student will be expected to notify the department of their intent to sit for this examination. Regardless of which method is employed, the questions involved may cover any phase of the coursework taken by the student during graduate study or any subject logically related to an understanding of the subject matter in the major and minor areas of study. The questions are designed to measure the student’s mastery of his/her field and the adequacy of preparation for research.

   b. Notification of completion. Committee chair(s) must notify the DGP when a student has completed the written examination.

2. Preliminary oral examinations
   • The oral examination is designed to test the student’s ability to relate factual knowledge to specific circumstances, to use this knowledge with accuracy and promptness and to demonstrate a comprehensive understanding of the field of specialization and related areas.

   a. Format of the exam. Though the format of the oral preliminary examination may vary according to the culture of
individual graduate programs, as a general guideline such examinations generally include the following three elements.

• Presentation by the candidate. The candidate makes a presentation of a research proposal. This presentation may be open if the program wishes it to be, but NC State graduate faculty may not be excluded, and the committee chair or Graduate School Representative can restrict the session to all but graduate faculty as deemed necessary.

• Questioning of the candidate. Anyone attending the presentation will be allowed to ask questions of the candidate at the conclusion of the presentation.

• Deliberation and decision. Only the advisory committee and the Graduate School Representative, if one has been appointed, will be allowed to participate in the deliberation and decision."

b. Outcomes

• Passing the preliminary examination. A unanimous vote of approval of the advisory committee is required for passing the preliminary examination. Approval may be conditional, however, and require students to meet specific requirements prescribed by their advisory committee. These conditions must be written in a clear and distinct way and communicated in such a manner that the student clearly understands what is expected; they must also be submitted to the DGP and the Graduate School.

• Failure to pass the preliminary examination. A student who fails the preliminary examination is terminated from graduate work at NC State unless the graduate advisory committee unanimously requests a re-examination. Only a single re-examination will be allowed; it can encompass written, oral, or both components as determined by the advisory committee. If the DGP or the Graduate School denies the request, the student’s program is terminated.

3. Candidacy

• A doctoral student is admitted to candidacy by the Graduate School upon successfully passing the preliminary examinations. This does not include students receiving a conditional pass.

4. Final Oral Examination

• As with the preliminary oral examination, the chair of the student’s advisory committee oversees the final oral examination. Students in consultation with their advisors submit a Request to Schedule the Doctoral Oral Examination to their DGP, indicating that they wish to schedule the final oral examination.

• The final oral examination is scheduled after the dissertation is complete except for such revisions as may be necessary as a result of the examination, but not before all required coursework has been completed.

• After the Graduate School has approved the scheduling of the final oral examination, the signed and dated request form is emailed to the committee chair, committee members, Graduate School Representative, and graduate student listed on the form. A file copy of the approved request form will be sent to the DGP.

• The student should be sure to include the most current title of the dissertation, as the Graduate School mails information about the scheduled examination to the NC State Official Bulletin for publication.

a. Format of final examination. Though the format of the doctoral examination may vary according to the culture of individual graduate programs, all examinations include three elements:

• Presentation by the candidate. The candidate typically presents the methodology used, the data collected, and the conclusions reached as reported in the dissertation. For the purpose of dissemination of research, it is required that the presentation of the dissertation be open to the university community.

• Questioning of the candidate. Any member of the university community is allowed to ask questions of the candidate. The questioning phase may continue with a closed session in which the advisory committee questions the candidate.

• Deliberation and decision. Only the advisory committee and the Graduate School Representative are present. Throughout the process, the chair of the candidate’s advisory committee has the obligation to maintain a scholarly atmosphere and to keep academic integrity and the student’s best interest foremost.

b. Outcome of final examination

• Passing the final oral examination. A unanimous vote of approval of the advisory committee is required to pass the final oral examination. In the case of a conditional pass, the specific requirements must be submitted to the student as well as the Graduate School attached to the Exam Results form. Final approval by the advisory committee is dependent upon a student’s successful completion of those conditions.

• Failure to pass the final oral examination. Should a student fail the final examination, this terminates a student’s academic program unless the advisory committee recommends a re-examination.

D. Format for Remote Oral Exams

It is expected that oral examinations be conducted with all parties in the same room; however, it is recognized that circumstances may prevent this from happening. While technology can provide solutions for such situations, it should never be the case that remote exams are held simply as a matter of convenience. The student and major professor or at least a co-chair must be present in person.

When members attend examinations remotely, it is the responsibility of the chair of the committee to maintain the academic integrity of the exam and to ensure that the spirit of the requirements outlined in 3.6.B or 3.6.C above are followed. The technology used must allow all parties to interact visually and aurally to accomplish this. Failure of the technology during the exam will require that the exam be suspended until it is in functioning order or rescheduled for a later time.

It is the DGP’s responsibility to ensure that the reasons for a remote exam are valid and to submit a request to conduct the exam to the Graduate School in conjunction with the Request for a Permit to Schedule the Master’s or Doctoral Oral Examination.

3.6 Theses and Dissertations

A. Theses

In degree programs requiring preparation of a thesis, master’s students must undertake an original investigation into a subject that has been approved by the student’s advisory committee. All theses must be submitted in accordance with the Electronic Thesis and Dissertation (ETD) Guide (https://grad.ncsu.edu/students/etd/). Theses should be
submitted to the advisory committees at least two weeks prior to the final defense.

B. Dissertations

The doctoral dissertation must present the results of the student’s original investigation in the field of primary interest. It must represent a contribution to knowledge, adequately supported by data, and be written in a manner consistent with the highest standards of scholarship. All dissertations must be submitted in accordance with the ETD Guide. Publication is expected and encouraged. Dissertations should be submitted to the advisory committees at least two weeks prior to the final defense.

C. Company-Funded Research

For thesis or dissertation research that is funded by a company, students and their advisors must ensure that there is a clear agreement as to the ability to place the results in an ETD and, should there be proprietary information, that a mechanism be in place to ensure that the ETD remains viable. Furthermore, if a company’s requires approval of the document prior to a defense, this will require additional lead time to insure that only the appropriate information is included.

D. Submission Procedures for Theses and Dissertations

1. All advisory committee members must approve the thesis/dissertation prior to submission to the library for publication.
2. After receiving an unconditional pass on the final oral exam, the student must submit the thesis/dissertation electronically to the ETD system.
3. A thesis/dissertation must be submitted by the ETD deadlines as published in the Graduate School Calendar.
4. At the time of dissertation submission, students are also required to submit the required forms and fee as outlined on the ETD website. The Graduate School will not award the degree until these forms and fees have been submitted.

E. Publication in Compliance with Nondisclosure Provisions

Theses and dissertations containing disclosures of patentable discoveries may be embargoed by submitting a request through the ETD system. They may be granted for up to one year. Placing an embargo on a thesis or dissertation until a patent application is filed will not prevent a student from graduating on time.

3.7 Master’s Degree: Summary of Procedures

A. Requirements for All Master’s Degree Students

1. Application materials and required fees received.
2. Application materials reviewed by graduate program.
3. Graduate program forwards recommendation regarding applicant’s admisibility to the Dean of the Graduate School.
4. The Dean of the Graduate School reviews the recommendation and the student is notified of the action taken on the request for admission.

B. Option B Programs

The student must Apply to Graduate via MyPack Portal and the DGP set the Graduation Approval page to “Departmental Review Complete” no later than the “apply to graduate deadline” in the term in which they plan to graduate.

C. Master’s of Discipline or Non-thesis Programs (excluding Option B)

1. Graduate advisory committee of three or more Graduate Faculty members is appointed by the DGP.
2. When all requirements except completion of the course work in the final semester are satisfied, DGP submits to the Graduate School the Request for a Permit to Schedule the Master’s Oral Examination.
3. If Graduate School requirements are met, a Request for a Permit to Schedule the Master’s Oral Examination is approved by the Graduate School within 10 working days of receipt of the request and the permit, Admission to the Final Master’s Oral Examination, is issued.
4. Final examination is scheduled and conducted.
5. Final examination report, including date and result of the examination, submitted to the Graduate School by the DGP. The Graduate School should receive the report within five working days of the examination.
6. The deadline date for unconditionally passing the final examination in order for the student to graduate in a given semester or summer session appears in the Graduate School Calendar.
D. Thesis Programs

1. Graduate advisory committee of three or more Graduate Faculty members is appointed by the DGP.
2. A preliminary copy of the thesis is submitted to the chair of the student’s advisory committee.
3. When all requirements except completion of the course work in the final semester are satisfied and after the thesis is complete except for such revisions as may be necessary as a result of the exam, the DGP submits to the Graduate School the Request for a Permit to Schedule the Master’s Oral Examination.
4. If Graduate School requirements are met, the Request for a Permit to Schedule the Master’s Oral Examination is approved by the Graduate School within 10 working days of receipt of the request, and the permit, Admission to the Final Master’s Oral Examination, is issued.
5. At least two weeks prior to the final oral examination, the chair of the student’s advisory committee submits the thesis, if required, to the other members of the advisory committee for review.
6. Final examination is scheduled and conducted.
7. The Admission to the Final Master’s Oral Examination form is completed by the committee members, including date and result, and submitted to the Graduate School by the DGP. The Graduate School should receive the report within five working days of the examination.
8. Student submits the required PDF file into the Electronic Thesis and Dissertation (https://grad.ncsu.edu/students/etd/) (ETD) Submission System for the thesis review within 24 hours of passing the defense. The date the student properly submits the required PDF file into the ETD Submission System is the date of the thesis review.
9. The deadline for submitting the thesis to the Graduate School in order for the student to graduate in a given semester or summer session appears in the Graduate School Calendar.
10. The thesis is reviewed by the Graduate School to ensure that the format conforms to the specifications prescribed in the Thesis and Dissertation Guide.
11. The thesis must then be approved by the advisory committee members prior to publication by the library.

3.8 Doctoral Degree: Summary of Requirements

1. Application materials and required fees received.
2. Application materials reviewed by graduate program.
3. Graduate program forwards recommendation regarding applicant’s admissibility to the Graduate School.
4. The Graduate School reviews the recommendation and the student is notified of the action taken on the request for admission.
5. Outstanding official transcripts, if any, showing any or all post-secondary degrees conferred since application should be submitted by student to the Graduate School prior to matriculation.
6. Student matriculates, is assigned a graduate advisor, and develops a Plan of Work with the advisor/DGP.
8. Student formulates an advisory committees of at least four members of the Graduate Faculty. The Graduate School also selects a Graduate School Representative, if required.
9. Plan of Work is prepared by the student in consultation with the advisory committee.
10. Preliminary oral examinations in the major and, where required, minor fields are scheduled. The results are sent to the Graduate School.
11. At least two weeks prior to the final oral examination, the chair of the student’s advisory committee submits the dissertation to advisory committee members for review.
12. The chair submits, through the DGP, the request to Schedule the Doctoral Oral Examination (https://grad.ncsu.edu/faculty-and-staff/forms/graduate-school-forms/) at least two weeks prior to the examination. Upon approval of the request, the student and the examining committee, including the Graduate School Representative are notified of the time and place of the examination.
13. Students must submit their dissertation to the ETD System. Deadlines appear in the Graduate School Calendar. In addition, they must submit all required forms and fees prior to final approval.
14. Student must apply to graduate in MyPack Portal by the deadline in the term in which they plan to graduate to be placed on the graduation list, have their name printed in the graduation program, have the diploma ordered, and the transcript posted.
15. All coursework scheduled in a graduate degree classification must be completed prior to graduation.
16. The cumulative and program GPA must be at least 3.000 to graduate.
17. All degree requirements must be completed within ten calendar years of the admission term or the date of the first course used in the Plan of Work, whichever is earlier, unless a program has a more restrictive time limit.

3.9 Change in Degree Level or Program

Graduate students in good academic standing may change their degree level or degree program after the completion of one semester.

A. Requirements for Changing Degree Level/Program

1. Graduate students are not required to re-apply to change their degree level or program.
2. Students must consult with their advisors and current Director of Graduate Programs (DGP).
3. The student must sign a Request for Change of Degree Status or Curriculum form and submit it to the DGP of the program in which the student is currently enrolled.
4. No change in level/program will be effective without the approval of:
   a. the DGP of the program in which the student is currently enrolled;
   b. the DGP of the new program into which the student is requesting transfer; and
   c. the Graduate School. Upon approval of the request, the Graduate School will notify both departments, where applicable, and transfer the student’s records to the appropriate department.

B. Final Semester Transfers

If students request a change in degree level/program in their final semester, the deadline for submission is six weeks after the first day of classes in that semester.
C. Process for International Students

International students who have had a degree level/program approved must obtain a new I-20 from the Office of International Services (https://internationalservices.ncsu.edu/). The U.S. Citizenship and Immigration Services (https://www.uscis.gov/) requires a new visa when an academic program changes.

3.10 Dual Master’s Degrees

Students enrolled in a master’s degree program at NC State University may pursue additional master’s degrees simultaneously provided that:

1. the Director of Graduate Programs (DGP) of each program approves the pursuit of multiple degrees;
2. an approved Plan of Work for each master’s degree is submitted;
3. 18 hours are unique to each degree program; and
4. all other requirements and Graduate School rules are met for each degree;
5. the time limits in place for the initial degree apply to all others.

3.11 Master’s Degrees while in Doctoral Status

A. Master’s Degrees in the Same Field as the Doctoral Degree

Students admitted to doctoral programs at NC State may be awarded a master’s degree in the same field as the doctoral program provided that all of the following conditions are satisfied:

1. The student does not already have a master’s degree in the same field.
2. All Graduate School, College, and Department/Program requirements for the master’s degree are satisfied.
3. The graduate program may require students to transfer into the master’s program from the doctoral program (or other master’s). Once a doctoral student is transferred into a master’s program, the student must complete the requirements for the master’s degree before returning to the doctoral program.
4. All requirements must be completed before the six-year time limit for master’s degrees.
5. The minimum of 72 credit hours required for the doctoral degree is met, including the credits used for the master’s degree.
6. International doctoral students who wish to obtain a master’s degree in a different program from their doctoral program with the intention of applying for Optional Practical Training in the field of the master’s degree must be satisfied.
7. In rare instances where a student wishes to enroll in more than one master’s degree, the requirements for the master’s degree by submitting:
   • an approved patent agreement (via Student Self-Service in MyPack Portal) that includes the names of the members of the
master's advisory committee (or advisor for Option B programs), and
* a Plan of Work or a list of courses that are to be used to satisfy the master's requirements.

2. It is the responsibility of the student to meet all deadlines for graduation with a master's degree. The master's degree should be awarded when the degree requirements are fulfilled.

E. Eligibility for Graduate Student Support Plan Tuition Support

The number of semesters of eligibility for tuition support under the Graduate Student Support Plan does not change as a result of the student's electing to pursue a master's degree in another program along the way to the Ph.D. The Graduate School maintains current online information and requirements for the Graduate Student Support Plan (https://grad.ncsu.edu/students/gssp/).

3.11a Co-Majors and Minors

Co-Majors

Graduate students wishing to co-major must obtain approval from both programs. Co-majors must meet all requirements for majors in both programs. A representative from each program must also be included on the student's advisory committee. A student may not co-major in two different degree levels, i.e. a master's in one discipline and a doctoral in another.

One degree is awarded and the co-major is noted on the transcript. Enrolled co-majors will be classified in only one program for record purposes. [Recommended by the Administrative Board of the Graduate School and approved by the Dean of the Graduate School on 9/23/93.]

1. Master's Students: Students may co-major at the master's level in programs with identical degrees, although the degrees do not necessarily have to have identical requirements (e.g., two Master of Science programs, one with a thesis requirement and one without). No student is required to declare a minor.

2. Doctoral Students: Students may co-major at the doctoral level with the approval of both programs and with the appointment of a co-chair from each program on the advisory committee. The co-chairs will have equal responsibilities for directing and mentoring the student (see Section 3.2 Advisory Committees, A.1.c). Co-majors are not permitted between Doctor of Philosophy and Doctor of Education degree programs.

Minors

The Graduate School does not require a minor, although individual programs may require one. If a program does not require a minor, the graduate student has the option of choosing one, except in an Option B master's program in which a minor is not allowed. The minor work will usually be from a single discipline or field that in the judgment of the advisory committee provides relevant support to the major field. However, the committee has the alternative of developing an interdisciplinary minor if it best serves the needs of the student. [Recommended by the Administrative Board of the Graduate School and approved by the Dean of the Graduate School on 12/12/91.]

When a student selects a minor, the advisory committee must include a representative from the minor field. The minor credits on the Plan of Graduate Work must be approved by the graduate advisory committee member representing the minor, and, in some cases, the Director of Graduate Programs (DGP) from the minor program.

Minors That Require Approval of DGP of Minor Program

Students wishing to minor in Biotechnology, Plant Physiology, Statistics, and Water Resources, must obtain the approval from the respective DGP.

1. Doctoral Students: For doctoral students, this approval must be obtained from the minor field's DGP and then indicated on the Plan of Graduate Work submitted after the completion of 12 graduate hours at NC State.

2. Master's Students: For master's students, this approval must be obtained from the minor field's DGP at the onset of course work in the minor field so that they are able to meet any specific requirements in that minor well before the time they wish to schedule their final oral examination.

3.12 Accelerated Bachelor's/Master's Program

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the bachelor's and master's degrees at an accelerated pace. These undergraduate students may double count up to 12 graduate-level credits (500 or 700 level) and obtain a master's degree within 12 months of completing the bachelor's degree.

ABMs provides an opportunity for the Directors of Graduate Programs (DGPs) to recruit rising juniors to their graduate programs. However, approval to pursue an ABM degree program does not guarantee an admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

A. Creating an Accelerated Bachelor's/Master's Program

There are two options for creating ABM programs. The first option is a disciplinary model in which a bachelor's program and a master's program in the same department or in departments of closely related disciplines establish an ABM degree. Prior to admission of any student into such a degree program, the program must be developed by the undergraduate and graduate units and approved by the associated college(s) Deans, the Administrative Board of the Graduate School, and the Dean of the Graduate School.

The other option is an individualized model in which a student is in a department that has not established a formal ABM program or is in a department in one discipline and wants to pursue a master's degree in a different discipline. For this option, an ABM arrangement must be made between the student and the Director of Graduate Programs the graduate degree program and must be approved by the coordinator of the undergraduate program in which students are obtaining their bachelor’s. The Director of Graduate Program must recommend admission to the Graduate School and this must be approved by the Dean of the Graduate School.
B. Student Eligibility Requirements

1. Students may apply once they have completed a minimum of seventy-five credit hours in their undergraduate programs, including credits earned from advanced placement, but prior to the completion of their bachelor’s.
2. Transfer students must have completed a minimum of 24 hours as a full-time student at NC State.
3. Students must have a minimum overall undergraduate grade point average (GPA) of 3.500 at NC State at the time of admission into the ABM program. This GPA must be maintained throughout their undergraduate program to remain in an ABM program.
4. Students must receive a grade of B or better in the double counted graduate-level courses (500 or 700 level) while maintaining a 3.500 GPA. Courses with a grade of B- or below cannot be double counted between the two degrees.
5. If students’ undergraduate GPAs drop below 3.500, the DGP must inform the directors of their undergraduate programs and the students in writing of their ineligibility. A copy of this letter must also be sent to the Graduate School.
6. A student who is ineligible to participate in or withdraws from the ABM program, cannot double count any courses for both bachelor's and master's degrees.
7. Students in the ABM must receive the bachelor’s degree prior to entering graduate status.

C. Application to the Accelerated Bachelor’s/Master’s Program

1. Interested students that meet the GPA requirement should schedule a meeting with their Directors of Undergraduate and Graduate Programs to develop tentative academic plans for the bachelor’s and master’s degree programs. The Graduate School requires an approved ABM Plan of Work form to admit a student into an ABM program. The ABM Plan of Graduate Work should clearly indicate:
   • the courses (a maximum of 12 graduate credit hours, 500 or 700 level) that will be double counted for both bachelor’s and master’s degrees,
   • the courses that will be taken after matriculating into the graduate program,
   • the graduation date for the master’s degree that meets the time limit for the ABM program.
2. While still an undergraduate, students must submit the standard application for admission to the Graduate School including an application fee and other documents/standardized test scores required by individual programs.
3. Any deviations from the approved ABM Plan of Work form, require that the updates be approved by the Directors of Undergraduate and Graduate Programs as well as the Graduate School.

D. Withdrawal

Student may withdraw at any time from an ABM program by informing the Directors of Undergraduate and Graduate programs in writing. A copy of this request must also be sent to the Graduate School.

3.13 Graduate Certificate Programs

A. Definition

A Graduate Certificate Program (GCP) is a prescribed set of related graduate-level academic courses, designed by an academic department or program. To receive a certificate, non-degree-seeking students must submit an application and fee through the Graduate School and obtain admission, whereas enrolled graduate students are required to submit the Graduate Certificate Plan Entry form. Certificates cannot be conferred retroactively for students not continuously enrolled in a graduate degree program when the required coursework was completed. Upon completion, the GCP will be designated on the student’s transcript and the student shall receive a certificate from Registration and Records entitled “Graduate Certificate in….” In most cases, certificate students are not eligible for federal financial aid, although some students in teaching certificate programs may be eligible (contact the Financial Aid Office for specific eligibility requirements).

B. Minimum Requirements for Graduate Certificate Programs

1. All students enrolled in a GCP must have a bachelor’s degree from a regionally accredited institution of higher education; the transcript of this degree indicating conferral date must be submitted to the Graduate School.
2. All GCP coursework must be taken at NC State. Transfer credit from other institutions is not allowed.
3. The minimum number of credits required for a GCP is 12.
4. For most GCP, required courses must be regular graduate-level academic courses; 400-level courses may only be used for those certificates where a course at that level has been approved by the Administrative Board as part of the GCP’s approval process.
5. All courses should be letter graded, although three credits of S/U-graded coursework can be used where the courses are relevant to the certificate and S/U is the only grading option.
6. GCP students do not have the option of taking the courses for “credit only” if they intend for the course to be part of their GCP.
7. To receive a Graduate Certificate, a student must have a minimum 3.000 grade point average (GPA) on all course work. All grades on courses taken towards the certificate program in courses numbered 400 and above are included in the GPA.
8. A minimum grade of a C- is required to receive certificate credit for a course, although departments/programs may require a higher minimum and the overall GPA requirement must still be maintained.
9. GCPs must be completed within four years, beginning with the date the student commences courses applicable to the GCP, unless a more restrictive time limit has been established by the program or academic college/school.
10. Students can obtain multiple certificates from NC State. Each certificate must have at least nine credit hours that are unique to it; see Section C for certificates taken by students in a degree program.
C. Graduate Certificates and Graduate Degree Program

1. Internal and Shared Credit
   a. Graduate certificate courses taken while enrolled in a degree program may be double-counted with the degree courses to the extent that the courses unique to the degree remains eighteen hours for a master’s or thirty-six hours for a doctorate.
   b. Interinstitutional courses count as NC State courses.
   c. Certificate and graduate minor coursework shall not be shared, i.e., a student getting a minor using a set of coursework may not also get a certificate using that same coursework.

2. Transferring Certificate Coursework into a Degree Program
   a. Up to 12 hours of certificate credit taken prior to enrollment in an NC State master’s or doctoral degree program may be transferred into that degree program so long as eighteen hours remain unique to the master’s and thirty-six hours to the doctorate.

3.14 Minimum Enrollment Requirements

A. Requirements of Continuous Enrollment

After students are admitted to the Graduate School and enroll for the first time, they are required to maintain continuous enrollment. This mandates that students enroll each Fall and Spring semester, excluding Summer terms, until they graduate. Failure to maintain continuous enrollment results in termination of academic program. To re-enroll following termination, students must reapply for admission, pay the admission fee, and be granted admission by the program and the Graduate School (see Readmission, Section 2.3 (p. 644))

Exceptions

1. Leave of Absence
   Students in good academic standing who must interrupt their enrollment may, with a strong justification, request a leave of absence from graduate study for up to two semesters within a given graduate degree program. Students should initiate the request with their advisor and have it approved by their DGP before its submission to the Graduate School. The time spent on an approved leave of absence will be included in a degree’s time limit; i.e., the degree “clock” does not stop, nor is it reset.

2. Withdrawal
   • Withdrawal prior to Census. An approved Leave of Absence is required of any graduate student who withdraws prior to Census.
   • Withdrawing after Census. Withdrawal following Census constitutes continuous enrollment; therefore, a Leave of Absence is not required.

Required Summer Enrollment

All students who take their final oral examination or submit their thesis/dissertation to the Graduate School during the Summer must be registered for at least one of the two summer sessions.

No Registration Requirement related to ETD Submission

To be eligible for no registration, students must have been registered in the preceding semester or Summer term. Furthermore, they must have unconditionally passed their final oral exam and submitted their ETD for review prior to the first day of a subsequent term (inclusive of Summer) are not required to register for that semester/term (see the Table below for more details).

<table>
<thead>
<tr>
<th>Term Enrolled</th>
<th>Last Date for ETD Submission</th>
<th>No-Registration Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>The last business day prior to the start of Spring semester</td>
<td>Spring</td>
</tr>
<tr>
<td>Spring</td>
<td>The last business day prior to the start of the first Summer term</td>
<td>Summer (either I or II)</td>
</tr>
<tr>
<td>Summer I or II</td>
<td>The last business day prior to the start of the Fall term</td>
<td>Fall</td>
</tr>
</tbody>
</table>

*If students do not complete the ETD process by the term denoted here, they will be required to register for additional coursework to graduate.

Graduation without Registration

Students who complete all degree requirements prior to the first day of the Fall or Spring semester or the first Summer term may graduate during the next semester or Summer term without being registered provided:

1. they were registered in the immediately preceding semester or summer session; and
2. they apply to graduate during that subsequent term.

Students whose only remaining requirement for graduation is removal of an “IN” (Incomplete) grade are not required to be registered in the following semester or term to complete the work and graduate; however, only one registration-free semester or term is allowed. See Section 3.18 for more details.

B. Requirements for Full-/Half-Time Registration

Fall and Spring Semesters

Thesis master’s or doctoral students

• Full-Time: To be full-time, students must be enrolled in at least 9 hours per semester. If they have accumulated or will accumulate sufficient hours to meet the degree requirements (a minimum of 30 and 72 for master’s and doctoral degrees, respectively), they will be considered full-time until they complete their thesis or dissertation provided they enroll for at least 3 credit hours.

• Half-Time: To be half-time, students must enroll in a minimum of 4.5 but not more than 8.5 hours a semester unless they have fulfilled the hours required for program (see details above).

Master’s students enrolled in a program not requiring a thesis

Master’s students enrolled in plans allowing both a thesis and a non-thesis option will be classified as “non-thesis” students and subject to
these rules until such time as a graduate Plan of Work designating the
thesis-option is approved by the Graduate School.

- Full Time: To be full-time, students must be enrolled in at least 9
  hours per semester.
- Half Time: To be half-time, students must enroll in a minimum of 4.5
  but not more than 8.5 hours a semester.

International Students

The U.S. Citizenship and Immigration Services (USCIS) (https://
www.uscis.gov/) requires international students on F-1 or J-1 visas to
carry a full-time course of study to remain in status. Students in their final
semester who have completed the minimum hours required for a degree
can use the Reduced Course Load form to enroll in fewer hours.

Co-op Students

Co-op students registered for COP 500 will be considered full-time.
Students registered for only COP 501 will be considered half-time.

Waiver of Hours

Graduate students who meet certain prescribed special conditions,
may be certified as either a full-time or half-time in cases where they do
not meet the requirements for such as outlined above. A waiver of the
uniform academic load rules requires attestation on behalf of the student
by their committee chair, academic advisor, or their Director of Graduate
Program and approval by the University.

Summer Terms

- Graduate students are not required to register during the summer.
- Students not enrolled in the Summer maintain their access to the
  library, but other facilities that are funded by students fees, such as
  the gym and Student Health Services, cannot be accessed without
  paying for a summer membership.
- Students who are employed as Graduate Research Assistants, but
  who are not enrolled in the University during a period of at least five
  weeks, are subject to Social Security tax withholding. Specifically,
given Federal tax law as it relates to employment outside of student
status, Social Security taxes will be withheld in June for RAs who
are not registered in Summer Session I and in July for RAs who are
not registered in Summer Session II. The source of funds that pays
the stipend must pay the same amount of Social Security tax as is
withheld from the student’s paycheck during these months.
- Two special registration categories are available for Graduate
  Research Assistants who would not otherwise take courses in the
  summer: XXX 696 (Summer Thesis Research) and XXX 896
  (Summer Dissertation Research), where XXX represents the course
  prefix of a specific department/program. Each of these courses is
  for 1 hour of credit, which is considered full-time enrollment for tax
  purposes, for the Summer and which run for 10 weeks, beginning
  the first day of Summer Session I and extend into Session II. Social
  Security taxes will not be withheld from the June or July paychecks of
  RAs who register for either 696 or 896.
- Please note that students who are not registered at least half time
during the Summer are ineligible for Financial Aid during that period.

3.15 Course Registration

A. Graduate Course Levels

1. Graduate students typically enroll for courses at the 500 through 800
   level.
2. Advanced undergraduate students may enroll in 500-level courses
   unless otherwise specified.
3. Only graduate or PBS students may enroll in 700- and 800-level
courses.
4. A student may take up to 6 hours of 400-level courses for graduate
   credit provided that they are outside the student’s major and the
   program is not at the doctoral level. No more than one 400-level
   course of up to 4 credit hours may be used for a graduate certificate.
5. Students may not count 900-level courses toward a graduate degree
   program or graduate certificate.

B. Course-Load Requirements (see Section 3.14)

C. Maximum Course Load

The maximum course load for graduate degree students is 15 credit
hours in a semester and six credit hours in a summer session, although
students on assistantships may have lower limits imposed by their
advisors or programs. Graduate students who wish to enroll for more than
15 hours must complete a Schedule Revision form that is approved at the
departmental, college, and Graduate School levels.

D. Credit-Only Course Limitations

Courses at the 500 and 700 level are letter graded and cannot be taken
for “credit only.” Graduate students must take 400-level courses that are letter-graded if
they intend for them to fulfill programmatic requirements.

E. Enrolling for Courses in MyPack Portal

After consulting with their advisor, students may register through MyPack
Portal using their Unity ID and password. Students cannot register before
their enrollment access is scheduled. If an advisor has not yet been
appointed, the student should consult their DGP to determine appropriate
coursework.

Course descriptions are available through the Registration and Records
online Course Catalog (https://www.acs.ncsu.edu/php/coursecat/
directory.php).

Instructor consent is required for all practica, individual special topics
or special problems courses, internships, and thesis or dissertation
research.

F. Adding Courses

1. During the first week of a semester, students may add courses via
   MyPack Portal without permission; during the second week, course
   additions require instructor permission.
2. Summer courses can be added during the first two days of a session
   without permission and during the third and fourth days with instructor
   permission.
3. To add a student to a course after the Census date, a Schedule Revision Form (https://grad.ncsu.edu/faculty-and-staff/forms/graduate-school-forms/) is required.

G. Dropping Courses

All 500-800 level courses may be dropped through MyPack Portal without grades during the first eight weeks of a semester and during the first two weeks of a summer session. Tuition will not be refunded for any courses dropped after the Census date.

A Schedule Revision Form (https://grad.ncsu.edu/faculty-and-staff/forms/graduate-school-forms/) is required to drop a course after the deadline. Late dropping of courses requires documented medical reasons or other verified evidence of hardship. Courses may not be dropped after final grades have posted.

H. Dropping Non-Traditional Courses

For courses that deviate from the regular semester/session calendars, students should refer to their class syllabus and/or contact their instructor to verify the last day to drop a course without a grade.

I. Requirements for Auditing Courses

To audit a course, graduate students must have the approval of their advisor and the course instructor. While auditors receive no course credit, they are expected to attend class. Should an instructor conclude that an auditor has failed to attend, the instructor may assign a grade of “NR” (no recognition given for an audit). Graduate students may audit one course a semester tuition free; additional audits will require tuition payment.

J. Taking Courses for Credit at Other North Carolina Institutions

Interinstitutional Registration Program

• NC State participates in an Interinstitutional Registration program. Under this agreement, NC State graduate students are permitted to register for classes on one of the other campuses as approved by their advisory committees provided those courses are not offered at NC State.

• Even though taking a course on another campus, the student is exclusively under the administrative direction of the NC State Graduate School. Enrollment for courses on other campuses will take place on this campus following guidelines from Registration and Records. The Graduate School considers such courses part of the student’s normal load and the student will be billed for the courses through the NC State University Cashier’s Office. During the summer, the procedure is somewhat different in that a student must be enrolled in at least one course on the NC State campus during the same session as the requested interinstitutional registration.

• As the grading systems of University of North Carolina at Chapel Hill and Duke differ from that of NC State, grades received under Interinstitutional Registration will be converted to the NC State system. For example, “H,” “P,” “L,” and “F” grades earned at the University of North Carolina at Chapel Hill and “E,” “G,” “S” and “F” grades earned at Duke University will be converted to “A,” “B,” “C” and “F” grades, respectively.

Cooperating Raleigh Colleges

• The Cooperating Raleigh Colleges (CRC) is a program organized for the purpose of developing and conducting cooperative educational activities among Raleigh institutions. Graduate students may enroll in courses not offered by NC State. Registration and Records maintains CRC registration procedures.

• Any NC State graduate degree student who is enrolled in at least three graduate credit hours on the NC State campus may take a course through the CRC during the Fall or Spring semester, provided that:
  • (a) the course is not taught on the NC State campus;
  • (b) the advisory committee considers the course essential; and
  • (c) the student receives prior approval from the Graduate School.

• NC State students may not register for more than a total of six credits. Grades from CRC are not used in computing a student’s NC State grade point average.

• Under this agreement, regular tuition and fees are paid to NC State. Students are responsible for any special fees.

3.16 Withdrawal from the University

Degree Seeking Students

A. Terminating an Active Program

1. A student who wishes to terminate his/her graduate program must first notify his/her department or program in writing.

2. The Director of Graduate Programs (DGP) then forwards the request to the Graduate School for approval.

3. If the student is not in good standing, the student will receive a ‘Termination’ notation on their transcripts. If the student is in good standing, the student receives a ‘Termination without prejudice’ notation on their transcripts.

4. If the student has preregistered, notification to withdraw must be approved before the last day of the drop period. The student is responsible for dropping all classes for the upcoming semester.

B. Withdrawal Prior to the End of the Official Drop Period (of the semester in which currently enrolled)

1. Withdrawal prior to the end of the drop period is a release from the University for the remainder of the semester.

2. Students considering withdrawal should consult their major advisor and DGP.

3. A student who wishes to drop all courses and who has preregistered and prepaid must go through the official withdrawal process which can be found at MyPack Portal: Student Self Service > Enrollment > Term Withdrawal.

4. NC State students carrying course work at another campus under the Interinstitutional Registration Program must also contact the Department of Registration and Records to initiate the paperwork necessary for removal from the class roll at the other institution.

C. Late Withdrawals

Graduate students may receive withdrawals after the last day of the official drop period but before the end of the semester. Students considering withdrawal should consult their major advisor and DGP. A student who wishes to pursue a withdrawal must go through the official withdrawal process can be found at MyPack Portal: Student Self Service.
Enrollment > Term Withdrawal. Withdrawals will be considered under one or more of the following conditions:

1. Certification by a physician of inability to continue for medical reasons. Such medical petitions are subject to review by a University physician at the Student Health Center.

2. Certification by the Counseling Center or by an independent psychiatrist or psychologist of inability to continue for psychiatric/psychological reasons. In this case, the Counseling Center reserves the right to review pertinent records and to reexamine the student if necessary before recommending withdrawal. This is to certify that:
   a. there has been a significant decrease in the student’s usual level of psychological functioning, and
   b. that regaining the previous level of functioning will involve a process of sufficient academic disruption to make continuing as a student unreasonable. In this situation a “hold” may be placed on the student’s readmission pending certification by the Counseling Center or independent psychologist/psychiatrist that the student has regained an appropriate level of function and can be expected to maintain that usual level of psychological competence.

3. Documentation of a personal or family hardship that adversely affected the student’s academic performance in a significant way.

The DGP, Dean of the College, and the Graduate School will review the student’s request, consulting with the Counseling and Student Health Centers as appropriate. Once a final decision has been rendered, the student will be notified of that decision.

D. Retroactive Withdrawals

Requests for retroactive withdrawals may be made if the semester in which the student was registered has passed. Such withdrawals will normally be for an entire semester rather than for individual courses. Students considering such withdrawals should consult their major advisor and DGP. A student who wishes to pursue a retroactive withdrawal must go through the official withdrawal process through the Counseling Center. Withdrawals will be considered under one or more of the following conditions:

1. Certification by a physician of inability to perform during the semester in question. Such medical petitions are subject to review by a University physician if a request for consultation is made by the Counseling Center.

2. Certification by the Counseling Center, or by an independent psychiatrist or psychologist, of inability to perform during the semester in question for psychiatric/psychological reasons. In this case, the Counseling Center reserves the right to review pertinent records and to reexamine the student if necessary before recommending withdrawal. The certification must show a significant decrease in the student’s usual level of psychological functioning resulting in severely diminished performance.

3. Documentation of a personal or family hardship that adversely affected the student’s academic performance significantly during the semester in question.

The Counseling Center will communicate their recommendation to the Dean of the College in which the student was enrolled. The Dean of the College will review the student’s request and the Counseling Center’s recommendation, consulting with the student’s DGP if appropriate, and make a recommendation to the Graduate School. The Dean of the Graduate School will approve or deny the student’s request accordingly.

E. Effect of Withdrawal on Meeting Continuous Registration Requirement

Any student enrolled in a graduate program who is registered for a given semester or summer session and withdraws during the official registration period (typically the first 10 or 5 working days of a semester or summer session, respectively) must obtain a leave of absence to meet the requirement for continuous registration. However, those students withdrawing after the official registration period ends DO NOT need to obtain a leave of absence and will be considered by the Graduate School as having met their continuous registration requirement.

F. Effect of Withdrawal on Permanent Record

Neither courses nor grades are recorded on the permanent record for students who withdraw during the regular drop period. After the last day of the official drop period withdrawals without academic penalty are approved only under exceptional circumstances. In such cases, neither courses nor grades are recorded on the permanent record.

G. Retroactive Withdrawal

Requests for retroactive withdrawals may be made if the semester in which the student was registered has passed. Such withdrawals will normally be for an entire semester rather than for individual courses. Students considering such withdrawals should consult their major advisor and DGP. A student who wishes to pursue a retroactive withdrawal must go through the official withdrawal process through the Counseling Center. Withdrawals will be considered under one or more of the following conditions:

1. Certification by a physician of inability to perform during the semester in question. Such medical petitions are subject to review by a University physician if a request for consultation is made by the Counseling Center.

2. Certification by the Counseling Center, or by an independent psychiatrist or psychologist, of inability to perform during the semester in question for psychiatric/psychological reasons. In this case, the Counseling Center reserves the right to review pertinent records and to reexamine the student if necessary before recommending withdrawal. The certification must show a significant decrease in the student’s usual level of psychological functioning resulting in severely diminished performance.

3. Documentation of a personal or family hardship that adversely affected the student’s academic performance significantly during the semester in question.

The Counseling Center will communicate their recommendation to the Dean of the College in which the student was enrolled. The Dean of the College will review the student’s request and the Counseling Center’s recommendation, consulting with the student’s DGP if appropriate, and make a recommendation to the Graduate School. The Dean of the Graduate School will approve or deny the student’s request accordingly.

3.17 Grades

A. General Information

1. Evaluation of a student’s performance in a particular course or section is the prerogative of the instructor responsible for that course or section. No grade assigned to a student in a particular course or section may be changed without the consent of the faculty member responsible for that course or section unless required by the result of grievance.

2. Each faculty member who assigns grades has the responsibility to implement grading procedures that are fair and equitable, and to provide a reasonable evaluation of the student’s performance in the course.

3. At the beginning of the semester, faculty must include their grading scale and how grades will be determine in each course syllabus.
B. Types of Grading Systems

Performance in 500- and 700-level courses is evaluated on a scale ranging from “A+” through “F”, with a plus/minus designation if selected by the instructor. Performance in most 600- and 800-level courses is evaluated as either “S” (Satisfactory) or “U” (Unsatisfactory); these grades are not used in computing the GPA.

C. Minimum Grade Requirements for Graduate Credit

A course in which a student earns below a C- or a “U” will not be included in the minimum hours required for a given degree. Depending on the course, students may be required to repeat it.

D. Regular Grading Scale and Grade Points

The following grade points are used to calculate GPAs:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>4 1/3</td>
</tr>
<tr>
<td>A</td>
<td>4</td>
</tr>
<tr>
<td>A-</td>
<td>3 2/3</td>
</tr>
<tr>
<td>B+</td>
<td>3 1/3</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
</tr>
<tr>
<td>B-</td>
<td>2 2/3</td>
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<td>C+</td>
<td>2 1/3</td>
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<td>D+</td>
<td>1 1/3</td>
</tr>
<tr>
<td>D</td>
<td>1</td>
</tr>
<tr>
<td>D-</td>
<td>2/3</td>
</tr>
<tr>
<td>F</td>
<td>0</td>
</tr>
</tbody>
</table>

E. Grade Point Average (GPA)

To determine a student’s GPA, the total number of grade points earned is divided by the number of graded credit hours at the 400 level or higher that are attempted. The cumulative and semester GPAs will include the effect of any A+ grades awarded (at 4.33 grade points) up to a grade point average of 4.000. The grade point average will be calculated to three decimal places.

F. Post-Baccalaureate Studies (PBS)

Up to 12 credits earned in PBS courses with at least a grade of “B” can be officially transferred into a student’s program; these courses are also included in the GPA.

G. Incompletes

The grade of Incomplete (“IN”) may be given in any course at the instructor’s discretion for work not completed because of a serious interruption in the student’s work not caused by their own negligence. An “IN” must not be used, however, as a substitute for an “F” or “U” when the student’s performance in the course is not passing. An “IN” is only appropriate when the student’s record in the course is such that the successful completion of particular assignments, projects, or tests missed as a result of a documented serious event would enable that student to receive at least a C. Only work missed may be completed; no additional assignments can be included.

A student who receives an “IN” must complete the unfinished work by the end of the next semester in which the student is enrolled, provided that this period is no longer than 12 months from the end of the semester or summer session in which the “IN” was received. Otherwise, the “IN” will be automatically converted to “F” or “U,” in accord with the grading option for a particular course. All grades of “IN” must be cleared prior to graduation. Students must not register again for any courses in which they have “IN” grades. Such registration does not remove “IN” grades, and the completion of the course on the second occasion will automatically result in an “F” for the incomplete course.

- Students whose only remaining requirement for graduation is removal of an “IN” are not required to register in the following semester to complete the work and graduate; however, only one registration-free semester is allowed.

In special cases, the Graduate School may grant an extension of a student’s incomplete grade. Either the online Grade Change system or an Extension of Incomplete Grade form must be submitted.

To discourage excessive and/or unwarranted use of incomplete grades and extensions for an individual student, an extension of an incomplete grade will not be granted by the Graduate School if the student holds incomplete grades in other courses at the time of the request.

H. External Transfer Credit

Except in the case of interinstitutional courses, grades transferred from another institution will not be included in the GPA. See Section 3.1 for more information about transferring graduate credits.

I. Repeating Courses

A graduate student may repeat a course in which a grade of “C-” or lower has been earned. Repeating a course where a grade of “C” or higher has been earned requires the specific recommendation of the advisory committee as well as the approval of the DGP and the Graduate School. Students who repeat a course, regardless of the grade previously earned, will have both grades counted in their GPA. The semester hours will be counted only once toward the required minimum hours.

J. Grade Changes (see Section 5 in NC State REG 02.50.03)

After grades are posted, they are not subject to change based on a change in an instructor’s judgment; nor are submitted grades to be revised on the basis of a second trial (e.g., a new examination or additional work undertaken or completed). Changes must be made within one calendar year after the date final grades were posted to correct an error of computation or transcription or where part of the student’s work has been overlooked.

To change a grade, the instructor submits a grade change accompanied by a justification. This change must be approved by the DGP and Department Head relevant to the course, the appropriate Associate Dean, and the Graduate School. “IN” or “LA” grade changes require only departmental approval.
3.18 Graduate Courses

A. Credentials Required for Teaching Graduate Courses

The Southern Association of Colleges and Schools Commission on Colleges (SACSCOC) requires that graduate courses be taught by faculty with an earned doctorate/terminal degree in the teaching discipline or a related discipline. To that end, the following requirements for the teaching of graduate courses are established:

1. Both primary and secondary instructors must be graduate faculty in the academic program offering the course or approved non-graduate faculty (see Section 1.3 of the Administrative Handbook, sub-sections C and E).

2. All instructors must have an active record in HR (Human Resources).

3. Sections of the following courses must be taught by associate or full members of the graduate faculty:
   - XXX 685 Master’s Supervised Teaching
   - XXX 686-687 Master’s Other Teaching
   - XXX 690 Master’s Exams
   - XXX 691-699 Master’s Research
   - XXX 885 Doctoral Supervised Teaching
   - XXX 886-887 Doctoral Other Teaching
   - XXX 890 Doctoral Exams
   - XXX 891-899 Doctoral Research

4. Support personnel do not need to be graduate faculty but they must have 0% teaching load assigned.

5. All sections must have valid instructors listed (STAFF or blank is not acceptable).

B. Graduate Courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>5XX</td>
<td>Letter Graded Master’s Courses</td>
</tr>
<tr>
<td>6XX</td>
<td>S-U Graded Master’s Courses</td>
</tr>
<tr>
<td>7XX</td>
<td>Letter Graded Doctoral Courses (ALL 7XX courses are restricted to the following classification of students: MR, DR, SR, SP and GR)</td>
</tr>
<tr>
<td>8XX</td>
<td>S-U Graded Doctoral Courses (ALL 8XX courses, with the exception of those specifically listed at the end of this section, are restricted to the following classification of students: MR, DR, SR, SP and GR)</td>
</tr>
<tr>
<td>9XX</td>
<td>Professional Courses in the College of Veterinary Medicine are not graduate courses and may not be counted in Plans of Work for graduate degrees.</td>
</tr>
</tbody>
</table>

C. 500-Level Letter Graded Master’s Courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>500-589</td>
<td>Undesignated</td>
</tr>
<tr>
<td>590-599</td>
<td>Letter Graded Special Topic Master’s Courses</td>
</tr>
</tbody>
</table>

Note: Courses at the 500 level are letter graded. Students cannot enroll in these courses for ‘credit only.’

D. 600-Level S/U Graded Master’s Courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>Introduction to Graduate Study (in department or program)</td>
</tr>
<tr>
<td>601</td>
<td>Seminar (in department or program)</td>
</tr>
<tr>
<td>602-606</td>
<td>Seminar in &lt;specialization&gt; (in department or program)</td>
</tr>
<tr>
<td>607</td>
<td>Advanced Seminar</td>
</tr>
<tr>
<td>609</td>
<td>Colloquium</td>
</tr>
<tr>
<td>610-617</td>
<td>Topics Courses</td>
</tr>
<tr>
<td>610</td>
<td>Special Topics (in department or program)</td>
</tr>
<tr>
<td>611-613</td>
<td>Special Topics in &lt;specialization&gt; (in department or program)</td>
</tr>
<tr>
<td>615</td>
<td>Advanced Special Topics (in department or program)</td>
</tr>
<tr>
<td>616-617</td>
<td>Advanced Special Topics in &lt;specialization&gt; (in department or program)</td>
</tr>
<tr>
<td>620-626</td>
<td>Problems Courses</td>
</tr>
<tr>
<td>620</td>
<td>Special Problems (in department or program)</td>
</tr>
<tr>
<td>621-622</td>
<td>Special Problems in &lt;specialization&gt; (in department or program)</td>
</tr>
<tr>
<td>623-624</td>
<td>Miscellaneous Special Problems</td>
</tr>
<tr>
<td>625-626</td>
<td>Advanced Special Problems</td>
</tr>
<tr>
<td>630-634</td>
<td>Independent/Individual Study</td>
</tr>
<tr>
<td>630</td>
<td>Independent Study (in department or program)</td>
</tr>
<tr>
<td>631-634</td>
<td>Other independent or individual study courses</td>
</tr>
<tr>
<td>635-639</td>
<td>Readings</td>
</tr>
<tr>
<td>635</td>
<td>Readings (in department or program)</td>
</tr>
<tr>
<td>636-639</td>
<td>Advanced Readings</td>
</tr>
<tr>
<td>640-649</td>
<td>Practicums</td>
</tr>
<tr>
<td>640</td>
<td>Prepracticum</td>
</tr>
<tr>
<td>641-649</td>
<td>Practicum in &lt;specialization&gt; (in department or program)</td>
</tr>
<tr>
<td>650-659</td>
<td>Internships</td>
</tr>
</tbody>
</table>
### E. 700-Level Letter Graded Doctoral Courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>700-789</td>
<td>Undesignated</td>
</tr>
<tr>
<td>790-799</td>
<td>Letter Graded Special Topic Doctoral Courses</td>
</tr>
</tbody>
</table>

**Note:** Courses at the 700 level are letter graded. Students cannot enroll in these courses for a letter grade. Registration in 700-level courses is restricted to graduate or PBS status.

### F. 800-Level S/U Graded Doctoral Courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>800-809</td>
<td>Introductory, Seminars, Colloquiums</td>
</tr>
<tr>
<td>800</td>
<td>Introduction to Graduate Study (in department or program)</td>
</tr>
<tr>
<td>801</td>
<td>Seminar (in department or program)</td>
</tr>
<tr>
<td>802-806</td>
<td>Seminar in &lt;specialization&gt; (in department or program)</td>
</tr>
<tr>
<td>807</td>
<td>Advanced Seminar</td>
</tr>
<tr>
<td>809</td>
<td>Colloquium</td>
</tr>
<tr>
<td>810-817</td>
<td>Topics Courses</td>
</tr>
<tr>
<td>810</td>
<td>Special Topics (in department or program)</td>
</tr>
<tr>
<td>811-813</td>
<td>Special Topics in &lt;specialization&gt; (in department or program)</td>
</tr>
<tr>
<td>815</td>
<td>Advanced Special Topics (in department or program)</td>
</tr>
<tr>
<td>816-817</td>
<td>Advanced Special Topics in &lt;specialization&gt; (in department or program)</td>
</tr>
<tr>
<td>820-826</td>
<td>Problems Courses</td>
</tr>
<tr>
<td>820</td>
<td>Special Problems (in department or program)</td>
</tr>
<tr>
<td>821-822</td>
<td>Special Problems in &lt;specialization&gt; (in department or program)</td>
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<tr>
<td>823-824</td>
<td>Miscellaneous Special Problems</td>
</tr>
<tr>
<td>825-826</td>
<td>Advanced Special Problems</td>
</tr>
<tr>
<td>830-834</td>
<td>Independent/Individual Study</td>
</tr>
<tr>
<td>830</td>
<td>Independent Study (in department or program)</td>
</tr>
<tr>
<td>831-834</td>
<td>Other independent or individual study courses</td>
</tr>
<tr>
<td>835-839</td>
<td>Readings</td>
</tr>
<tr>
<td>835</td>
<td>Readings (in department or program)</td>
</tr>
<tr>
<td>836-839</td>
<td>Advanced Readings</td>
</tr>
<tr>
<td>840-849</td>
<td>Practicums</td>
</tr>
<tr>
<td>840</td>
<td>Prepracticum</td>
</tr>
<tr>
<td>841-849</td>
<td>Practicum in &lt;specialization&gt; (in department or program)</td>
</tr>
<tr>
<td>850-859</td>
<td>Internships</td>
</tr>
<tr>
<td>850</td>
<td>Internship (in department or program)</td>
</tr>
<tr>
<td>851-859</td>
<td>Internship in &lt;specialization&gt; (in department or program)</td>
</tr>
<tr>
<td>860-869</td>
<td>Miscellaneous</td>
</tr>
<tr>
<td>860-869</td>
<td>Miscellaneous that do not fit into any other category</td>
</tr>
<tr>
<td>870-871</td>
<td>Lab Rotations</td>
</tr>
<tr>
<td>870-871</td>
<td>Lab Rotations</td>
</tr>
<tr>
<td>875-879</td>
<td>Projects</td>
</tr>
<tr>
<td>875-879</td>
<td>Project courses (of all types)</td>
</tr>
<tr>
<td>880-884</td>
<td>Directed Study</td>
</tr>
<tr>
<td>880-882</td>
<td>Directed Study (in department)</td>
</tr>
<tr>
<td>883-884</td>
<td>Advanced Directed Study</td>
</tr>
<tr>
<td>885-887</td>
<td>Teaching</td>
</tr>
<tr>
<td>885</td>
<td>Doctoral Supervised Teaching</td>
</tr>
<tr>
<td>886-887</td>
<td>Other Teaching</td>
</tr>
<tr>
<td>890</td>
<td>Exams</td>
</tr>
<tr>
<td>890</td>
<td>Doctoral Exams</td>
</tr>
<tr>
<td>891-899</td>
<td>Research</td>
</tr>
<tr>
<td>891-899</td>
<td>Doctoral Supervised Research</td>
</tr>
<tr>
<td>893</td>
<td>Doctoral Thesis Research</td>
</tr>
<tr>
<td>895</td>
<td>Summer Thesis Research</td>
</tr>
<tr>
<td>896</td>
<td>Final Research Project</td>
</tr>
<tr>
<td>897</td>
<td>Doctoral Thesis Preparation</td>
</tr>
</tbody>
</table>

**Note:** Courses at the 600 level are S/U graded. Students cannot enroll in these courses for a letter grade. Registration in 600-level courses is restricted to graduate or PBS status.
Note: ALL 800-level S/U graded doctoral courses with the exception of those specifically listed below are restricted to graduate or PBS status.

G. Catalog Descriptions for Research, Teaching, and Examination Courses

- XXX 685 Master's Supervised Teaching. Restricted to master's students. 1-3. Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion.

- XXX 688 Non-Thesis Master's Continuous Registration – Half-Time Registration. Restricted to master's students. 1. For students in non-thesis master's programs who have completed all credit-hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc. As noted in the prerequisite above, the course-inventory system restricts enrollment in this course to master's students only (class MR).

- XXX 689 Non-Thesis Master's Continuous Registration – Full-Time Registration. Restricted to master's students. 3 credit hours. For students in non-thesis master's programs who have completed all credit-hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. As noted in the prerequisite above, the course-inventory system restricts enrollment in this course to master's students only (class MR). Students may register for this course a maximum of one semester. Registration restricted to 3 credits only.

- XXX 690 Master's Examination. Restricted to master's students. 1-6 credit hours. For students in non-thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam. As noted in the prerequisite above, the course-inventory system restricts enrollment in courses with this number to master's students only (class MR). XXX 690 cannot be used to fulfill course requirements, cannot be listed on the Plan of Work for credit, and cannot be transferred to another program.

- XXX 693 Master's Supervised Research. Restricted to master's students. 1-9 credit hours. Instruction in research and research under the mentorship of a member of the Graduate Faculty. In spite of the noted prerequisite the course inventory system actually restricts enrollment in courses with this number to student class MR or DR.

- XXX 695 Master's Thesis Research. Restricted to master's students. 1-9 credit hours. Thesis research. Ten-week course beginning the first day of Summer Session I. 895 Doctoral Dissertation Research courses are restricted to Doctoral students only (class DR) as indicated by the prerequisite noted above.

- XXX 696 Summer Dissertation Research. Restricted to doctoral students. 1 credit hour. Dissertation research. Ten-week course beginning the first day of Summer Session I. 895 Doctoral Dissertation Research courses are restricted to Doctoral students only (class DR) as indicated by the prerequisite noted above.

- XXX 890 Doctoral Preliminary Examination. Restricted to doctoral students. 1-9 credit hours. For students who are preparing for and taking written and/or oral preliminary exams. 890 Doctoral Preliminary Examination courses are restricted by the course-inventory system to Doctoral students only (class DR) as indicated by the prerequisite noted above. XXX 890 cannot be used to fulfill course requirements, cannot be listed on the Plan of Work for credit, and cannot be transferred to another program.

- XXX 893 Doctoral Supervised Research. Restricted to doctoral students. 1-9 credit hours. Instruction in research and research under the mentorship of a member of the Graduate Faculty. 893 Doctoral Supervised Research courses are restricted to Doctoral students only (class DR) as indicated by the prerequisite noted above.

- XXX 895 Doctoral Dissertation Research. Restricted to doctoral students. 1-9 credit hours. Dissertation research. 895 Doctoral Dissertation Research courses are restricted to Doctoral students only (class DR) as indicated by the prerequisite noted above.

- XXX 896 Summer Dissertation Research. Restricted to doctoral students. 1 credit hour. Dissertation research. Ten-week course beginning the first day of Summer Session I. 895 Doctoral Dissertation Research courses are restricted to Doctoral students only (class DR) as indicated by the prerequisite noted above. XXX 896 cannot be used to fulfill course requirements, cannot be listed on the Plan of Work for credit, and cannot be transferred to another program.

- XXX 899 Doctoral Dissertation Preparation. Restricted to doctoral students. 1-3 credit hours. For students who are writing their dissertation. May count toward the Graduate Plan of Work.

Master's students going on to pursue a Ph.D. can register for Ph.D. coursework during their last semester of the master’s degree instead of 689, 695, or 699 provided they have completed the master's degree requirements.

The courses are all variable credit, but none are zero credit courses.

1. The number of credits students register for in the courses should not exceed the upper limits stated in the descriptions.

2. As a general rule, master's students should not register for 8XX-level courses and doctoral students should not register for 6XX-level courses. The course inventory allows scheduling of students in the classes FR, JR, SO, SR in courses numbered 800 where the course prefix is II.

H. Credit Hours for Intensive Graduate Courses

A maximum of one credit hour will be awarded per week of full-time study for graduate courses offered by NC State University. At least 60 days before such a course is taught, the syllabus must be submitted to the Graduate School for approval.

I. Syllabus Requirement for Graduate Courses

All instructors of graduate courses are required, no later than the first class, to provide students with a written or electronic course syllabus which contains the information listed below.
A syllabus must be approved by the Administrative Board of the Graduate School as part of a new course proposal or a revision of an existing course.

A course syllabus must include the information listed below. The language enclosed within quotes in subsections 13 and 14 below should be used without changes.

1. Instructor’s name, office address, telephone number, e-mail address, regularly scheduled class meeting times, and office hours for out-of-class consultation. The course prefix, number, title, credit hours, and semester should be listed.

2. Course prerequisites, co-requisites or statement on enrollment restrictions. If none, state “none”.

3. Student learning outcomes for the course. Student learning outcomes in different sections of the same course should not differ significantly.

4. All required textbook(s) and other instructional material, and the cost of each. For each required textbook, include the author, title, and date or edition. Statement on required expenses (e.g., museum admission fee, field trip costs, liability insurance), if applicable.

5. Course overview including at least the catalog description.

6. Course structure (such as group activities, lectures, discussion, labs, field trips, studio, etc.). Explain how the course will operate.

7. Course schedule including the following (Note in the syllabus that the course schedule is subject to change with appropriate notification to students):
   a. Projected schedule of required readings, assignments, quizzes, and tests.
   b. Major topics to be covered.
   c. Required field trips and other out-of-class activities, if any.
   d. Laboratory, studio, or problem session topics, if any.
   e. Statement on transportation, if applicable. Students must be informed whenever they must provide their own transportation to a field trip or internship site.

8. Statement on safety and risk assumption in courses requiring a laboratory, physical activity, field trips, studios and other special activities. Consult with your department on appropriate wording. Safety issues must be part of the course schedule at the first opportunity.

9. Detailed explanation of how grades are determined including:
   a. The relative value of the various evaluation components of the course, (the portion of the grade that derives from quizzes, tests, final exam, projects, attendance, participation, etc.) and the specific expectation for each component. When attendance and/or participation are graded, the requirements for earning full value must be explained.
   b. The conversion system from numerical to letter grading, if applicable. The University’s regulation on grades and grade point average can be found at http://policies.ncsu.edu/regulation/reg-02-50-03 (Grades and Grade Point Average).”

10. Instructor’s policy on late assignments, including the impact of late assignments on the grading of the assignment and the course.

11. Instructor’s policies on attendance, (excused and unexcused) absences, and scheduling makeup work. Penalties associated with the number of absences in a course must be explicitly explained. Accepting excused absences of any kind is the prerogative of the instructor. When excuses are accepted, the procedures for submitting excuses and for scheduling makeup work must be explained. The attendance section should also explain whether students with excused absences are still expected to complete the missed work. If excused absences are accepted, refer to the University’s Attendance Regulation at http://policies.ncsu.edu/regulation/reg-02-20-07 (http://policies.ncsu.edu/regulation/reg-02-20-07/) for further information, including the University’s definition of excused absences.

12. Academic Integrity Statement: List the instructor’s expectations concerning academic integrity in the completion of tests, assignments, and course requirements. Include reference to the Code of Student Conduct policy (NCSU POL 11.35.1).

13. Statement for students with disabilities: “Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services for Students at 1900 Student Health Center, Campus Box 7509, 919-515-7653. For more information on NC State’s policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation (REG 02.20.01).”

14. N.C. State University Policies, Regulations, and Rules (PRR): “Students are responsible for reviewing the PRRs which pertain to their course rights and responsibilities. These include:
   • http://oied.ncsu.edu/oied/policies.php (https://oied.ncsu.edu/oied/policies.php) (Office for Institutional Equity and Diversity),
   • http://policies.ncsu.edu/policy/pol-11-35-01 (https://policies.ncsu.edu/policy/pol-11-35-01/) (Code of Student Conduct), and
   • http://policies.ncsu.edu/regulation/reg-02-50-03 (https://policies.ncsu.edu/regulation/reg-02-50-03/) (Grades and Grade Point Average)."

### 3.19 Academic Difficulty

Graduate students may be terminated from the program at any time if, in the judgment of the degree-granting Department/Program and the Graduate School, a student fails to make satisfactory progress towards the completion of the degree (regardless of grades) or violates the NC State Code of Student Conduct. The definition of satisfactory progress toward completion of the degree program may differ among degree-offering units. Examples of unsatisfactory progress may include, but are not limited to, inadequate GPA, inadequate research and/or research skill or progress, failure to obtain satisfactory grades in required courses for the program, or failing the preliminary or final oral examination.

An overall GPA of at least 3.000 is required for graduation.

#### A. Academic Warning

Graduate students are given a notice of academic warning if they have accumulated 18 or fewer hours at the 400 level or above and have less than a 3.000 GPA. Students on academic warning may continue to hold their course rights and responsibilities. These include:

- http://policies.ncsu.edu/policy/pol-11-35-01/ (Code of Student Conduct)

#### B. Academic Probation

Graduate students will be placed on academic probation if they have accumulated more than 18 hours at the 400 level or above and have a GPA in the range of 2.667 to 2.999. Students placed on academic probation will be ineligible for financial aid and appointment or reappointment to an assistantship or fellowship.
C. Termination

Graduate students will be terminated from their program of study if they have accumulated more than 18 hours at the 400 level or above and have a GPA below 2.667, or if they have accumulated 30 or more hours and have less than a 3.000 GPA. When terminated, a student may no longer register in a graduate classification (see Section 3.16 – Withdrawal from the University (p. 663) for more information on program termination.)

If a student’s graduate degree program is terminated, s/he cannot use courses taken in PBS status after termination for credit toward the same graduate degree program.

D. Reinstatement

Under extenuating circumstances, the Director of Graduate Programs (DGP) may recommend and provide justification to the Graduate School to reinstate a student’s graduate classification using the Reinstatement Form. This recommendation must be in writing and must be signed and approved by the advisory committee and the DGP or the Department Head before it will be considered. It must include a reasonable academic and mentoring plan for achieving at least a 3.00 average.

If approved, the Graduate School will execute a “Matriculation” action in SIS, accompanied by a confirmation letter to the DGP and a request to Registration and Records to update the student’s academic standing. To register, the “advising service indicator” must be removed by either the Graduate School or the program as early as the following day. Students who request reinstatement of their assistantships/fellowships should ask their DGP to submit a request to the Graduate School along with the academic reinstatement request. The expectation is that the student’s GPA will be at least a 3.00 at the end of the semester. Please refer to Section 4.2 (p. 674).

3.20 Graduation

A. Official Graduations

There are three official graduations per year at NC State: at the end of the Fall and Spring semesters and at the end of the second Summer session. Formal commencement exercises are held at the end of the Fall and Spring semesters; any student who completed their degree during a summer session is eligible to participate in the Fall commencement exercises. All students scheduled to graduate in the Fall or Spring semesters are strongly encouraged to attend the respective commencement. Any doctoral candidate wishing to have the degree conferred in absentia must notify the Graduate School in writing; master’s candidates should contact their departments or programs. The diploma will include the program or, in the case of dual PhDs, both programs will be noted; concentrations will not be included.

Students may not participate in a University commencement ceremony until all degree requirements are met.

B. Date of Degree Conferral

The date of completion of the course of study is Commencement Day for a given semester or the last day of classes in the second summer session.

To graduate by that date, students in Ph.D./Ed.D. programs and in thesis master’s programs must submit their dissertations/theses by the Graduate School’s ETD deadlines (https://grad.ncsu.edu/students/etd/etd-deadlines/).

C. Graduation Clearance Period

Students who are on the graduation list but have outstanding requirements (incomplete grades, corrections in theses or dissertations, etc.) are put on “hold” by the Graduate School for a period of 30 days following graduation. The Director of Graduate Programs (DGP) and Graduate Service Coordinators (GSCs) will be notified of this action. If these outstanding requirements are not completed within 30 days following the conferral date, the graduation application will be denied. The student must reapply for graduation in a future term once those requirements are completed.

D. Student Requests for Graduate School Certification of Completion of Certain Requirements

Graduate students who have completed all program requirements and are awaiting graduation can request the Graduate School to write a letter for a prospective employer or graduate program certifying that these requirements have been met. The Graduate School will respond to a request to certify completion of requirements within five working days of the receipt of the request in the Graduate School.

3.21 Diplomas

To receive a diploma, a student must use the ‘Apply for Graduation’ link in MyPack Portal for the term in which they plan to graduate by the deadline noted in the Graduate School Calendar (Student Self Service > Degree Progress/Graduation > Apply for Graduation).

Doctoral students graduating in the Spring and Fall are awarded their diplomas during the commencement exercises. Both master’s and doctoral students graduating at the end of second summer session, or those students receiving permission to receive the degree in absentia will be mailed their diploma from Registration and Records.

Students earning a Master of Arts, Master of Science, Doctor of Education or Doctor of Philosophy degree will receive diplomas designating the degree and the major or program of study; subplans or concentrations will be denoted on the transcript, but not on the diploma. Students earning a master degree in a designated field will receive diplomas indicating the field of specialization, e.g., Master of Forestry.

3.22 University Patent Agreement and Copyright Procedures

All students must sign the Patent Agreement via Student Self-Service in MyPack Portal by the completion of 12 hours or before they start their research, whichever is earlier.

For more details, refer to the Patent and Copyright Procedures (https://policies.ncsu.edu/policy/pol-10-00-01/) of NC State and the NC State policy on copyright regulation (https://policies.ncsu.edu/regulation/reg-01-25-03/).
3.23 Release of Student Information

Written Permission of Student Required to Release Records

In compliance with the Family Educational Rights and Privacy Act of 1974 (Buckley Amendment), the Graduate School will require written permission of the student before releasing any information in the student’s educational record to any party outside of the University. The student must complete an Authorization to Release Information (https://grad.ncsu.edu/faculty-and-staff/forms/graduate-school-forms/) and submit it to the Graduate School Records Unit.

Student Requests for Graduate School Certification of Completion of Certain Requirements

Graduate students who have completed all program requirements and are awaiting graduation can request the Graduate School to write a letter to a prospective employer or graduate program certifying that these requirements have been met. The Graduate School will provide these certifications, but requires that the student submit the Authorization to Release Information form. The Graduate School will respond to a request to certify completion of requirements within five working days of the receipt of the request in the Graduate School.

3.24 Schedule of Required Documents

Required Forms/Actions

Complete, official transcripts from universities and colleges attended, including degrees and dates awarded

When Required: Before the beginning of the first semester of enrollment

Who Initiates: Student is responsible for providing official transcripts to the Graduate School.

Patent Agreement

When Required: Before the end of the first semester of enrollment

Who Initiates: Initiated by student online via Student Self-Services in MyPack Portal.

Appointment of Advisory Committee and submission of Plan of Work

When Required: During second semester or earlier

Who Initiates: Initiated by student with Advisor and Committee. Approved and submitted to the Graduate School by the DGP (doctoral students only)

Assignment of Graduate School Representative, if required (doctoral students only)

When Required: After Plan of Graduate Work has been approved by Graduate School

Who Initiates: Appointed by the Graduate School

Request to Schedule the Preliminary Oral Examination (http://www.ncsu.edu/grad/faculty-and-staff/forms-list.html) (doctoral students only)

When Required: After written preliminary exams have been passed, but no later than one semester prior to final oral exam. Request must be received in Graduate School at least 2 weeks prior to proposed exam date.

Who Initiates: Initiated by student and submitted to the Graduate School by the DGP

Report on Outcome of Preliminary Oral Examination (doctoral students only)

When Required: Immediately after oral examination is completed

Who Initiates: Submitted to the Graduate School by the DGP within 5 working days of exam

Application to Graduate (replaces old Diploma Order Request card)

When Required: Thesis Students – when Final Oral Exam is Scheduled but no later than the Apply to Graduate Deadline

Who Initiates: Initiated by student online via MyPack Portal, by navigating to Student Self Services, Degree Progress/Graduation, Apply for Graduation

Request to Schedule the Final Oral Examination (http://www.ncsu.edu/grad/faculty-and-staff/forms-list.html) (doctoral students only)

When Required: Must be received in Graduate School at least 2 weeks prior to proposed exam date (see right), and no earlier than 4 calendar months after successful completion of preliminary exam

Who Initiates: Initiated by student and submitted to the Graduate School by the DGP.

Student must also apply to graduate at the same time via MyPack Portal.

Request for a Permit to Schedule the Master’s Oral Examination (http://www.ncsu.edu/grad/faculty-and-staff/forms-list.html) (master’s students only)

When Required: Must be received in the Graduate School at least 10 working days before the examination is scheduled

Who Initiates: Initiated by student and submitted to the Graduate School by DGP.
Student must also apply to graduate at the same time via MyPack Portal.

Report on Outcome of Final Oral Examination (http://www.ncsu.edu/grad/faculty-and-staff/forms-list.html) (master’s or doctoral)

Who Initiates: Submitted to the Graduate School by the DGP

Draft submission of thesis or dissertation to Graduate School for thesis review

When Required: Immediately after final oral exam

Who Initiates: Student must electronically submit the final PDF file to the Thesis Editor via the ETD submission system for acceptance by the Graduate School.

Final submission of thesis or dissertation to Graduate School for Graduate School acceptance

When Required: Final error free file must be submitted before the deadline for the semester as noted in the Graduate School Calendar (http://www.ncsu.edu/grad/faculty-and-staff/calendars.html).

Who Initiates: Student must electronically submit the final error free file to the Thesis Editor via the ETD submission system for acceptance by the Graduate School.

Final committee approval of thesis or dissertation

When Required: Online approval by the student’s advisory committee, through MyPack Portal before the deadline for the semester as noted on the ETD web page.

Who Initiates: Student unconditionally passes the final exam and the ETD is accepted by the Thesis Editor.

1 Receipt of materials in the Graduate School can be by campus mail, hand delivery, fax, or e-mail, as appropriate.

4.1 Assistantships, Fellowships, Traineeships, and Grants

Students admitted to the Graduate School may be awarded financial support in the form of an assistantship or fellowship (sometimes referred to as a traineeship). These programs provide financial support to enable students to focus their work on their degrees. Student’s assignments should be in direct or general support of the teaching, research or extension missions of the university for the mutual benefit of the graduate students and his/her graduate program.

A. Eligibility

In order to be eligible for graduate teaching, research, or extension assistantships and fellowships (traineeships), students must be admitted into the Graduate School in full graduate standing and be enrolled in the fall and spring semesters. Students must also be in good academic standing (with a 3.000 grade point average or higher), unless granted an exception by the Graduate School. Some fellowships (traineeships) have additional eligibility requirements, e.g., a GPA higher than 3.000 or a specific research focus. It is the responsibility of the student to consult the Director of Graduate Programs (DGP) for information on specific eligibility requirements. Graduate Certificate Students are eligible for appointment as Graduate Service Assistants but not research, teaching or extension assistantships.

The position of the Graduate School is that any graduate student holding a graduate research, teaching, or extension assistantship requiring 20 hours of work per week or more (i.e. half-time or greater) must, as a condition of such assistantship, maintain his/her status as a full-time student, and therefore, should not be otherwise employed. The reason for this position is to encourage students to work on their degrees rather than part-time jobs and to ensure that additional employment is approved by the student’s department. If a department wishes to increase a graduate assistant’s financial support, the stipend should be increased. If additional time is required, the student’s FTE should be adjusted accordingly. International graduate students on F-1 and J-1 visas are limited to 20 hours of service work per week.

B. Definitions

The following definitions have been recommended by the Administrative Board of the Graduate School and approved by the Graduate School. Graduate departments and programs have the responsibility of determining whether or not the assignments given to their graduate student assistants are in direct or general support of the teaching, research or extension missions of the university.

1. Graduate Teaching Assistant – A student who is appointed in an academic department or program and
   a. directly participates in the teaching mission of the unit as instructor of record, lab instructor, recitation leader, lab or lecture assistant, or who has responsibilities in direct support of classroom instruction in the unit, such as setting up labs or working in an instructional computer lab; or
   b. provides general support to the teaching mission of the department or program.

2. Graduate Research Assistant – A student who is appointed in an academic department or program and
   a. directly participates in the research mission of the unit, or an on-campus or off-campus organization that is affiliated with the unit, in the design of experiments, data collection, analysis, or reporting of research results in the student’s field of study, where research may, but is not required to, contribute directly to the student’s thesis or dissertation; or
   b. provides general support to the research mission of the unit or discipline.

3. Graduate Extension Assistant – A student who is appointed in an academic department or program and
   a. directly participates in the extension, outreach and engagement mission of the unit, or an on-campus or off-campus organization that is affiliated with the unit, in the design of projects, data collection, analysis, application, or reporting of results in the student’s field of study, where these activities may, but are not required to, contribute directly to the student’s thesis or dissertation; or
b. supports the extension, outreach and engagement mission of the unit or discipline, including substantive interaction with individuals or groups beyond the university.

4. Graduate Services Assistant – A student who is appointed to a position that serves the university outside of an academic department or program’s teaching or research mission during the academic year.

5. Graduate Fellow (Trainee) - A student who is provided a stipend that has no corresponding service obligation. Stipends from graduate fellowships (traineeships) are based on academic scholarship and/or financial need criteria. Students may contact the DGPs or Graduate Services Coordinators to notify the university about fellowships (traineeships) that may also provide tuition, fees and/or educational expense allowances.

C. Responsibilities

1. Graduate Teaching Assistants – A 1/2-time Graduate Teaching Assistant is required to spend approximately 20 hours per week fulfilling assigned teaching responsibilities associated with the stipend. These duties may be independent of teaching activities that contribute to the requirements of the degree program. Time commitment for students whose appointment is less than or greater than 1/2-time are in the same proportion to a 40-hour week as that of the 1/2-time appointment, i.e., 10 hours for a 1/4-time appointment and 30 hours for a 3/4-time appointment.

   a. Orientation to Teaching for New Graduate Teaching Assistants. All new Graduate Teaching Assistants and other graduate students with newly assigned teaching responsibilities are required to attend a University-wide Teaching Orientation, which has traditionally been held each August, shortly before classes start. The Orientation is sponsored by the Graduate School.

   b. International Teaching Assistant (ITA) Screening. All International Teaching Assistants (ITAs) whose responsibilities include significant interaction with undergraduates in a classroom or laboratory must be screened for oral English proficiency before they are permitted to assume these responsibilities. If the screening process indicates that an ITA needs to improve his or her spoken English significantly in order to communicate effectively with his or her students, he or she must take FLE 400 (American English Pronunciation for International Students) or FLE 401 (Oral Communication and Teaching Skills for International Teaching Assistants) before being re-screened. ITA’s are held each August, November, January, and April. DGPs and Graduate Services Coordinators will receive a request that they sign up students online for the SPEAK test six to eight weeks prior to each screening. It is the responsibility of the DGPs or Graduate Services Coordinators to notify the students of their test date, time, and location.

The Spoken English Assessment Test (SPEAK), an institutional version of the Educational Testing Service’s Test of Spoken English, screens ITAs for proficiency in oral English. Administered in the Foreign Language Laboratory and rated by specialists in English as a Second Language, the SPEAK test consists of a series of prompts for which each student’s responses are recorded. No special preparation is necessary. After each student’s test is graded, scores are posted on a secure website for departmental access. The score will determine what responsibilities each ITA may assume.

Depending on their scores, ITAs may be cleared for either lead teaching responsibility in a classroom or lab or for limited teaching responsibility in settings where a faculty member or experienced TA has primary teaching responsibility. If an ITA is cleared only for limited teaching responsibility, before being assigned full responsibility for a class, lab, discussion section, etc., he or she must take FLE 400 or FLE 401, be re-screened, and achieve the score appropriate for full teaching responsibility. ITAs whose scores indicate that their spoken English must improve before they can assume even limited teaching responsibilities should not be assigned any duties that require significant verbal interaction with undergraduates. If their departments wish them to assume either limited or full teaching responsibilities, these students must first take FLE 400 and/or 401 and then be re-screened and achieve the appropriate score for either limited or full responsibility.

2. Graduate Research Assistants – A 1/2-time Graduate Research Assistant is required to spend approximately 20 hours per week fulfilling the assigned research responsibilities associated with the stipend. These duties may be independent of research activities that contribute to the requirements of the degree program. Time commitment for students whose appointment is less than or greater than 1/2-time are in the same proportion to a 40-hour week as that of the 1/2-time appointment, i.e., 10 hours for a 1/4-time appointment and 30 hours for a 3/4-time appointment.

3. Graduate Extension Assistants – A 1/2-time Graduate Extension Assistant is required to spend approximately 20 hours per week fulfilling his/her assigned extension, outreach and engagement responsibilities associated with the stipend. This may be independent of time spent in research or teaching or extension, outreach and engagement activities that are part of the academic requirements of the degree program. Time commitment for students whose appointment is less than or greater than 1/2-time are in the same proportion to a 40-hour work week as that of the 1/2-time appointment, i.e., 10 hours for a 1/4-time appointment and 30 hours for a 3/4-time appointment.

4. Graduate Services Assistants – A 1/2-time Graduate Services Assistant is required to spend approximately 20 hours per week fulfilling assigned responsibilities associated with the stipend. Commonly, the duties are independent of time spent in research or teaching activities contributing to the requirements of the degree program. Time commitment for students whose appointment is less than or greater than half-time are in the same proportion to a 40-hour work week as that of the 1/2-time appointment, i.e., 10 hours for a 1/4-time appointment and 30 hours for a 3/4-time appointment.

5. Graduate Fellows (Trainees) – Graduate fellows (trainees) have no service obligation. However, they must fulfill all research and teaching requirements of their degree programs and, in many cases, additional requirements stipulated by their fellowship (traineeship) programs.

D. Benefits of Assistantships and Fellowships

1. Graduate Teaching Assistants, Graduate Research Assistants, Graduate Extension Assistants, and Graduate Fellows (Trainees) are provided health insurance through the Graduate Student Health Insurance (GSHI) Plan under the conditions specified in the Graduate Student Support Plan.

2. Graduate Teaching Assistants, Graduate Research Assistants, Graduate Extension Assistants, and Graduate Fellows (Trainees) are provided in-state tuition and tuition remission as specified in the Graduate Student Support Plan (https://grad.ncsu.edu/students/gssp/).
3. The Graduate Student Support Plan excludes the participation of Graduate Services Assistants in health insurance, in-state tuition and tuition remission benefits.

4. Student assistants, i.e., biweekly appointees, will under no conditions be eligible for the health insurance plan or the tuition benefits of the Graduate Student Support Plan.

5. Many fellowships and traineeships include “cost-of-education” (COE) or “educational enhancement” funds in addition to funds for stipends, tuition, and health insurance. The Graduate School processes all expenditures of these funds. By the first of September, the Graduate School Fellowship Office sends each department/program a list of all its current Fellows (Trainees) who have access to COE funds. These funds may be used for research- and course-related books, supplies, equipment, and travel. Fellows are informed of this support in their award letters and are provided instructions as to making expenditures.

### 4.2 RA and TA Appointments

#### A. Appointing Students to Graduate Assistantships

All Graduate Teaching Assistants (GTAs), Graduate Research Assistants (GRAs), and Graduate Services Assistants (GSAs) are appointed in the University’s HR System and are paid on the University’s biweekly payroll cycle. Students must sign up for direct deposit through Employee Self-Service in MyPack Portal.

Graduate students who are paid on a temporary/hourly basis may not be given the title Graduate Research Assistant, Graduate Teaching Assistant, Graduate Extension Assistant, or Graduate Services Assistant. Temporary appointees may be referred to as student workers.

- **Graduate Teaching Assistants:** Appointed in the University HR system under Job Code A138, A178, A438, A478/Employee Class GRD, Department ID from 11#### -20####.
- **Graduate Research Assistants:** Appointed in the University HR System under Job Code A148, A178, A448, A478/Employee Class GRD, Department ID from 11#### -20####.
- **Graduate Extension Assistants:** Appointed in the University HR System under Job Code A428, A438, A448, A478/Employee Class GRD, Department ID from 11#### -20####.
- **Graduate Services Assistants:** Appointed in the University HR System under Job Code A198/Employee Class GRD.

#### B. Procedures for Paying Fellowship Stipends/Awards

**NC State University, effective July 1, 1997 (updated June 1, 2012)**

All graduate fellowship stipends/awards are entered in the University’s Financial Aid System by the Graduate School based on information provided by departments on the Graduate Fellowship Payment Information Form. A copy of the graduate fellowship stipend/award letter attached to the Graduate Fellowship Payment Information Form must be forwarded to the Graduate School for all new fellowship stipends/awards by the 15th of the month in which disbursements begin.

Students receive monthly payments through the Cashier’s Office, and students must sign up for direct deposit through Student Financials in MyPack Portal.

1. Determining the Primary or Supplemental Status of a Fellowship

A primary fellowship is one that pays a stipend/award of $3,000 or more for the Fall or Spring academic term. Health insurance benefits, in-state tuition awards, and tuition remission (if applicable) must be provided under the terms and conditions of the Graduate Student Support Plan, if the student meets the Plan’s registration requirements. A primary fellowship is responsible for the total cost of the health insurance benefits, in-state tuition, and tuition remission matching (if applicable). Tuition remission match is 25% of the out-of-state tuition amount and is only applicable to out-of-state students. Health insurance coverage remains in force only as long as the fellowship appointment remains in effect. If any part of the benefits package (where applicable) cannot be paid by the fellowship funds, the college must cover it from other sources of funds.

A supplemental fellowship is one that pays a stipend/award less than $3,000 for the Fall or Spring academic term. Supplemental fellowships are not used to determine eligibility for health insurance, in-state tuition awards, or tuition remission. Recipients of supplemental fellowships will not be eligible for health insurance and tuition remission unless they have other qualifying assistantship appointments or primary fellowships.

2. Fellowship Assignment Guidelines

The following guidelines apply to fellowships in order to distinguish them from assistantships and retain their “exempt from withholding” status:

All fellowship assignments will be entered in the SIS Financial Aid System with an stipend/award amount and the dates for disbursement. The designation of the fellowship as primary or supplemental will be determined by both the award amount and the dates for disbursement.

Examples are:

- **a.** If a student will be paid a graduate fellowship of $14,000 in equal monthly installments over an academic year (fall and spring terms), the stipend/award amount entered into the Financial Aid System will be $14,000. The effective date will be 8/1/XX and the end date will be 5/31/XX, with disbursements paid August through May. This is a primary fellowship.
- **b.** If a student will be paid a graduate fellowship of $5,000 in equal monthly installments over an academic year (Fall and Spring Terms), the stipend/award amount entered into the Financial Aid System will be $5,000. The effective date will be 8/1/XX and the end date will be 5/31/XX, with disbursements paid August through May. This is a supplemental fellowship.

**Note:** Fellowship payments default to equal monthly amounts over the disbursement period. The default disbursement schedule/monthly amount can be overridden when needed. The reason for the adjustment should be provided on the Graduate Fellowship Payment Information Form.

- **c.** If a student will be paid $2,500 in August, and $2,500 in January, a stipend/award of $5,000 will be entered in Financial Aid. The first $2,500 installation will be designated for the Fall term with disbursement in August, and the second $2,500 installment will be designated for Spring term with disbursement in January. Since the payments are not continuous, this is a supplemental fellowship; please keep in mind that in order to qualify for continuous health insurance benefits throughout the academic
year, the student must be receiving continuous biweekly “primary” fellowship payments.

The process to determine a graduate student’s eligibility for health insurance benefits, in-state tuition, and tuition remission will read this stipend/award in Financial Aid in the same way it reads a graduate assistantship appointment in the HR System. In the case of a primary fellowship, eligibility and payment responsibility for graduate student support will be determined on the value of the primary fellowship stipend/award alone.

If the country of legal residence is not the US, taxes will be withheld, or not, based on the country of residence.

In addition to the stipend/award amount, many fellowships include the cost of education and/or educational enhancement funds. These funds may be used to pay the fellow’s tuition, fees, books, supplies, travel, and other costs that directly support the student’s educational program. These funds will be managed by the fellow’s department or college and in some cases, the Graduate School. Expenditure of these funds will continue to be processed through Accounts Payable as it has in the past.

A No-Pay Graduate Fellowship job will be entered in the HR System by the Graduate School based on information provided in the Graduate Fellowship Payment Information Form; this No-Pay job record will provide the student with access to the University’s Marketplace and Travel Systems. Cost of education and educational enhancement funds will not be used to determine eligibility for the health insurance benefits, in-state tuition awards, or tuition remission.

### C. Terms and Conditions of Assistantship Appointments

When appointing students to Graduate Research/Teaching/Extension Assistantships, the terms and conditions for the appointment must be presented in writing to the student. The Terms and Conditions for Appointment document may be used as a stand-alone document. If the department chooses to send its own letter of appointment, the Conditions for Appointment statement must be attached. Also, a checklist, Items to be Included in Letters of Offer Along With Generic Form of Conditions for Appointment, is provided to ensure that departments include all necessary information in their assistantship offer letters.

The “Terms and Conditions” document must be used to make clear the expectations the University has for Teaching, Research and Extension Assistantships and for the individual on these appointments to know the conditions upon which they are appointed and the benefits they are entitled to in exchange for their performance.

#### Procedures

1. Initial Graduate Assistantship Appointment

   Each student who is offered a Graduate Research/Teaching/Extension Assistantship will be notified in writing of the terms and conditions of their appointment. The following documentation is required for all new or initial Graduate Research/Teaching/Extension Assistantship appointments:

   a. Completed and signed Terms and Conditions for Appointment document OR the Conditions for Appointment document, along with a letter of offer stating the “terms” of appointment.

2. Extension of Graduate Assistantship appointment or additional Graduate appointment

   A change to the appointment such as an extension of the current appointment that is not reflected in the initial “Terms and Conditions” document or the initial “Conditions for Appointment” document and letter of offer necessitates a new, signed Terms and Conditions document reflecting the change(s). Both the student and the Director of Graduate Programs (DGP) must be in agreement to change the terms and conditions of the existing appointment.

   For example, if the initial Terms and Conditions of the Graduate Assistantship indicated support for a three (3) year appointment, the initial document would cover continuous payments for that three-year period of time unless changes were made to the terms of the appointment. If the initial “Terms and Conditions” document reflected support for a one (1) year Graduate Assistantship, this initial document would cover continuous payments as a Graduate Assistant for the one-year term only.

   Any appointment not covered in the initial Terms and Conditions requires a new Terms and Conditions document. Appointments that are extended necessitate a new, signed Terms and Conditions. Payroll actions extending the appointment must be processed in the HR System at least three weeks prior to the planned exit date to insure that continuous pay is not disrupted. The department submits completed and signed documents attached to the HR System Personnel Action Form (PAF) to the Graduate School.

3. Termination of Graduate Assistantship prior to the end of the contract

   If a graduate assistant resigns prior to the end of the contract stated in his/her “Terms and Conditions” document, a letter of resignation or a memorandum documenting the resignation is required. A copy of the required back-up documentation in #8 of the “Terms and Conditions” document attached to the HR System Personnel Action Form (PAF) to the Graduate School.

   If a department terminates a graduate assistant prior to the end of the contract stated in the “Terms and Conditions” document, a copy of the required back-up documentation in #8 of the “Terms and Conditions” document attached to the HR System Personnel Action Form (PAF) must be forwarded to the Graduate School once the termination action has been entered and approved in the HR System.

4. Reinstatement of Assistantship
Students who have their assistantship terminated due to academic difficulty must have their DGP submit a separate request for reinstatement and academic exception to their Graduate School Liaison.

5. Human Resources (HR) System

Data entry in the HR System must reflect the current appointment(s). This includes title, compensation rate, FTE, and dates of appointment, as reflected in the “Terms and Conditions” document.

6. Terms and Conditions for Self-Supporting Students

Self-supporting students enrolling at NC State may be asked by their department to complete the Terms and Conditions for Self-Supporting Students document when they enter a graduate program. This document outlines their academic obligations, but in no way obligates the University to any financial responsibility for the student.

D. Assistantship Course Load

Students appointed to assistantships should consider the number of credit hours for which they register in any given fall or spring semester in light of the duties expected of them as a result of the assistantship. Limits to the number of credits such students may register for in a semester may be imposed by individual advisers or by programs. In such cases, registration should be established in consultation with the student’s adviser and/or DGP.

E. Taxation of Assistantships and Fellowships

All scholarship and fellowship payments are reportable on the recipient’s income tax returns. This includes the amount of any tuition remission a student may have received, which is treated as a fellowship for tax purposes.

All assistantship payments are considered wages and will be paid and reported by the University payroll system. They will be subject to tax withholding.

The University Payroll Office can answer questions concerning current tax issues. Also refer to the Internal Revenue Service and/or NC Department of Revenue.

F. Managing Fellowships and Grants

In addition to fellowships and traineeships administered by individual colleges and departments, the Graduate School administers a number of fellowships (traineeships) and grants. These include:

1. “Portable” fellowships awarded by foundations and government agencies, which individual students “bring” to the University and which the Graduate School is asked to administer;
2. Federally funded fellowships (traineeships) awarded to the University as a result of grant proposals, which are often used to recruit students to specific interdisciplinary programs of study and research;
3. Institutional fellowships funded with income from university fellowship endowments;
4. Grants to support graduate student diversity (see below).

Regarding University-awarded fellowships, in most cases students are nominated by their graduate programs or colleges rather than applying directly for the fellowships. Recipients are selected either by the Credentials and Awards Committee of the Administrative Board of the Graduate School or by a selections committee of faculty who help direct a specific training program.

1. Fellowship Information and Nominations Procedures

Graduate School Fellowship Information on the Graduate School web site provides an overview of types of funding available for graduate education, descriptions of selected NC State fellowships administered by the Graduate School, and searchable databases for nationally competitive fellowships and other funding opportunities. Both campus-based and national fellowship competitions are routinely announced in the NC State Online Bulletin. For University-wide fellowships, calls for nominations are sent to DGPs and/or Associate Deans, depending on the selections process. For training grants, which are much narrower in scope, calls for nominations are e-mailed to the training faculty identified in the grant proposal or to DGPs whose programs are eligible to nominate trainees. To nominate students for diversity grants, DGPs should contact the Graduate School. Further information on all funding opportunities is available by contacting Dr. David Shafer, Assistant Dean of the Graduate School.

2. Generating Fellowship (Traineeship) Programs

Researching opportunities and submitting proposals for new fellowship (traineeship) programs is a coordinated effort among the NC State Graduate School, faculty, and the Proposal Development Unit (PDU), which is part of the Office of Research, Innovation, and Economic Development. The PDU provides support for faculty producing large-scale proposals for graduate fellowships with a goal of enhancing competitiveness for research and graduate fellowship funding. In most cases, funded fellowship proposals are administered by the Graduate School.

3. Managing Fellowship (Traineeships) and Diversity Grants: The Role of the Graduate School

For all fellowships (traineeships) and grants administered by the Graduate School, the Graduate School appoints the students through the Financial Aid System and sets up their accounts. If their award qualifies them for the Graduate Student Support Plan, the Graduate School also pays their tuition, health insurance, and any other fees covered by the fellowship or traineeship, as well as the monthly stipend.

For fellowships and grants with a need-based stipend, the Graduate School also calculates the appropriate stipend/award level. If the fellowship brings with it an educational enhancement allowance for books, supplies, professional travel, etc., the Graduate School sets up an account for these funds and monitors their disbursement. Finally, the Graduate School monitors the academic progress of students receiving funding from fellowships, traineeships, and grants to ensure that they are meeting the academic requirements of their funding.

For institutionally awarded fellowship and traineeship programs and for diversity grants, the Graduate School, in consultation with the training faculty, has some or all of the following additional responsibilities:

a. Sending out calls for nominations and collecting nomination/application materials
b. Coordinating the selections process for the faculty selections committee
c. Sending out award letters
5. Diversity Grants for Students from Underrepresented Groups

Diversity Enhancement Grants are funded by the State of North Carolina for students who are accepted in master’s or Ph.D. programs at NC State. Criteria for selection include: academic record, character, creativity, educational and economic background, race and ethnicity, gender, exceptional personal talents, unique work or service experience, and leadership potential. Applicants must add to the goal of increasing diversity in graduate education at North Carolina State University. Recipients are awarded stipends based on financial need for the academic year, with an option of additional support for study in the summer session.

5.1 Discipline and Grievance Procedures

Graduate Student Discipline Procedures

Disciplinary procedures that apply when a graduate student is charged with academic misconduct in violation of the Code of Student Conduct and the misconduct involves the graduate student’s thesis or dissertation are contained in REG 11.35.03 (Graduate Student Discipline Procedures).

Allegations of research misconduct involving a graduate student’s thesis or dissertation are subject to REG 10.00.02 (Responding to Allegations of Research Misconduct).

REG 11.35.02 (Student Discipline Procedures) govern all other alleged violations of the Code of Student Conduct by graduate students.

Grievance Procedures for Graduate Students

Most problems encountered by graduate students can be resolved through communication between the student and the party whose action created the problem. If that is not the case, REG 11.40.02 (Grievance Procedure for Graduate Students outlines both informal and formal methods for resolving the problem.

Graduate Catalog Archives (2003-2020)

Incoming students are governed by the rules and regulations in force the semester they are accepted into a program. Previous Graduate Catalogs can be downloaded in PDF format here:

Doctor of Veterinary Medicine

At the NC State College of Veterinary Medicine, world leading faculty lead extraordinary programs in learning and discovery. We instruct students in a range of scientific disciplines related to health and disease control in animals. In addition to teaching foundational classes in medical topics, students are trained in clinical skills needed to diagnose and treat illness in animals.

The clinical program at NC State Veterinary Medicine provides a heavy emphasis for actual “hands-on” clinical practice and is demanding both physically and mentally. Students select “focus areas” to increase their depth of training in their intended area of post-graduate activity, while still retaining a broad based veterinary education.

Faculty also encourage and challenge students to develop the personal and professional knowledge and skills needed to serve a global community. For detailed information regarding our program, choose an area of interest from the menu on the left hand side of this page.

The Evolution of an Expert

Our goal is to prepare graduates who step into the profession with the most up-to-date veterinary medical knowledge possible, skills that prepare them to practice veterinary medicine at the top of their fields, an awareness of the veterinary issues at a local, national, and international level, and a dedication to the continued pursuit of knowledge throughout their professional lives. As such, we have built into our curriculum the following measures of success in each of these important areas:

Knowledge

A graduate will effectively use knowledge of comparative medical science in the provision of veterinary clinical care and other contexts in which veterinary medicine plays a key role. This is characterized as the ability to:

• possess and apply the knowledge needed to solve animal health problems
• locate the needed knowledge efficiently and successfully, using contemporary media and technology to access and manage information
• critically evaluate information and its sources
• integrate medical and scientific information and apply it to the solution of animal health problems

Skills

A graduate will effectively use cognitive and psychomotor skills in the practice of veterinary clinical care and other contexts in which veterinary medicine plays a key role. This will be characterized as the ability to:

• identify, define and analyze clinical problems of a diverse range of species
• identify or create processes to solve clinical problems in a diverse range of species
• interpret facts and data in the context of the clinical problems to be solved
• design preventative and therapeutic plans for common medical problems of animals and animal-human disease interactions
• perform surgical and medical procedures needed to care for veterinary patients, demonstrating acceptable standards of animal handling, pain control, sterility, instrument and device handling, tissue handling and safety
• perform imaging and other diagnostic procedures and accurately interpret obtained data used for the diagnosis and treatment of disease in animals
• use scientific methods for the investigation of problems and use research-based information in the clinical care of veterinary patients

Awareness

A graduate will effectively use awareness of local, national, international and professional communities in which he or she practices to meet the needs of society in an effective and ethical manner. This will be characterized as the ability to:

• acknowledge personal responsibility for one’s value judgments and behavior
• understand and accept social, cultural, global and environmental responsibilities, particularly as they relate to animal welfare, sustainability of animal resources, and one health
• demonstrate professionalism in the face of societal diversity, including racial, ethnic, gender, sexual orientation, socio-economic and cultural differences
• work with, manage, and lead others in ways that facilitate their contribution to the organization and the wider community
• use communication as a tool for interacting and relating to others, demonstrating patience, compassion and empathy
• make effective use of oral, written, and visual means to critique, negotiate, create and communicate understanding
• apply sound business and management principles to the organizations in which one works
• operate within the legal constraints of the society in which one lives
• exhibit truth, honesty, integrity, open-mindedness, fairness and generosity

Life-long Learning

A graduate will continuously update his or her knowledge, skills and awareness. This will be characterized as the ability to:

• be independent learners who take responsibility for their own learning and practice continuous reflection, self-evaluation and self-improvement
• critically evaluate one’s current knowledge, skills and awareness, recognizing areas for improvement
• be open to new ideas, methods and ways of thinking be able to identify processes and strategies to learn and meet new challenges
• have a personal vision and goals and be able to work towards these in a sustainable way

Applicants are evaluated on their academic performance (https://cvm.ncsu.edu/education/dvm/admission/eligibility/), their understanding of the veterinary medical profession, their achievements, and their professional potential.

Pre-veterinary students can pursue any undergraduate major they choose, and the required pre-professional courses can be obtained
through the curricula of a number of fields of study. An undergraduate degree, however, is not required for admission. “Pre-vet” is not a major; it is a track that can be chosen within a major. Popular majors for preprofessional students include animal science, poultry science, zoology, biology, biochemistry, and microbiology. Applicants must only complete prerequisite courses to fulfill academic admission requirements (https://cvm.ncsu.edu/education/dvm/admission/faq/).

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### NC STATE ANNOUNCES THE FOLLOWING ADVISORY TO ADMISSIONS REQUIREMENTS FOR THE 2021 ADMISSIONS CYCLE:

1. **P/F grades**: NC State will allow a Pass in P/F or Satisfactory in the S/U grading systems for prerequisites completed in Spring or Summer 2020
   - courses submitted in the P/F or S/U scale will not be factored into the Required Course GPA calculation

2. **GRE**: NC State has waived the GRE General Test for the 2021 admissions cycle
   - If you have already taken the test, please do not send scores to NC State directly or to NC State via VMCAS. A decision about requiring the GRE for the 2022 admissions cycle will be made in Fall 2020.

3. **LORs**: NC State will continue to require three (3) letters of recommendations. Additionally, we still highly recommend that 2 of 3 letters come from DVMs or PhD scientists with whom you have worked.

4. **Experience Hours**: NC State will continue to require 200 hours of veterinary experience hours for the 2021 admissions cycle.

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Letter grades with at least a C- or better will be required in all semesters following Spring and Summer 2020 as long as COVID-19 restrictions have been lifted. A “Pass” or “Satisfactory” grade for a prerequisite taken in Spring or Summer 2020 will be accepted in any future admissions cycle.

Please contact the Student Services Office at dvminformation@ncsu.edu if you have any questions about these changes.

The academic professional program calls for two phases of education: a preclinical three-year phase and a clinical phase in the fourth year of training. The first through the third years of the professional program are concerned with a gradual progression from a basic science presentation to a more clinical application of veterinary science. Two summer-vacation periods are allowed in the first three years of the professional program.

- DVM Program (p. 681)
Doctor of Veterinary Medicine Program

The academic professional program calls for two phases of education: a preclinical three-year phase and a clinical phase in the fourth year of training. The first through the third years of the professional program are concerned with a gradual progression from a basic science presentation to a more clinical application of veterinary science. Two summer-vacation periods are allowed in the first three years of the professional program.

The clinical program at NC State Veterinary Medicine provides a heavy emphasis for actual “hands-on” clinical practice and is demanding both physically and mentally. Students select “focus areas” to increase their depth of training in their intended area of post-graduate activity, while still retaining a broad based veterinary education. There are ten focus areas from which to choose:

- Clinician Scientist
- Epidemiology, Public Health, and Public Policy
- Equine Practice
- Food Animal
- Laboratory Animal Medicine
- Mixed Animal Practice
- Pathology
- Small Animal Practice
- Small and Exotic Animal Medicine
- Zoological Medicine

In the first year, a DVM student will be able to describe the evolution, development, function and identification of normal microscopic and gross anatomy, explain the physiological and biochemical basis for common tests used in the diagnostic process, and learn how to effectively communicate in small groups in a professional veterinary context.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>VMP 916</td>
<td>Health Maintenance and Animal Production I</td>
<td>1</td>
</tr>
<tr>
<td>VMP 920</td>
<td>Infection and Immunity 2</td>
<td>4</td>
</tr>
<tr>
<td>VMP 921</td>
<td>Problem Solving for Cases in Infectious Diseases and Immunity 1</td>
<td>2</td>
</tr>
<tr>
<td>VMC 937</td>
<td>Introduction to Physical Examination Skills-Small Animal</td>
<td>1</td>
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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>VMB 943</td>
<td>Veterinary Pharmacology II</td>
<td>3</td>
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<tr>
<td>VMB 944</td>
<td>Veterinary Toxicology and Poisonous Plants</td>
<td>2</td>
</tr>
<tr>
<td>VMC 942</td>
<td>Principles of Medicine</td>
<td>2</td>
</tr>
<tr>
<td>VMC 943</td>
<td>Laboratory Animal and Zoological Species Health and Disease I</td>
<td>1</td>
</tr>
<tr>
<td>VMC 944</td>
<td>Introduction to Clinical and Professional Communication</td>
<td>1</td>
</tr>
<tr>
<td>VMP 941</td>
<td>Veterinary Pathology II</td>
<td>4</td>
</tr>
<tr>
<td>VMP 942</td>
<td>Veterinary Clinical Pathology</td>
<td>3</td>
</tr>
<tr>
<td>VMP 945</td>
<td>Epidemiology &amp; Public Health</td>
<td>3</td>
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<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>VMC 951</td>
<td>Companion Animal Medicine and Surgery I</td>
<td>4</td>
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<tr>
<td>VMC 952</td>
<td>Equine Medicine and Surgery</td>
<td>3</td>
</tr>
<tr>
<td>VMC 953</td>
<td>Laboratory Animal and Zoological Species Health and Disease II</td>
<td>3</td>
</tr>
<tr>
<td>VMC 956</td>
<td>Advanced Clinical and Professional Communication</td>
<td>1</td>
</tr>
</tbody>
</table>
Fourth-year students must complete required and elective rotations that vary depending on the students' selected focus area (https://cvm.ncsu.edu/education/dvm/program/focus-areas/). Students must complete 43 credits in the senior year: 40 credits of clinical rotations and three credits in Clinical Conference. The clinic year consists of 24 blocks, two-to-three weeks in length, with up to four vacation blocks and three extramural experiences (Clinician Scientist, Epidemiology, & Food Animal Focus Areas have different extramural requirements). A total of 168 credit hours are required for graduation. Clinical Conference presentations are required of each senior.

The clinic scheduling process begins in fall of third year with information sessions with senior clinicians and/or clinical coordinators, Academic Affairs, and Students Services.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>VMC 996</td>
<td>Advanced Avian Clinical Medicine</td>
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<tr>
<td>VMC 959</td>
<td>Advanced Primate Medicine</td>
<td>2.4</td>
</tr>
<tr>
<td>VMC 958</td>
<td>Advanced Prosimian Medicine</td>
<td>2</td>
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<tr>
<td>VMP 975</td>
<td>Advanced Topics in Veterinary Anatomic Pathology</td>
<td>1-6</td>
</tr>
<tr>
<td>VMB 977</td>
<td>Clinical Anesthesia Rotation</td>
<td>2</td>
</tr>
<tr>
<td>VMC 998</td>
<td>Basic Wildlife Rehabilitation Medicine</td>
<td>2</td>
</tr>
<tr>
<td>VMC 972</td>
<td>Clinical Small Animal Veterinary Cardiology</td>
<td>2</td>
</tr>
<tr>
<td>VMB 978</td>
<td>Clinical Behavior &amp; Nutrition</td>
<td>2</td>
</tr>
<tr>
<td>VMC 995</td>
<td>Clinical Conference</td>
<td>1</td>
</tr>
<tr>
<td>VMP 978</td>
<td>Clinical Pathology and Laboratory Medicine</td>
<td>2</td>
</tr>
<tr>
<td>VMB 962</td>
<td>Clinician Scientist Research Experience</td>
<td>1-10</td>
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<tr>
<td>VMC 983</td>
<td>Dermatology</td>
<td>2</td>
</tr>
<tr>
<td>VMP 979</td>
<td>Epidemiology</td>
<td>2</td>
</tr>
<tr>
<td>VMC 966</td>
<td>Equine Emergency and Critical Care</td>
<td>2</td>
</tr>
<tr>
<td>VMC 978</td>
<td>Equine Lameness and Imaging</td>
<td>2</td>
</tr>
<tr>
<td>VMC 979</td>
<td>Equine Medicine</td>
<td>2</td>
</tr>
<tr>
<td>VMC 968</td>
<td>Equine Orthopedic Surgery and Lameness</td>
<td>2</td>
</tr>
<tr>
<td>VMC 949</td>
<td>Equine Primary Care</td>
<td>4</td>
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<tr>
<td>VMC 993</td>
<td>Equine Special Topics</td>
<td>2</td>
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<tr>
<td>VMC 975</td>
<td>Equine General Surgery</td>
<td>2</td>
</tr>
<tr>
<td>VMC 988</td>
<td>Exotic Animal Medicine</td>
<td>2</td>
</tr>
<tr>
<td>VMC 946</td>
<td>Extramural Business Management Experience</td>
<td>2</td>
</tr>
<tr>
<td>VMC 995</td>
<td>Extramural Experiences in Lab An Med</td>
<td>2</td>
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<tr>
<td>VMP 994</td>
<td>Extramural Experience in Pathology</td>
<td>1-4</td>
</tr>
<tr>
<td>VMC 994</td>
<td>Small Animal 4th Year Extramural Studies</td>
<td>1-6</td>
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<tr>
<td>VMC 963</td>
<td>Extramural Experience in Zoological Medicine</td>
<td>2</td>
</tr>
<tr>
<td>VMP 971</td>
<td>Food Animal Diagnostics for Disease Diagnosis, Control, and Population Surveillance</td>
<td>2</td>
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<tr>
<td>VMP 976</td>
<td>Food Animal Pharmacology</td>
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<tr>
<td>VMP 977</td>
<td>Autopsy/ Clinical Pharmacology</td>
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<tr>
<td>VMP 974</td>
<td>Food Supply Veterinary Medicine</td>
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</tr>
<tr>
<td>VMC 939</td>
<td>General Limited Small Animal Practice</td>
<td>2</td>
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<tr>
<td>VMC 981</td>
<td>Lab Animal Medicine</td>
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</tr>
<tr>
<td>VMC 974</td>
<td>Equine Dentistry and Podiatry</td>
<td>2</td>
</tr>
<tr>
<td>VMC 986</td>
<td>Adv Com An Int Med</td>
<td>2</td>
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<tr>
<td>VMP 971</td>
<td>Comp Animal Med II</td>
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</tr>
<tr>
<td>VMC 954</td>
<td>Companion Animal Medicine for Food Animal Students</td>
<td>2</td>
</tr>
<tr>
<td>VMC 984</td>
<td>Intro Clin Neuro</td>
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</tr>
<tr>
<td>VMC 980</td>
<td>Vet Clin Oncology</td>
<td>2</td>
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<tr>
<td>VMC 982</td>
<td>Ophthalmology</td>
<td>2</td>
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<tr>
<td>VMP 982</td>
<td>Poultry Health Management I</td>
<td>2</td>
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<tr>
<td>VMP 983</td>
<td>Poultry Health Management II</td>
<td>2</td>
</tr>
<tr>
<td>VMC 948</td>
<td>Clinical Rotation in Veterinary Radiation Oncology</td>
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<tr>
<td>VMB 976</td>
<td>Radiology Rotation</td>
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</tr>
<tr>
<td>VMC 997</td>
<td>Raptor Medicine and Rehabilitation</td>
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</tr>
<tr>
<td>VMC 930</td>
<td>Rehabilitation and Mobility Clinical Rotation</td>
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<tr>
<td>VMP 970</td>
<td>Ruminant Health Management I</td>
<td>2</td>
</tr>
<tr>
<td>VMP 972</td>
<td>Ruminant Health Management II</td>
<td>2</td>
</tr>
<tr>
<td>VMP 987</td>
<td>Ruminant Topics</td>
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</tr>
<tr>
<td>VMC 950</td>
<td>Sea Turtle Medicine and Rehabilitation</td>
<td>2</td>
</tr>
<tr>
<td>VMC 960</td>
<td>Small Animal Emergency Service</td>
<td>2</td>
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<tr>
<td>VMC 973</td>
<td>Small Animal Surgery (Topics Include: Small Animal General Surgery; Small Animal Orthopedic Surgery)</td>
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<tr>
<td>VMP 973</td>
<td>Special Topics in Epidemiology</td>
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<tr>
<td>VMC 941</td>
<td>Special Topics in Theriogenology</td>
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<tr>
<td>VMP 984</td>
<td>Swine Health Management I</td>
<td>2</td>
</tr>
<tr>
<td>VMP 985</td>
<td>Swine Medicine &amp; Production II</td>
<td>2</td>
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<tr>
<td>VMC 940</td>
<td>Clinical Theriogenology</td>
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</tr>
<tr>
<td>VMB 976</td>
<td>Radiology Rotation (Ultrasound)</td>
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<tr>
<td>VMC 976</td>
<td>Veterinary Critical Care</td>
<td>2</td>
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<tr>
<td>VMP 999</td>
<td>Extramural in Vet International Programs</td>
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<tr>
<td>VMC 964</td>
<td>Zoological Husbandry and Nutrition</td>
<td>2</td>
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<tr>
<td>VMC 989</td>
<td>Zoological Medicine</td>
<td>4</td>
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<tr>
<td>VMC 947</td>
<td>Practice Management: Evaluating the workflow, services, and financial performance of a hospital</td>
<td>2</td>
</tr>
<tr>
<td>VMP 990</td>
<td>Extramural Experiences - Large Animal (Topics include: Extramural Experiences in Equine; Extramural Experiences in Food Animal/Mixed Animal)</td>
<td>2</td>
</tr>
</tbody>
</table>
Course Descriptions

The course descriptions are arranged first in alphabetical order according to course prefix reflecting the department or discipline of the course. Some courses are cross-listed, indicating that they are offered in two or more departments or disciplines. Within each of the prefix groups, the course descriptions are arranged by course number. Numbers 100-299 are courses intended primarily for freshmen and sophomores. Numbers 300-499 are courses intended primarily for juniors and seniors; numbers 490-498 are seminar, project, or special topics courses; number 499 is for undergraduate research.

Courses numbered 500 - 600 are taught at the Masters level and most are available to advanced undergraduates. Doctoral courses are numbered 700 - 899. Graduate courses numbered at the 500 and 700 levels are letter graded (A+ through F), while 600 and 800 level courses are S/U graded. Courses regularly letter graded (A+ through F) may not be taken for S/U grading by graduate students. Courses numbered in the 900 series are open to College of Veterinary Medicine students.

A typical course description shows the prefix, number, and title followed by prerequisite, credit and offering information. Prerequisites are courses or levels of achievement that a student is expected to have completed successfully prior to enrolling in a course. Corequisites are courses which should be taken concurrently by students who have not previously completed the corequisites. Prerequisites or corequisites for a given course may be waived by the instructor of the course or section. It is the student's responsibility to satisfy prerequisites, or obtain from the instructor written waiver of prerequisites, for any course in which he or she may enroll. Failure to satisfy prerequisites may result in removal from enrollment in the course. Consent of the department is required for all practicum and individual special topics or special problems courses as well as internships and thesis or dissertation research. Some courses also have restrictive statements, such as "Credit in both MA 141 and MA 131 is not allowed." Restrictive statements for a given course may be waived only by a college dean.

An example of credit information is: ACC 200 Introduction to Managerial Accounting 3. The 3 indicates the number of semester hours credit awarded for satisfactory completion of the course. Some courses are offered for variable credit, and a listing of 1-6 indicates that from one to six semester hours of credit may be earned as arranged by the department writing the course.

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ACC 200 Introduction to Managerial Accounting (3 credit hours)
Analysis of accounting data that are useful in managerial decision making and in the control and evaluation of the decisions made within business organizations. An introduction to basic models, financial statement analysis, cost behavior analysis and cost control procedures.
Prerequisite: ACC 210
Typically offered in Fall, Spring, and Summer

ACC 210 Concepts of Financial Reporting (3 credit hours)
Financial reporting concepts, the accounting information generating process, reporting practices, financial statement preparation, and the interpretation and analysis of financial statements. Basic accounting principles and concepts, the accounting cycle, income measurement, and internal controls.
Typically offered in Fall, Spring, and Summer

ACC 220 Introduction to Managerial Accounting (3 credit hours)
The course is designed to provide students with a basic understanding of managerial accounting concepts. Students will analyze accounting data that are useful in managerial decision making and in the control and evaluation of the decisions made within business organizations.
Prerequisite: ACC 210
Typically offered in Fall, Spring, and Summer

ACC 230 Individual Income Taxation (3 credit hours)
The course focuses on the fundamental concepts of individual income taxation. It is suitable for business and nonbusiness students. Students will apply tax law learned in the course to a real world setting by conducting tax research and preparing actual tax returns.
Typically offered in Spring and Summer
ACC 280 Survey of Financial and Managerial Accounting (3 credit hours)
This course covers the basic principles and concepts of financial and managerial accounting. Students will learn about the role of accounting in business including how to prepare basic financial statements and how accounting information is used by: (1) external stakeholders (i.e., stockholders, creditors and government) to evaluate the financial performance of an organization; and (2) internal users (management) to fulfill the planning, control and performance evaluation functions.

This course cannot be used to satisfy degree requirements for the accounting degree or the business degree within the Poole College of Management. This course does not substitute for either ACC 210 or ACC 220.
Typically offered in Fall and Spring

ACC 295 Special Topics in Accounting (1-6 credit hours)
Presentation of accounting material at the 200-level not normally available in regular course offerings, or offering of new courses on a trial basis. Course may be taken multiple times only if topic is different.
Typically offered in Fall, Spring, and Summer

ACC 310 Intermediate Financial Accounting I (3 credit hours)
This course introduces the conceptual framework of financial accounting and process of developing professional standards along with the foundations of accounting and reporting systems. Students are provided an in-depth analysis of the income statement, the balance sheet, the statement of cash flows, and the reporting process. The course also covers measurement and reporting issues for major categories of assets on the balance sheet.
Prerequisite: ACC 210 with a C+ or better
Typically offered in Fall, Spring, and Summer

ACC 311 Intermediate Financial Accounting II (3 credit hours)
A continuation of topics introduced in Intermediate Financial Accounting I [ACC 310]. Topics include the Statement of Cash Flows, the Statement of Stockholders Equity, accounting for investments in equity and debt securities, liabilities, leasing, pension and post-retirement benefit plans, deferred income taxes, revenue recognition, and various forms of stock-based compensation plans.
Prerequisite: ACC 310 with grade of C- or better
Typically offered in Fall, Spring, and Summer

ACC 330 An Introduction To Income Taxation (3 credit hours)
Basic income tax principles and procedures (including research and planning) with an emphasis on all types of entities and business transactions. Exposure to a range of tax concepts within the framework of financial reporting.
Prerequisite: ACC 210 with a grade of C- or better
Typically offered in Fall, Spring, and Summer

ACC 340 Accounting Information Systems (3 credit hours)
Accounting is an information system that supports business processes and decision-making through record-keeping, reporting, and control. This course covers transaction cycles, related internal controls, and the use of computer applications (Microsoft Excel and Access, SAP, and Sage 50) to collect, organize, analyze, and report accounting data. Students will design, develop, and implement a database in this course.
Prerequisite: BUS 340 and ACC 210 with a grade of C- or better
Typically offered in Fall, Spring, and Summer

ACC 411 Business Valuation (3 credit hours)
Conceptual framework of how businesses work, value generation and reporting. Interpretation of financial statements and their use in valuation of the firm.
Prerequisite: ACC 210, BUS 320, and (BUS/ST 350 or ST 312 or ST 370 or ST 372)
Typically offered in Fall and Spring

ACC 420 Cost Accounting for Effective Management (3 credit hours)
Cost Accounting for Effective Management focuses on the development and use of managerial accounting information in planning, control, and decision making activities and in designing and implementing business strategies. Integration of performance measurement and cost control with corporate strategy.
Prerequisite: ACC 210 with C- or better and ACC 200 or ACC 220 with a C- or better
Typically offered in Fall and Spring

ACC 440 Enterprise Resource Planning Systems (3 credit hours)
Enterprise resource planning (ERP) systems are business systems that integrate and streamline data across the company into one complete system that supports the needs of the entire organization. Course content includes ERP marketplace, ERP technology, business process redesign and process mapping, planning, package selection, implementation and operation of ERP systems, ERP module functionality, and visualization of ERP data. As NCSU is a member of the SAP University Alliance, you will have the opportunity to obtain hands-on experience with the SAP ERP system and SAP data analytics software. Credit will not be allowed for both ACC 440 and MBA 515.
Prerequisite: ACC 340
Typically offered in Fall and Spring

ACC 450 Auditing and Assurance Services (3 credit hours)
Introduction to auditing practice and theory. Focuses on developing skills for interpreting business strategies and identifying related business risks that may impact the risk of material misstatement in financial statements, describing internal control solutions to those risks, identifying evidential sources, and designing strategies to provide assurance about the financial statements, internal control over financial reporting, and other business information.
Prerequisite: ACC 311 with a C- or better and ACC 340 and (BUS/ST 350, or ST 312, or ST 370, or ST 372)
Typically offered in Fall, Spring, and Summer

ACC 451 Internal Auditing (3 credit hours)
An overview of the theory, practice, and design of internal audit activities. Examine industry standards and the professional practices of the internal audit. Evaluate risk and controls related to operations, information technology, fraud, and compliance. Design and manage assurance activities. Assess audit evidence and communicate engagement results.
Prerequisite: ACC 210 with grade of C- or better and ACC 340
Typically offered in Fall and Spring

ACC 460 Governmental and Nonprofit Accounting (3 credit hours)
Accounting and reporting for state and local governments, including budgeting and financial analysis. Accounting for nonprofit organizations emphasizing voluntary health and welfare organizations.
Prerequisite: ACC 210
Typically offered in Fall and Spring
ACC 495 **Special Topics in Accounting** (1-6 credit hours)
Presentation of material not normally available in regular course offerings, or offering of new courses on a trial basis.

ACC 498 **Independent Study in Accounting** (1-6 credit hours)
Detailed investigation of topics of particular interest to advanced undergraduates under faculty direction on a tutorial basis. Credits and content determined by faculty member in consultation with the associate department head. Individualized/Independent

*Typically offered in Fall, Spring, and Summer*

ACC 499 **Internship in ACC** (1-6 credit hours)
A full-time accounting-related professional internship. Participants will communicate with instructor weekly over the course of the internship to discuss progress and insights. A post-internship interview and paper is also required. Internships may vary

Prerequisite: Completion of ACC 310 and ACC 311. Restricted to accounting majors. Departmental approval required.

*Typically offered in Spring and Summer*

**ACC 508 Advanced Commercial Law** (3 credit hours)
A study of law and regulation as a structure in which to develop business goals and strategies. Students will examine those elements of law and regulation that are a context for ethical business behavior. Students will also study the provisions of law

Prerequisite: MAC Program

*Typically offered in Spring only*

**ACC 510 Advanced Financial Accounting** (3 credit hours)
Study of complex financial reporting topics affecting U.S. corporations. Focus on the underlying business rationales associated with transactions/events triggering the complex financial reporting issue. Topics will include international accounting, consolidations, mergers and acquisitions, derivatives, SEC reporting, and other emerging issues.

Prerequisite: MAC Program

*Typically offered in Spring and Summer*

**ACC 519 Applied Financial Management** (3 credit hours)
A study of key business decision made and tools used by CFOs in their executive management roles. Students will focus on managerial analysis tools (e.g., business plans; budgeting) and finance issues (e.g., funding alternatives, treasury, and cash management). The course will include management skills related to the CFO, such as negotiations, leadership, delegation, interactions with boards, etc.

Prerequisite: MAC Program

*Typically offered in Fall and Summer*

**ACC 520 Advanced Management Accounting** (3 credit hours)
A study of how accounting and operating information is used in management planning and decision making. Students will apply advanced costing models and design and evaluate management decision making information systems. Topics will include issues that

Prerequisite: MAC Program

*Typically offered in Spring only*

**ACC 530 Advanced Income Tax** (3 credit hours)
A study of the tax consequences of business, financial, and personal wealth-planning transactions. Students will examine the economic or legal context of transactions along with the non-tax motives of the transacting parties. The course will consider the efficiency of tax strategies in terms of their impact on net cash flows and other financial reporting effects.

Prerequisite: MAC Program

*Typically offered in Fall only*

**ACC 533 Accounting and Tax Research** (3 credit hours)
A study of research methods, procedures and tools used to develop solutions to technical and policy-oriented business problems. Students will consult various competent authorities on taxation, accounting, auditing, and general business in the development of business problem solving techniques.

Prerequisite: MAC Program

*Typically offered in Fall and Summer*

**ACC 540 IT Risks and Controls** (3 credit hours)
A study of how business strategies use information technology (IT) as an efficient enabler of redesigned core business processes. Students will focus on how the use of IT affects risk management by eliminating certain risks and introducing others. Study

Prerequisite: MAC Program

*Typically offered in Fall only*

**ACC 550 Advanced Auditing** (3 credit hours)
A study of the impact of business risks on the design and performance of audit procedures to detect material misstatements in financial statements. Students will be exposed, through a case-based approach, to significant business issues related to audit planning, risk assessment and auditor response, corporate governance, reporting, and other significant business issues affecting audit professionals in their first years of employment.

Prerequisite: MAC Program

*Typically offered in Fall and Summer*

**ACC 560 Tools for Tax Analytics** (1 credit hours)
In this course we will teach the skills needed to identify many of the situations where the method of accounting for tax purposes for revenue and expense differs from that used in financial accounting. Focus will be placed on analyzing and outlining those differences in a concise and visual manner in order to assist upper management understand the tax implications of their operational and financial accounting decisions. To assist us in this, we will utilize analytic tools that are regarded as required knowledge by today's tax departments. After a brief review of basic analytics skills, we will focus on more advanced analytic tools which will be reinforced with tax-focused examples and assignments specifically to allow the student to apply these featured analytics topics in tax situations. An undergraduate degree and basic tax and accounting knowledge required.

R: Graduate Standing or PBS

*Typically offered in Fall, Spring, and Summer*
ACC 561 Database Management in Tax (1 credit hours)
In this course, we will teach the skills needed to understand and identify many aspects of the state income tax apportionment process. Focus will be placed on the calculations and analyses required to present the state and local tax information in such a manner as to assist upper management in the business-expansion decision-making process. The tax apportionment process requires a solid understanding of database management. To assist us in this, we will utilize database management tools that are considered required knowledge by today's tax departments. After a brief review of introductory database management topics, we will focus on more advanced database management topics which will be reinforced with tax-focused examples and assignments specifically created to allow students to see these featured database management topics when applied to tax scenarios. An undergraduate degree and basic tax and accounting knowledge required.

R: Graduate Standing or PBS  
Typically offered in Fall, Spring, and Summer

ACC 562 Forecasting Effective Tax Rates and Scenario Analysis - Introduction (1 credit hours)
In this course we will examine the different definitions of book income and taxable income with a focus on accounting for income taxes under ASC 740. Students will contrast the principles of conservatism reflected by generally accepted accounting principles and by the tax law. In addition, students will learn how to utilize regression analysis and scenario analysis to provide additional insights about these tax topics and to forecast future effective tax rates. Tax-focused examples and assignments created specifically to allow the student to apply regression analysis in tax situations will reinforce the technology covered in this course. In addition to utilizing regression analysis, this course will examine tax technical subjects to provide the student sufficient knowledge to complete the examples and assignments. An undergraduate degree and basic tax and accounting knowledge required.

R: Graduate Standing or PBS  
Typically offered in Fall, Spring, and Summer

ACC 563 Forecasting Effective Tax Rates and Scenario Analysis - Advanced Application (1 credit hours)
In this course we will continue to examine the different definitions of book income and taxable income but the primary focus will be on examining tax disclosures in financial statements and gaining an understanding of how they can be used for financial statement analysis. We will also carry out regression and scenario analysis to provide additional insights into disclosed tax information. These types of insights are of significant benefit and often utilized in decision making by company management and financial analysts employed by investment funds. The skills learned will be reinforced with tax-focused examples and assignments created specifically to allow the student to apply regression and scenario analysis in tax situations. In addition to utilizing regression and scenario analysis, this course will examine tax technical subjects to provide the student sufficient knowledge to complete the examples and assignments. An undergraduate degree and basic tax and accounting knowledge required.

P: ACC 562  
Typically offered in Fall, Spring, and Summer

ACC 564 Project Management and Process Documentation in Tax (1 credit hours)
In this course we will focus on tax project management and tax process documentation skills. Students will develop an understanding of project management in the context of a tax provision process assessment for a hypothetical company, Project Clarity. Students will also develop an understanding of internal control best practices and how they apply to a corporate tax department's tax provision process. In addition, they will develop the skills necessary to identify improvements within the tax provision process and learn how to prepare a flow chart of the process. An undergraduate degree and basic tax and accounting knowledge required.

R: Graduate Standing or PBS  
Typically offered in Fall, Spring, and Summer

ACC 565 Visual Analytics in Tax (1 credit hours)
We will teach visual analytics to enhance the value and quality of the tax information provided to decision makers in an organization. All aspects of tax including planning, tax provision work, compliance and controversy work will be covered. The focus will be on state and local nexus, sales and use taxes, and foreign bank account reporting (FBAR) requirements. Students will also learn to manipulate data into a visual front end so that those reviewing the data with the purpose of decision-making will have an easier time reading and interpreting the data analytics. An undergraduate degree and basic tax and accounting knowledge required.

P: ACC 560  
Typically offered in Fall, Spring, and Summer

ACC 566 Database Management Applications in Tax (1 credit hours)
In this course, we will teach the skills needed to understand and identify more advanced aspects of the state income tax apportionment process, including combinations and consolidations. The student will gain knowledge in the areas of data query language, data definition language, and data manipulation language using structured query language. Students will learn more advanced tools to retrieve, define, store, and update state income tax data in a database management program. These tools will be reinforced with tax-focused examples and assignments specifically created to allow the student to see these featured topics when applied to tax scenarios. An undergraduate degree and basic tax and accounting knowledge required.

P: ACC 561  
Typically offered in Fall, Spring, and Summer

ACC 567 Enterprise Resource Planning for Tax (1 credit hours)
In this course, we will teach Enterprise Resource Planning (ERP) concepts that will be useful to tax professionals to better understand the client's information environment and gauge how best to access needed client tax information. Students will learn about ERP systems and obtain hands-on experience with the financial accounting, asset accounting (AA), and plant maintenance (PM)1 courses in the SAP ERP system. ERP concepts will be reinforced with tax-focused examples and assignments including revisiting tax deduction material, as well as learning more about the Tangible Property and Repair Regulations. Credit will not be allowed for this course and for MBA 515. An undergraduate degree and basic tax and accounting knowledge required.

R: Graduate Standing or PBS  
Typically offered in Fall, Spring, and Summer
ACC 568 Analysis of Unstructured Data in Tax (1 credit hours)
The objective of this course is to get insight into the analysis of
unstructured data and gain an understanding of how to utilize it within
a tax-focused environment. Upon finishing the course, students will be
able to extract tax-related information from a collection of text documents.
Also, students will be able to uncover concepts and themes that are
concealed in those documents. There will also be a demonstration of
traditional data mining techniques. An undergraduate degree and basic
tax and accounting knowledge required.

P: ACC 565
Typically offered in Fall, Spring, and Summer

ACC 569 Advanced Visual Analytics in Tax (1 credit hours)
Visualization helps us see and understand the story the data tells us. In
this course, students will be introduced to an interactive data visualization
tool which allows users to select specific tax information and customize
the format of visualization to assist in the management decision making
process. Students will learn how to use this tool to increase the
relevance and usefulness of tax data. The software will be used in
specific tax-related applications, including foreign bank account reporting
exposure and compliance, country by country reporting, state income tax
exposure, compliance data and risk analysis. An undergraduate degree
and basic tax and accounting knowledge required.

R: Graduate Standing or PBS
Typically offered in Fall, Spring, and Summer

ACC 570 Data Security and Warehousing in Tax (1 credit hours)
The course is focused on the importance of data security with respect
to all financial data but specifically tax data. It also covers the area of
tax data warehousing from the standpoint of the differing financial detail
needs of a tax department and th

R: Graduate Standing or PBS
Typically offered in Fall, Spring, and Summer

ACC 571 Enterprise Resource Planning - Advanced Applications (1 credit hours)
In this course, we will focus on extracting and manipulating data housed
in an Enterprise Resource Planning system in order to address complex
tax issues. The tax technical subjects to be covered include revisiting the
tangible personal property regulations, the uniform capitalization rules as
they apply to inventory, VAT taxes and the consolidated return rules. An
undergraduate degree and basic tax and accounting knowledge required.

P: ACC 567
Typically offered in Fall, Spring, and Summer

ACC 588 Special Topics in Accounting (1-6 credit hours)
Course objectives dependent upon unique circumstances motivating
offering of course. Timely curriculum innovation the primary motivation.
Departmental consent required.

Typically offered in Fall and Spring

ACC 600 Managerial and Career Effectiveness (1 credit hours)
Knowledge and skills needed to advance professional accounting career.
Strategic communication of self and ideas in professional and classroom
settings. Diagnosis of organizational culture. Impression management
and appropriate business behavior. Leadership of individuals, group
dynamics, and team building.

Prerequisite: MAC Program
Typically offered in Fall only

ACC 630 Independent Study (1-3 credit hours)
Advanced topics not otherwise included in curriculum by advanced
graduate students on a tutorial basis. Determination of credits and
content by participating faculty in consultation with Director of Graduate
Programs. Departmental consent required

Typically offered in Spring only

Adult & Higher Education (EAC)

EAC 301 Introduction to Leadership Fundamentals (3 credit hours)
This course will provide basic understandings of the components of
leadership that can be applied to their current and future leadership
experiences on campus or in their individual communities, and to provide
a model of critical reflection for those applications.

Prerequisite: Sophomore standing, Junior standing, or Senior standing
Typically offered in Fall and Spring

EAC 496 Special Topics in Adult Learning and Leadership (1-6 credit hours)
Exploration of specialized areas and topics of current interest in adult
learning and leadership.

EAC 517 Current Issues in Higher Education (3 credit hours)
Examination of important social, political and economic issues affecting
present and future operation of colleges and universities in America.
Graduate standing or PBS status required.

Typically offered in Spring only

EAC 522 Foundations of Adult Education (3 credit hours)
Introduction to the field of adult education as an area of graduate study
and practice. It is intended for those who have experience or desire to
work with adult learners or with organizations that serve adult learner
populations.

Typically offered in Fall only

EAC 532 Health Care Delivery Systems and Environments (3 credit hours)
Organization of health care delivery system, services and resources.
Focus on major social, economic, political and professional factors
contributing to shaping the system and influencing change. Analysis of
organizations and environments in regard to demand for health personnel
and the implications for health occupations education.

Prerequisite: Graduate standing
Typically offered in Summer only

EAC 536 Issues and Trends In Education For the Health Professions (3 credit hours)
An analysis of educational and social factors influencing change in
health professions education. Problems of student selection and program
articulation, and implications for health occupations education and health
services of recent legislation impacting health care.

Prerequisite: Graduate standing
Typically offered in Spring only
EAC 538 Instructional Strategies in Adult and Higher Education (3 credit hours)
Forms of instruction appropriate for the teaching of adults. Special emphasis upon methods for maximum involvement of the adult learner. Relevant concepts, theories and principles for selection, utilization and evaluation of instructional strategies with focus on integration of theory into practice. Development of student proficiency in use of applicable teaching techniques for adult and community college education through participation in classroom exercises.

Prerequisite: Graduate standing or PBS status

EAC 539 Teaching in the Online Environment (3 credit hours)
The course focuses on exploring the issues and considerations in online teaching and introduce students to some of the tools involved in the process. Students will develop strategies for teaching online and for managing the online classroom.

Typically offered in Fall and Spring

EAC 540 Foundations of Higher Education and Student Affairs (3 credit hours)
Examines knowledge that guides professional practice in higher education and student affairs, such as: history of higher education, professional development practices, student characteristics, group process, and helping and advising skills. Programmatic applications are emphasized through class assignments.

Typically offered in Fall only

EAC 541 Administration and Finance of Student Affairs (3 credit hours)
Examination of the role of student affairs in higher education institutions to include: organizational structures, leadership and decision-making, planning and budgeting, staffing and supervision.

Prerequisite: EAC 540

Typically offered in Spring only

EAC 542 Student Characteristics and the College Environment (3 credit hours)
Study of the history and philosophy of student affairs, the impact of college on students and current issues of concern to students and student affairs professionals. Good practices of student affairs in the context of student learning are identified and current literature is reviewed.

Typically offered in Spring only

EAC 543 Student Development Theory (3 credit hours)
Gain an understanding of the major student development theories and emerging professional literatures in this area. Provide opportunities for students to develop skills in applying student developmental theory to specific student affairs settings, issues, and populations.

Prerequisite: EAC 540

Typically offered in Fall only

EAC 544 History of the College Student Experience in the United States (3 credit hours)
This course will review the history of higher education in the United States from the colonial period to the present with particular attention to the ways in which shifting policies and practices in higher education institutions have affected the college

Typically offered in Fall only

EAC 545 Higher Education Masters Professional Seminar (3 credit hours)
Emphasizes application of concepts and theories learned in previously completed coursework to understand and analyze current issues facing student affairs professionals. Focuses particularly on the job search process and transition out of graduate school. Facilitates the transition from student to full-time student affairs professional through critical examination, synthesis, integration, and practical application of prior and concurrent coursework.

R: EAC 540 and EAC 542 and EAC 543

Typically offered in Spring only

EAC 551 Research in Adult & Higher Education (3 credit hours)
Introduces master's students studying adult learning and higher education to two major research paradigms in education, quantitative and qualitative research, and to the research literature of disciplines related to the education of adults. Students will learn how to distinguish between research and non-research materials, and how to evaluate quantitative and qualitative research studies on the basis of their research merit.

Prerequisite: Master's students in ACCE

Typically offered in Fall, Spring, and Summer

EAC 552 College Student Retention (3 credit hours)
Exploration of college student retention theories, relevant research, and exemplary retention programs. Examines student retention and completion within four-year colleges and universities as well as student persistence within and transfer from community colleges.

Typically offered in Spring only

EAC 555 Ethics in the Workplace and Education (3 credit hours)
Introduction to ethics and social responsibility in adult education, training, higher education and other work and educational environments in a global setting. Emphasis on addressing moral and ethical issues in the workplace and education by applying critical thinking and analysis processes to ethical dilemmas. Graduate standing or PBS status required.

Typically offered in Fall only

EAC 556 Organization Change in HRD: Theory & Practice (3 credit hours)
Organization Change in Human Resource Development provides an introduction to the theory and practice of change within the context of adult education programs, other organizations, communities and societies. Graduate standing or PBS status required.

Typically offered in Spring only

EAC 559 The Adult Learner (3 credit hours)
An inquiry into the characteristics and background, learning processes, motivation and participation of adult learners in a variety of educational contexts. Emphasis on adult learning theories, models, principles and their application to educational design and delivery.

Typically offered in Fall, Spring, and Summer

EAC 560 Assessment & Evaluation in Adult & Higher Education (3 credit hours)
Introduces students to assessment and evaluation principles and practices from a range of perspectives. Covers uses and limitations of a broad range of assessment and evaluation approaches in adult education settings, with particular focus on college and university teaching.

Typically offered in Spring and Summer
EAC 580  Designing Instructional Systems in Training and Development (3 credit hours)
Introduction to instructional design models including needs assessment, systematic training design and development techniques and proactive strategies for evaluating training programs. Instructional design issues of work-based training, learner characteristics and effects of technology on instructional design, implementation and evaluation processes. Graduate standing or PBS status required.

Typically offered in Fall, Spring, and Summer

EAC 581  Advanced Instructional Design in Training and Development (3 credit hours)
In-depth analysis of instructional systems design (ISD) theory and practice using professional competency models. Organizational training requirements, development of performance objectives and measures, design of instructional materials, and address of evaluation issues in training programs in business and industry. Research and development of instructional design projects relating to ISD process and model. Graduate standing or PBS status required.

Typically offered in Fall and Spring

EAC 582  Organization and Operation Of Training and Development Programs (3 credit hours)
Overview of occupational education practice in business and industrial settings. Presentation of roles common to training and development specialists, including managerial concerns related to organization, operation and financial training and development programs.

Typically offered in Fall only

EAC 583  Needs Assessment and Task Analysis in Training and Development (3 credit hours)
Current needs assessment and task analysis methods and techniques used in business and industrial settings. Development of comprehensive needs assessment plans for diagnosing and documenting human performance deficiencies/improvement opportunities through

Typically offered in Fall only

EAC 584  Evaluating Training Transfer and Effectiveness (3 credit hours)
Philosophy, strategies, and procedures for evaluating effectiveness of training programs. Development of multi-level evaluation plan for use with training program to study outcomes and process of training from perception to organizational impact. Design of evaluation methods and instruments, data collection, analysis, and interpretation for each level of evaluation emphasizing transfer of training. Graduate standing or PBS status required.

Typically offered in Fall and Spring

EAC 585  Integrating Technology into Training Program (3 credit hours)
Appropriate technologies for design and delivery of effective training programs. Performance-based training models for distance and individualized learning through audio, video, computer-based, and multimedia technologies. Planning decisions for selecting/developing appropriate technologies to support specific training outcomes, adult learner characteristics, and organizational training resources. Graduate standing or PBS status required.

Typically offered in Fall and Summer

EAC 586  Methods and Techniques Of Training and Development (3 credit hours)
Methods and techniques common to model occupational education programs in business and industrial settings. Focus on design and evaluation of effective learning programs and instructional methodologies. Graduate standing or PBS status required.

Typically offered in Fall and Spring

EAC 587  Marketing for Education and Training Programs (3 credit hours)
Strategic marketing in education and training. Identifying and understanding targeted organization and audience for education or training program. Design of basic marketing strategy for education or training program incorporating elements of marketing

Typically offered in Spring only

EAC 595  Special Topics (3-6 credit hours)
Typically offered in Fall, Spring, and Summer

EAC 602  Seminar In Adult and Higher Education (1-3 credit hours)
Identification and scientific analysis of major issues and problems relevant to adult education or higher education. Course credit at the master's level through active student participation in a formal seminar and scientific appraisal and solution of a problem.

Prerequisite: Graduate standing

EAC 624  Topical Problems In Adult and Community College Education (1-3 credit hours)
Study and scientific analysis of problems in adult education and preparation of a scholarly research type of paper. Credits Arranged.

Prerequisite: Graduate standing or PBS status

EAC 630  Independent Study in Adult and Community College Education (1-3 credit hours)
Independent study for master's students in Adult and community College Education.

Typically offered in Fall, Spring, and Summer

EAC 651  Internship In Adult and Community College Education (1-9 credit hours)
Utilization of the participant-observer role with required participation in selected educational situations. Emphasis upon observational skills' development, the recording of relevant observations through written journals, analysis of experiences identifying critical incidents and projection of events and consequences. Student development and selection of possible alternative courses of action in various situations and evaluation of the consequences of the selected course of action.

Prerequisite: Nine hrs. in graduate level courses

Typically offered in Fall, Spring, and Summer

EAC 685  Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student

Typically offered in Fall, Spring, and Summer
EAC 692 Research Projects In Education (1-3 credit hours)
A project or problem in research in education for graduate students, supervised by members of graduate faculty. Choice of research on basis of individual students' interests and not to be part of thesis or dissertation research.

Prerequisite: EAC 732
Typically offered in Fall, Spring, and Summer

EAC 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

EAC 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

EAC 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

EAC 699/ECO 699/ECI 699/ELP 699/EMS 699/EOE 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Summer only

EAC 700 Community College and Two-Year Postsecondary Education (3 credit hours)
Comprehensive community colleges and technical institutes and the state systems of which they are part: underlying concepts, design of educational needs to be serve, role in meeting these needs, historical development, issues in establishment and operation of state systems and individual institutions, unresolved issues and emerging trends.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Spring

EAC 701 Administrative Concepts and Theories Applied To Adult and Community College Educ (3 credit hours)
For persons interested in building more consistent philosophy of educational administration, extension and strengthening of understanding of administrative concepts and processes, improved comprehension of theoretical and research foundations upon which administrative processes predicated, and increased ability for application of administrative concepts, theories and principles to management of complex education system.

Prerequisite: EAC 787 or a comparable course(s) on organizational theory
Typically offered in Spring only

EAC 703 The Programming Process In Adult and Community College Education (3 credit hours)
Principles and processes in programming, including basic theories and support of concepts in programming process. Attention to general programming framework, organizational needs and program roles of both professional and lay leaders.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

EAC 704 Leadership In Higher and Community College Education (3 credit hours)
Issues and concepts of leadership development and practice in two- and four-year colleges and universities; interpretation and communication of institutional values and understanding of organizational processes. Attention to role of organizational culture

Typically offered in Summer only

EAC 705 Group Process In Adult and Higher Education (3 credit hours)
Application of research and theory in small group behavior to administration and teaching in adult and higher education settings. Opportunities for participant experience of various aspects of group behavior and practice of group leadership skills applied.

EAC 706 The College and University Presidency (3 credit hours)
Promotion of understanding of many facets of the college and university presidency. Investigation and analysis of college and university from the perspective of students' own careers and from the literature on the presidency. The president as institution

Prerequisite: EAC 700 or EAC 716
Typically offered in Spring only

EAC 707 The Politics Of Higher Education (3 credit hours)
Differing and changing perceptions of role of higher education in American society; politics of competition for priority of attention and resources; organizational alternatives in its control; relevant elements in structure and processes of government.

Prerequisite: Graduate standing or Management Development Certificate Program and six sem. hrs. of 500-level course work

EAC 708 Continuing Education for the Professions (3 credit hours)
Theoretical and research literature related to continuing education for the professions. Examination of role of educator in providing and managing continuing professional education.

Prerequisite: EAC 703, 759
Typically offered in Summer only

EAC 710 Adult Education: History, Philosophy, Contemporary Nature (3 credit hours)
Historical and philosophical foundations of adult education from ancient times to present, with attention to key figures, issues, institutions, movements and programs, including consideration of relationship between adult education's historical development and prevailing intellectual, social, economic and political conditions. Consideration of adult education's contemporary nature, present-day schools of thought on its objectives and trends.

Prerequisite: Advanced Undergraduate standing
Typically offered in Fall only
EAC 711  Reflective Practice and Research Inquiry  (3 credit hours)
Initial doctoral seminar to enhance understanding of critically reflective practice, doctoral scholarly inquiry and current issues and debates in adult education scholarship and research.

Typically offered in Fall only

EAC 712  The Change Process in Adult Education  (3 credit hours)
Provides an introduction to theory and practice of change within the context of adult education organizations, communities, and societies. Emphasis on theory and practice of change in adult education and training and developmental contexts.

Prerequisite: Adult Education Doctoral student
Typically offered in Spring only

EAC 716  History Of Higher Education In the United States  (3 credit hours)
History of higher education from colonial period to the present. Emphasis on influence of philosophic, political, social and economic forces upon function and structure of higher education.

Prerequisite: Six hrs. of grad. ED courses
Typically offered in Fall only

EAC 730  Foundations of Adult, Higher, and Human Res Education  (3 credit hours)
An inquiry into the characteristics and background, learning processes, motivation and participation of adult learners in a variety of educational contexts. Emphasis on adult learning theories, models, principles and their application to educational design and delivery. Doctoral status required.

Typically offered in Fall only

EAC 731  Technology In Adult, Higher, and Human Resource Education  (3 credit hours)
Introduces the students to the role of technology in education. Positive and critical aspects will be addressed. Draws on theory and practice from numerous disciplines, including: adult education; distance education; educational, instructional and communication technologies; and, the teaching and learning sciences. Analysis of how education in the workplace, higher education and adult/community contexts is being transformed by technology. Evaluation of the complex interrelationships among education, learning and technology. Doctoral status required.

Typically offered in Fall only

EAC 732  Globalization Intl Issues Adult Higher Hum Res Ed  (3 credit hours)
This core course focuses on globalization and its implications for the study and practice of adult, higher, and human resource education, as well as the evolution and increase of diverse international perspectives in the scholarship and policy arenas viewed from an interdisciplinary perspective. Doctoral status required.

Typically offered in Spring only

EAC 737  The Extension and Public Service Function In Higher Education  (3 credit hours)
Examination of background, history, philosophy and contemporary nature of extension and public service function of institutions of higher education in U.S. Emphasis on adult education role of public and private universities and colleges. Specific focus on: general extension, industrial extension, engineering extension, cooperative extension and continuing education.

Prerequisite: EAC 710
Typically offered in Spring only

EAC 743  Adult Development and Learning  (3 credit hours)
This course examines key theories and research on the physical, and related socio-cultural changes across the adult lifespan. Special emphasis in this course will be on the intellectual and psycho-social aspects of adult development. Key implications for educational programs and services, as well as research investigations of adults in learning environments, will be explored.

Prerequisite: EAC 739
Typically offered in Spring only

EAC 745  Death and Dying: A Lifespan Issue  (3 credit hours)
Examination of issues associated with dying process, death itself and bereavement. Perceptions and responses to these issues at various stages of the lifespan. Implications for students' fields of practice.

Prerequisite: Graduate standing or PBS status
Typically offered in Summer only

EAC 749  Finance in Higher Education  (3 credit hours)
Examination of theory, research, practices and issues in development and management of financial resources in higher education.

Typically offered in Fall only

EAC 750  The Environment for Learning In Adult and Higher Education  (3 credit hours)
Planning and management of the physical environment for effective adult learning. Applicability of concepts and theories of learning and teaching environment to needs analysis, planning, resource development, cooperation with professional designers, and construction, operations, conservation and maintenance of educational facilities, equipment and grounds.

Prerequisite: EAC 700 and Graduate standing or PBS status

EAC 759  Adult Learning Theory  (3 credit hours)
Requisite involvement and undergirding of principles in adult education programs including theories and concepts. Emphasis on interrelationship of nature of adult learning, the nature of the subject matter and setting for learning occurrence. Applicability of relevant principles and pertinent research findings to adult learning.

Prerequisite: Six semester hours in ED
Typically offered in Spring only

EAC 760  Diversity in Higher Education  (3 credit hours)
This course uses a multicultural competence framework to explore issues of diversity and social justice in higher education and the broader society. Issues of privilege, power, and oppression are explored and discussed in depth as well as the intersection of multiple identities and oppressions.

Typically offered in Spring only
EAC 761 Gender Studies in Adult Higher Education (3 credit hours)
Exploring topics and issues related to the experiences of men and women in adult and higher education. This includes examination of meanings and applications of diverse feminisms, particularly as they apply to study of gendered patterns of student development in higher education.

Typically offered in Spring only

EAC 762 Spirituality in Higher Education (3 credit hours)
With a focus on spirituality and religion in higher education, this course provides an introduction to an emerging area of research and practice among higher education administrators and scholars. The course encourages the development of knowledge and skills to understand and engage in religious and worldview diversity in postsecondary educational contexts.

Typically offered in Spring only

EAC 765 Current Issues in Adult Education (3 credit hours)
Analysis of social, political, economic, and ethical issues influencing effective practice of adult education. Participant formulation and analysis of problems, issues, and challenges relevant to their practice and advanced graduate study.

Prerequisite: 15 Semester hours of graduate credit in the Department of Adult and Community College Education, including 3 semester hours of either quantitative or qualitative research methods.

Typically offered in Spring only

EAC 767 Education Of Special Adult Populations (3 credit hours)
Analysis and development of adult education responses to needs and characteristics of special adult populations such as nonliterate, unemployed, handicapped and older adults.

Typically offered in Spring and Summer

EAC 778 Law and Higher Education (3 credit hours)
Constitutional, statutory and case law in relationship to higher education. Emphasis on faculty, student and staff rights and tort liability.

Prerequisite: Six hrs. graduate credit

Typically offered in Fall only

EAC 779 Concepts and Principles Of Evaluation Applied To Non-Formal Adult Education Prog (3 credit hours)
Introduction to evaluation of non-formal adult educational programs; course topics include purposes of evaluation, alternative concepts and techniques, stake holders and their concerns, specification of evidence, selection of standards for making judgments, gathering and analysis of data, use and dissemination of results and handling problems in evaluation.

Prerequisite: EAC 703

Typically offered in Spring only

EAC 786/EMS 786 Teaching in College (3 credit hours)
Focus on development of competencies to perform fundamental tasks of a college teacher as well as consideration of more long-range tasks such as course development and university responsibilities of a professor. In addition to attending lectures and other types of presentations, students make video tapes of their teaching, develop tests, design introductory courses in their teaching fields and consider current issues related to university and college teaching.

Typically offered in Fall only

EAC 786/EMS 786 Teaching in College (3 credit hours)
Focus on development of competencies to perform fundamental tasks of a college teacher as well as consideration of more long-range tasks such as course development and university responsibilities of a professor. In addition to attending lectures and other types of presentations, students make video tapes of their teaching, develop tests, design introductory courses in their teaching fields and consider current issues related to university and college teaching.

Typically offered in Fall only

EAC 787 Organizational Theories and Concepts in Higher Education (3 credit hours)
For present and potential administrators interested in increasing their understanding of organizational theories as a basis for administration of effective higher education programs.

Typically offered in Fall and Spring

EAC 788 Applied Qualitative Data Analysis (3 credit hours)
Intermediate graduate level course in applied qualitative methodology following an introductory course in qualitative methods. Focuses on analytical approaches and tools used with qualitative data, with particular emphasis on adult and higher education and human resource development.

Prerequisite: EAC 785

EAC 790 Advanced Qualitative Research Methods (3-6 credit hours)
Advanced guidance for students designing or preparing for qualitative study. Emphasis on developing deeper understanding of theoretical issues informing qualitative research, including assessing validity of data and justifying design. Student development of a research proposal.

Prerequisite: EAC 785

Typically offered in Fall only

EAC 795 Topical Problems in Adult and Community College Education (1-3 credit hours)
EAC 802 Seminar in Adult and Higher Education (1-3 credit hours)
Identification and scientific analysis of major issues and problems relevant to adult education or higher education. Course credit at the doctoral level through active student participation in a formal seminar and scientific appraisal and solution of a problem.

Prerequisite: Graduate standing

EAC 803 Research Seminar in Adult and Higher Education (3-6 credit hours)
Examination and application of frameworks, processes and compositional approaches in developing research proposals focusing on problems in adult education and higher education.

Prerequisite: 6 semester hours of course work in research methodology/analysis

Typically offered in Spring only

EAC 824 Topical Problems In Adult and Higher Education (1-3 credit hours)
Study and scientific analysis of problems in adult and higher education at the doctoral level and preparation of a scholarly research paper or project. Credits Arranged.

Prerequisite: Graduate standing or PBS status

EAC 830 Independent Study in Adult and Higher Education (3 credit hours)
Independent study for doctoral students in Adult and Higher Education.

Typically offered in Fall, Spring, and Summer
EAC 851 Internship In Adult and Higher Education (1-9 credit hours)
Utilization of the participant-observer role with required participation in selected educational situations. Emphasis upon observational skills development, the recording of relevant observations through written journals, analysis of experiences identifying critical incidents and projection of events and consequences. Student development and selection of possible alternative courses of action in various situations and evaluation of the consequences of the selected course of action.

Prerequisite: Nine hrs. in graduate level courses
Typically offered in Fall, Spring, and Summer

EAC 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

EAC 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

EAC 892 Doctoral Research Project (1-3 credit hours)
A project or problem in research in education for graduate students, supervised by members of graduate faculty. Choice of research on basis of individual students’ interests and not to be part of thesis or dissertation research.

Prerequisite: EAC 732
Typically offered in Fall and Spring

EAC 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Summer only

EAC 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

EAC 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

EAC 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Advanced Analytics (AA)

AA 500 Analytics Tools and Techniques (3 credit hours)
This course equips the student with basic and advanced computer programming skills needed to use industry-standard analytics tools for data analysis, including but not limited to: data access and management, data cleaning, data mining, text mining, geospatial analytics, forecasting, and optimization. Restricted to AA majors.

Corequisite: AA 501
Typically offered in Summer only

AA 501 Analytics Foundations (3 credit hours)
This course equips the student with basic knowledge of statistics required for further study in analytics. Topics include, but are not limited to: Exploratory Data Analysis, Linear Regression, Multiple Linear Regression, Regression Diagnostics, Logistic Regression, ANOVA, Cluster Analysis, Analysis of Tables, and Survey Data Analysis. Restricted to AA major.

Corequisite: AA 670
Typically offered in Summer only

AA 502 Analytics Methods and Applications I (6 credit hours)
This course equips the students with the methods and applications of advanced analytics. Topics include, but are not limited to: Time Series and Forecasting, Geospatial Data Analytics, Linear Algebra, Data Mining, Survival Data Analysis and Logistic Regression Models. Restricted to AA major.

Prerequisite: AA 501 and AA 670; Corequisite: AA 504
Typically offered in Fall only

AA 503 Analytics Methods and Applications II (6 credit hours)
This course equips the student with the methods and applications of advanced analytics. Topics include, but are not limited to: Advanced Data Mining, Text Mining, Financial Analytics, Risk Analytics, Marketing Science and Customer Analytics, Linear and Non-Linear Programming. Restricted to AA major.

Prerequisite: AA 502; Corequisite: AA 505
Typically offered in Spring only

AA 504 Analytics Practicum I (6 credit hours)
This course equips the student with the knowledge and skills needed to conduct and present large-scale studies based on advanced analytics. Student teams conduct analysis using large amounts of real-world data. Restricted to AA major.

Prerequisite: AA 501 and AA 670; Corequisite: AA 502
Typically offered in Fall only

AA 505 Analytics Practicum II (6 credit hours)
A continuation of AA 504, this course equips the student with the knowledge and skills needed to conduct and present large-scale studies based on advanced analytics. Student team conduct analysis using large amounts of real-world data. Restricted to AA majors.

Prerequisite: AA 504; Corequisite: AA 503
Typically offered in Spring only

AA 591 Special Topics in Advanced Analytics (1-6 credit hours)
Special Topics in Advanced Analytics

AA 691 Special Topics in Advanced Analytics (1-6 credit hours)
Special Topics in Advanced Analytics
Aerospace Studies (AS)

AS 121 Heritage and Values I (1 credit hours)
AS 121 is the first semester of a survey course designed to introduce students to the United States Air Force and provide an overview of the basic characteristics, missions, and organization of the Air Force. Companion Lab AS201 required for active cadets.

Typically offered in Fall only

AS 122 Heritage and Values II (1 credit hours)
AS 122 is the second semester of a survey course designed to introduce students to the United States Air Force and provides an overview of the basic characteristics, missions, and organization of the Air Force. Companion Lab AS201 required for active cadets.

Typically offered in Spring only

AS 201 Freshman and Sophomore Leadership Laboratory (1 credit hours)
AS 201 is the leadership lab component for freshman and sophomore cadets enrolled in the AFROTC program. This laboratory is the hands-on military training where you will apply the knowledge and theory from your academic classes.

Typically offered in Fall and Spring

AS 221 Team and Leadership Fundamentals I (1 credit hours)
Part I of a two-semester course laying the foundation for teams and leadership. The topics include skills that will allow students/cadets to improve their leadership on a personal level and within a team. The courses will prepare students/cadets for the

Typically offered in Fall only

AS 222 Team and Leadership Fundamentals II (1 credit hours)
Part II of a two-semester course laying the foundation for teams and leadership. The topics include skills that will allow students/cadets to improve their leadership on a personal level and within a team. The courses will prepare students/cadets for the

Typically offered in Spring only

AS 321 Leading People and Effective Communication I (3 credit hours)
AS 321 is a three-credit hour elective and part I of a two-semester course that teaches students/cadets advanced skills and knowledge in management and leadership. Topics include leadership and management fundamentals, ethics training and communication skills. Students will gain a more in-depth understanding of how to effectively lead people, as well as, hone their writing and briefing skills. Companion Lab AS401 required for active cadets.

Typically offered in Fall only

AS 322 Leading People and Effective Communication II (3 credit hours)
Part II of a two-semester course that teaches students/cadets advanced skills and knowledge in management and leadership. Topics include leadership and management fundamentals, ethics training and communication skills. Students will gain a more in-depth understanding of how to effectively lead people, as well as, hone their writing and briefing skills. Companion Lab AS401 required for active cadets.

Typically offered in Spring only

AS 401 Junior and Senior Leadership Laboratory (1 credit hours)
AS 401 is the leadership lab component for junior and senior cadets enrolled in the AFROTC program. This laboratory is the hands-on military training where you will apply the knowledge and theory from your academic classes. Additionally it provides cade

Typically offered in Fall and Spring

AS 421 National Security Affairs/Preparation for Active Duty I (3 credit hours)
AS 421 is a three credit hour course and is designed for college seniors. It will give students the foundation to understand their role as military officers in American society. Course examines the factors affecting national security; analyzes the evolution and formulation of U.S. defense policy, strategy, and joint doctrine; and investigates the methods for managing conflict. Companion Lab AS401 required for active cadets.

Typically offered in Fall only

AS 422 National Security Affairs/Preparation for Active Duty II (3 credit hours)
AS 422 is a three credit hour course and is designed for college seniors. It will give students the foundation to understand their role as military officers in American society. Course examines the factors affecting national security; analyzes the evolution and formulation of U.S. defense policy, strategy, and joint doctrine; and investigates the methods for managing conflict. This final semester provides information that will prepare the cadets for Active Duty. Companion Lab AS401 required for active cadets.

Typically offered in Spring only

AS 495 Special Topics in Aerospace Studies (2 credit hours)
Offered as needed to treat new or special subject matter relating to the Department of the Air Force.

Typically offered in Fall and Spring

Africana Studies (AFS)

AFS 230/MUS 230 Introduction to African-American Music (3 credit hours)
Comprehensive survey of African-American music in the United States from Colonial times to the present, with emphasis on its unique features and contributions to American culture.

GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Fall only

AFS 240 African Civilization (3 credit hours)
An interdisciplinary study of centers of African civilization from antiquity to the 1960s. Such centers include ancient Egypt, Nubia, Axum, Ghana, Mali, Songhai, Kiliwa, Malinda, Sofola, Zinzibar and Monomotapa.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer
AFS 241 Introduction to African American Studies  (3 credit hours)  
Introduces students to the field of African American/Black Studies. A transdisciplinary approach is used that includes humanistic and social scientific disciplines. The course offers an intellectual and methodological framework for understanding the past, present, and future of people of African descent in the United States of America. Topical areas are covered that capture the historical, political, economic, cultural, sociological and psychological experiences of African Americans.

GEP Humanities, GEP U.S. Diversity  
Typically offered in Fall, Spring, and Summer

AFS 248/ENG 248 Survey of African-American Literature  (3 credit hours)  
African-American writing and its relationships to American culture and history. Covers such writers as Wheatley, Douglass, Chesnutt, Dunbar, DuBois, Hughes, Hurston, Wright, and Morrison.

GEP Humanities, GEP U.S. Diversity  
Typically offered in Fall, Spring, and Summer

AFS 260/MUS 260 History of Jazz  (3 credit hours)  
History of jazz and the contributions of major artists. Emphasis of the various styles that have contributed to this American art form. Investigation of structural forms in the jazz idioms.

GEP U.S. Diversity, GEP Visual and Performing Arts  
Typically offered in Spring and Summer

AFS 275/HI 275 Introduction to History of South and East Africa  (3 credit hours)  
The African kingdoms (Lunda, Buganda, and Zulu); the European encroachment; the origins of colonialism and the character of colonial societies and economies, South African apartheid; African protest, nationalism and independence.

GEP Global Knowledge, GEP Humanities  
Typically offered in Fall and Spring

AFS 276/HI 276 Introduction to History of West Africa  (3 credit hours)  
The history of Western Africa. Forest civilizations and the slave trade, trade and the expansion of Islam, colonialism in West Africa; African nationalism and the achievement of independence; and postcolonial West Africa.

GEP Global Knowledge, GEP Humanities  
Typically offered in Fall only

AFS 305/SOC 305 Racial and Ethnic Relations  (3 credit hours)  
Study of the nature of the relationships among racial and ethnic groups in societies around the world but with emphasis on the United States. Explores topics such as inequalities of wealth, power, and status, racism, conflict, and social boundaries among groups. Current trends in intergroup relations are discussed.

Prerequisite: 3 cr. in SOC, 200 level  
GEP Social Sciences, GEP U.S. Diversity  
Typically offered in Fall and Spring

AFS 342 Introduction to the African Diaspora  (3 credit hours)  
Exploration of the global experiences of people of African descent. Geographical areas include the Americas, Europe, Asia, and the Caribbean. Exploration of the web of interrelated histories, social dynamics, and politico-economic processes affecting and reflecting world cultures and histories. Foundational course for the exploration of methodological issues and theoretical concerns in the field of African Diaspora Studies.

GEP Global Knowledge, GEP Humanities  
Typically offered in Fall, Spring, and Summer

AFS 343/REL 343 African American Religions  (3 credit hours)  
History of religions among Americans of African descent from the period of the development of the transatlantic slave trade to the present. Exploration of the complex ways religion has shaped the lifeworld of African Americans.

GEP Humanities, GEP U.S. Diversity  
Typically offered in Spring only

AFS 344 Leadership in African American Communities  (3 credit hours)  
Historical, cultural and political examination of the dynamics of leadership in African American communities. Focus on structure of Leadership in the context of gender, ideology, and style. Interdisciplinary examination of impact of leaders on broader American society.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity  
Typically offered in Fall, Spring, and Summer

AFS 345/PSY 345 Psychology and the African American Experience  (3 credit hours)  
Historical and cultural examination of the psychological experiences of African American experience from pre-American times to the present. Focus on mental health, personality, identity development, racism, oppression, psychological empowerment and an African-centered world view. Discussion of contemporary issues within the African American community.

Prerequisite: PSY 200 or PSY 201  
GEP U.S. Diversity  
Typically offered in Fall and Spring

AFS 346/ARS 346 Black Popular Culture  (3 credit hours)  
A multidisciplinary examination of contemporary black cultural expression in film, music, art, and the media. Emphasis on race, class, gender, and political discourse. This class may be scheduled with a small percentage of seats held for IDS Students Only.

GEP Humanities, GEP U.S. Diversity  
Typically offered in Fall, Spring, and Summer

AFS 349/ENG 349 African Literature in English  (3 credit hours)  
Anglophone literature in Africa. Emphasis on the relationship between the African world-view and literary production and the persistent trend by African writers to connect literature with politics. Writers such as Achebe, Ngugi, Soyinka, and Serote.

Prerequisite: Sophomore standing and above  
GEP Global Knowledge, GEP Humanities  
Typically offered in Spring only
AFS 372/HI 372 African-American History Through the Civil War, 1619-1865 (3 credit hours)
African background and continuity of the particular role, experience and influence of African Americans in the United States through the Civil War.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

AFS 373/HI 373 African-American History Since 1865 (3 credit hours)
The history of African-Americans from the Reconstruction era through the Civil Rights movement of the 1950s and 1960s to the present.

GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

AFS 375/ENG 375 African American Cinema (3 credit hours)
Survey and analysis of African American film culture from 1900-present. Examination of pre-Hollywood, classical Hollywood, and Independent filmmaking. Particular focus on independent filmmakers’ response to dominant industry representations and the work of filmmakers who seek to create a specifically African American cinematic style.

GEP U.S. Diversity
Typically offered in Spring only

AFS 380/WGS 380 Black Feminist Theory (3 credit hours)
Focused examination of Black feminist theory as a significant and distinct body of work. Interdisciplinary exploration of the impact of Black feminist theory on movements for social justice, the development of academic feminism generally, and the lived experience of Black women both in the United States and internationally.

Prerequisite: Any 200-level course in either WGS or AFS
GEP U.S. Diversity
Typically offered in Fall and Spring

AFS 409/PS 409 Black Political Participation in America (3 credit hours)
African American political participation in the United States; political culture, socialization, and mobilization, with a focus on the interaction between African Americans and actors, institutions, processes, and policies of the American political system.

Typically offered in Fall only

AFS 440 Senior Seminar in Africana Studies (3 credit hours)
In-depth examination of Africana Studies Issues. Interdisciplinary exploration of key problems and proposed solutions for African communities on the African continent and throughout the world. Requires written research project using interdisciplinary approach.

Prerequisite: AFS 342; Africana Studies Majors or Africana Studies Minors
Typically offered in Spring only

AFS 442 Issues in the African Diaspora (3 credit hours)
Multidisciplinary exploration of the interrelated histories, social dynamics, and politico-economic processes of the experiences of people of African descent throughout the world. Particular focus on the experiences of slavery, artistic expression, gender practices, and the impact of the nation-state.

GEP Humanities
Typically offered in Fall and Spring

AFS 448/ENG 548/AFS 548/ENG 448 African-American Literature (3 credit hours)
Survey of African-American literature and its relationships to American culture, with an emphasis on fiction and poetry since 1945. Writers such as Bontemps, Morrison, Hurston, Baldwin, Hayden, Brooks, Naylor, Harper, and Dove.

Prerequisite: Junior standing.
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring and Summer

AFS 455/HI 555/AFS 555/HI 455 History of the Civil Rights Movement (3 credit hours)
The black revolution; stages and leaders of the movement; successes and failures in the fight for desegregation, the vote, and economic opportunity; impact of Civil Rights movement on the United States. Credit will not be given both for AFS/HI 455 and AFS/HI 555.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

AFS 475/HI 575/AFS 575/HI 475 History of South Africa (3 credit hours)
Evolution of the Republic of South Africa’s society, with emphasis on the interaction of diverse peoples and cultures. Particular attention is given to the period since 1870. Credit will not be given for both HI (AFS) 475 and HI 575.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Fall and Spring

AFS 476/HI 576/AFS 576/HI 476 Leadership in Modern Africa (3 credit hours)
Recent sub-Saharan African political history (excluding South Africa). Overview of concepts, vocabulary, historical trends. Detailed examination of specific African countries as case studies, such as Ghana, Nigeria, Zimbabwe, Tanzania. Credit will not be given for both HI (AFS) 476 and HI 576.

Prerequisite: 3 hours of history
GEP Global Knowledge

AFS 479/HI 579/AFS 579/HI 479 Africa (sub-Saharan) in the Twentieth Century (3 credit hours)
Developments in sub-Saharan Africa during the colonial period, from the end of the nineteenth century to the advent of decolonization in the early 1960s. Interplay of political, social, economic and cultural factors in the experiences of African peoples during this period. Credit will not be given for both HI (AFS) 479 and HI 579.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Spring only
AFS 490 Africana Studies and Community Involvement (3 credit hours)
First part of a two semester service-learning experience. Provides interdisciplinary and experientially based opportunity for students to engage in community and classroom-based experiences that examine issues of relevance to African American people (or communities in the African Diaspora). Students apply and examine concepts addressed in class to their own practical experience in service to others. Development of interpersonal and professional skills. Focus on the values, beliefs, attitudes, and ideas that are central to definitions of democracy, social justice, civic resiliency, self-help, and public life.
Prerequisite: Africana Studies Majors or Africana Studies Minors
Typically offered in Fall only

AFS 491 Study Abroad in Africana Studies (3 credit hours)
Specific category of revolving set of field/seminar courses involving multidisciplinary focal areas taught in foreign countries through Africana Studies. Course includes pre-trip orientation and readings and onsite field experiences and lectures. Additional program fees, travel costs and appropriate immunizations are required beyond registration fees.
Typically offered in Summer only

AFS 497 Topics in African-American Studies (3 credit hours)
Multidisciplinary examination of selected topics in African-American studies.
Prerequisite: AFS 240
Typically offered in Fall and Spring

AFS 548/ENG 448/AFS 448/ENG 548 African-American Literature (3 credit hours)
Survey of African-American literature and its relationships to American culture, with an emphasis on fiction and poetry since 1945. Writers such as Bontemps, Morrison, Hurston, Baldwin, Hayden, Brooks, Naylor, Harper, and Dove.
Prerequisite: Junior standing.
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring and Summer

AFS 555/HI 455/AFS 455/HI 555 History of the Civil Rights Movement (3 credit hours)
The black revolution; stages and leaders of the movement; successes and failures in the fight for desegregation, the vote, and economic opportunity; impact of Civil Rights movement on the United States. Credit will not be given both for AFS/HI 455 and AFS/HI 555.
P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

AFS 575/HI 475/AFS 475/HI 575 History of the Republic of South Africa (3 credit hours)
Evolution of the Republic of South Africa’s society, with emphasis on the interaction of diverse peoples and cultures. Particular attention is given to the period since 1870. Credit will not be given for both HI (AFS) 475 and HI 575.
Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Fall and Spring

AFS 576/HI 476/AFS 476/HI 576 Leadership in Modern Africa (3 credit hours)
Recent sub-Saharan African political history (excluding South Africa). Overview of concepts, vocabulary, historical trends. Detailed examination of specific African countries as case studies, such as Ghana, Nigeria, Zimbabwe, Tanzania. Credit will not be given for both HI (AFS) 476 and HI 576.
Prerequisite: 3 hours of History
GEP Global Knowledge

AFS 579/HI 479/AFS 479/HI 579 Africa (sub-Saharan) in the Twentieth Century (3 credit hours)
Developments in sub-Saharan Africa during the colonial period, from the end of the nineteenth century to the advent of decolonization in the early 1960s. Interplay of political, social, economic and cultural factors in the experiences of African peoples during this period. Credit will not be given for both HI (AFS) 479 and HI 579
Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Spring only

Agricultural and Extension Education (AEE)

AEE 101 Introduction to Career and Technical Education (1 credit hour)
Overview of career and technical education programs, objectives, and outcomes in secondary schools. Philosophy of career and technical education and how career and technical education programs fit into the overall mission of secondary education. Mission of agricultural education, major program objectives, and introduction to the curricula taught within the state. Roles and responsibilities of CTE teachers with specific emphasis on agricultural education teachers’ roles and responsibilities. Historical context of agricultural education and other career and technical education programs, including major legislation affecting development of career and technical education.
Typically offered in Fall only

AEE 103 Fundamentals of Agricultural and Extension Education (1 credit hour)
Introduction to the scope, purpose, and objectives of university education with an emphasis on agricultural education, extension education, and agricultural communications. Students will explore College and departmental resources, academic policies and procedures, the agricultural industry, career opportunities, and current trends and issues in agriculture. Cannot receive credit for both AEE 103 and ALS 103
Typically offered in Fall only

AEE 141 Computer Applications in the Agricultural Institute (2 credit hours)
Introduction to computing concepts and the computing infrastructure in the Agricultural Institute. Use of computing hardware and software to perform common tasks, explore networked computer resources and solve problems associated with the various curricula in the Agricultural Institute. BOSTICK
Typically offered in Spring only
AEE 206 Introduction to Teaching Agriculture (3 credit hours)
Introduction to teaching agricultural education in middle and secondary schools and collaborative efforts for teaching agricultural education to adults as rural community situations dictate. Field experiences include three hours per week of structured observations of classroom teachers, teacher assistant activities, and reflections of the experience.

Typically offered in Fall only

AEE 208/ANS 208/PB 208 Agricultural Biotechnology: Issues and Implications (3 credit hours)
Trends and issues of agricultural biotechnology in today's society are addressed while covering the basic biological science behind the technology. Applications of and policy issues associated with plant, animal, and environmental biotechnology used in the agricultural industry are examined from an interdisciplinary approach.

Prerequisite: (BIO 105 or BIO 115 or BIO 181 or BIO 183)
GEP Interdisciplinary Perspectives
Typically offered in Spring and Summer

AEE 226 Computer Applications and Information Technology in Agricultural & Extension Education (3 credit hours)
Use of computers and commercially produced agricultural software; the computer as a management tool; agricultural occupational applications of the computer; a multimedia instructional tool in agricultural classrooms and training situations; use of technology.

Typically offered in Fall and Spring

AEE 230 Introduction to Cooperative Extension (3 credit hours)
This course is designed for all students who are interested in pursuing a career with the cooperative extension service. An introduction to the cooperative extension mission, philosophy, history, organization, structure, administration, program areas, extension program development, extension teaching and delivery methods, and the involvement and use of volunteers. Students are expected to provide their own transportation for outside of class activities and assignments.

Typically offered in Fall only

AEE 303 Administration and Supervision of Student Organizations (3 credit hours)
Principles and techniques for organizing, administering and supervising student organization activities.

Prerequisite: AEE 206
Typically offered in Spring only

AEE 311 Communication Methods and Media (3 credit hours)
Foundations of agricultural communications. Technologies of agricultural communication and the systematic approach to the development of agricultural communication materials. Development of applied skills in design, production, evaluation, and dissemination of information unique to agricultural sciences and media.

Prerequisite: ENG 101
Typically offered in Fall and Spring

AEE 322 Experiential Learning in Agriculture (3 credit hours)
Planning, organizing, implementing, supervising and evaluating Supervised Agricultural Experience (SAE) programs in agriculture.

Prerequisite: AEE 206
Typically offered in Fall only

AEE 323 Leadership Development in Agriculture and Life Sciences (3 credit hours)
AEE 323 is designed to introduce you to the awesome complexity of leadership. Leadership educators believe that leadership can be learned. In this course, we study leadership theory to help us understand our leadership potential, the potential of others, and the impact great leadership can have on people, organizations, and society. We separate skills you gain from going out and doing leadership (the do) from theories that provide foundations for leadership (the think). Effective leadership is important in all contexts, including food and agriculture. We believe it is ESSENTIAL that effective leaders both THINK and DO!

GEP Social Sciences
Typically offered in Fall and Spring

AEE 325 Planning and Delivering Non-Formal Education (3 credit hours)
Adult learning theory and practice, including planning non-formal educational programs for adults, methods of instructional delivery, effective use of instructional technology, marketing educational programs, and evaluation of educational outcomes. Microteaching (practice teaching presentations) and group presentations required as part of laboratory assignments.

Typically offered in Fall only

AEE 326 Teaching Diverse Learners in AED (3 credit hours)
Legislation and issues regarding diverse learners in middle and high school agriculture education are examined. Discussion and practice in planning and facilitating teaching strategies to help those with special needs in an agricultural setting are emphasized.

Prerequisite: AEE 206; Junior standing; and AED Majors only
Typically offered in Spring only

AEE 327 Conducting Summer Programs in Agricultural Education (1 credit hour)
Field experience emphasizing summer agricultural education programs. Individualized instruction for students during supervised agricultural experience visits and youth organization activities. Professional development and program improvement activities.

Prerequisite: AEE 206, AEE 303, AEE 322, and Corequisite of AEE 426
Typically offered in Fall only

AEE 350 Personal Leadership Development in Agriculture and Life Sciences (3 credit hours)
This course focuses on the impact of personal leadership on agricultural organizations and society. The best leaders are those who have internalized personal leadership concepts and apply them to the practical situations in their environment. This course teaches individuals to achieve optimal results by changing their fundamental approach to work, relationships, and problem solving, using time-honored principles in time management, leadership, and effectiveness. Restricted to CALS students.

Typically offered in Spring only
AEE 360 Developing Team Leadership in Agriculture and Life Sciences (3 credit hours)
Students in this course will study the impact of organized teams and team leaders on the development of agricultural organizations. Principles and techniques involved in creating, organizing and directing teams will be explored. Students will develop skills in team decision-making and communication. Topics of discussion will include: components of a group and team, relationships of group and team members, effectiveness of groups and teams, and communication within groups and teams. This course is designed for students who are interested in positions of leadership and who want to learn more about making the groups and teams they work with more effective. Restricted to CALS students.
Prerequisite: AEE 323-Leadership Development in Agriculture Typically offered in Fall only

AEE 423 Practicum in Agricultural Extension/Industry (8 credit hours)
Participation in professional work experiences in preparation for effective leadership positions in the Cooperative Extension Service or the agribusiness industry.
Prerequisite: AEE 230, AEE 325, and Corequisite of AEE 490 Typically offered in Spring and Summer

AEE 424 Planning Agricultural Educational Programs (3 credit hours)
Principles of program planning applied to educational programs in agriculture; includes theory and field experiences in planning, organizing, and evaluating high school and adult education programs.
Prerequisite: AEE(ED) 426, Corequisite: AEE(ED) 427 Typically offered in Spring only

AEE 426 Methods of Teaching Agriculture (3 credit hours)
Discussion and practice in planning and presenting instruction in agriculture in formal and informal settings. Principles and application of approaches to teaching and organizing instruction, motivating students, developing instructional objectives, selecting and using teaching techniques, evaluating instruction, and managing classroom and laboratory instruction.
Prerequisite: Junior standing. Typically offered in Fall only

AEE 427 Student Teaching in Agriculture (8 credit hours)
Skills and techniques involved in teaching vocational agriculture through practice in a public school setting with concurrent on-campus seminars.
Prerequisite: AEE (ED) 426; Admission to Professional Semester, Corequisite: AEE (ED) 490, AEE (ED) 424; Typically offered in Spring only

AEE 433/AEE 533 Leadership and Management of Volunteers in Agricultural and Extension Education (3 credit hours)
This course is intended to prepare students to be effective managers of volunteer programs. Theory will be emphasized in the course because it is essential to be grounded in theory in order to apply it. Major topics of the course will include, but are not limited to: volunteer recruitment, training, evaluation and reward. Students will be required to be active in and outside of class sessions, including a 20-hour field experience. Students must provide their own transportation for field trips and outside of class activities. Cannot receive credit for both AEE 433 and 533.
Prerequisite: Junior standing Typically offered in Fall only

AEE 435 Professional Presentations in Agricultural Organizations (3 credit hours)
This course teaches effective listening strategies, communication strategies, interpersonal skills and presentation strategies essential for use in today's workplace. AEE 435 includes strategies and techniques for effective presentations in the food, agricultural, natural resources, as well as other professions, with emphasis on oral and visual presentation techniques. Presentation skills and strategies for formal and informal situations including conferences, poster presentations along with leadership, conflict resolution, interviewing, negotiation, and group communication theory and strategies will be discussed. Restricted to CALS students; Jr or Sr level status required.
Typically offered in Fall and Spring

AEE 460 Organizational Leadership Development in Agriculture and Life Sciences (3 credit hours)
This course focuses on the impact of effective leadership in organizations in both theory and practice. Students will examine the major theories and studies that are most relevant and informative with the regard to leadership in organizations. Students will develop skills in decision-making, management of organizations, and ethical leadership related to agricultural organizations. Restricted to CALS students.
Prerequisite: AEE 323-Leadership Development in Agriculture Typically offered in Spring only

AEE 478 Advanced Issues in Extension Education (3 credit hours)
Advanced issues and trends contributing to the administration, organization, and structure of extension education in a changing world. Senior standing required.
Prerequisite: AEE 230 Typically offered in Spring only

AEE 490 Seminar in Agricultural and Extension Education (1 credit hours)
Analysis of opportunities and challenges facing educational leaders in agriculture.
Prerequisite: Admission to Professional Semester Typically offered in Fall, Spring, and Summer

AEE 491 Seminar in Agricultural Education (1 credit hours)
This course helps students analyze the opportunities and challenges facing teachers of agriculture as they prepare for their careers. Topics include balancing work and professional life as a teacher, portfolio assessments of teachers and programs, classroom management, teacher liability, and preparation for the job search in agricultural education.
Corequisites: AEE 424 and AEE 427 Typically offered in Spring only

AEE 492 External Learning Experience in Agricultural and Extension Education (1-6 credit hours)
Learning experience within an academic framework that utilizes facilities and resources external to the campus. Contact and arrangements with prospective employers initiated by the student and approved by the faculty adviser, prospective employer, and the departmental teaching coordinator prior to the experience. Not intended for teaching licensure for students in AEE
Prerequisite: Sophomore standing Typically offered in Fall and Spring
AEE 493 Special Problems in Agriculture and Extension Education (1-6 credit hours)
A learning experience in agriculture and extension education within an academic framework that utilizes departmental campus facilities and resources. Arrangements must be initiated by the student and approved by a faculty adviser and the departmental t
Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

AEE 495 Special Topics in Agricultural and Extension Education (1-3 credit hours)
Offered as needed to present material not normally available in regular course offerings or for offerings of new courses on a trial basis.
Typically offered in Fall, Spring, and Summer

AEE 500 Agricultural Education, Schools and Society (3 credit hours)
The role and structure of modern agricultural education within the overall educational system. School organization and governance, curriculum, teacher roles and responsibilities, educational philosophy and history, multiculturalism, special need students, impact of technology, professionalism, and current educational trends and issues.
Typically offered in Fall and Summer

AEE 501 Foundations Of Agricultural and Extension Education (3 credit hours)
Development and organization of agricultural and extension education in America from colonial times to the present. Emphasis on role of societal and scientific changes, the federal government and philosophy on evolution of agricultural and extension education.
Typically offered in Fall only

AEE 503 Youth Program Management (3 credit hours)
Research, theory and principles of youth organization management. Analysis of youth development models and application of leadership theory in a youth organization. Using evaluation models to assess the effectiveness of major youth organization. Web-based course.
Typically offered in Spring only

AEE 505 Trends and Issues in Agricultural and Extension Education (3 credit hours)
Trends and Issues in Agricultural and Extension Education. Analysis and appraisal of current trends, problems and issues in Agricultural and Extension Education. May include but not limited to scientific, political, demographic, social, educational, technological, and environmental trends and issues that will contribute to the future structure and operation of agricultural and extension education in the United States.
Typically offered in Spring only

AEE 507 Comparative Agricultural and Extension Education (3 credit hours)
Organization and operation of formal and nonformal agricultural education and extension systems in the United States and in other countries. Field trip required - cost approx. $175.00.
Typically offered in Fall only

AEE 521 Program Planning in Agricultural and Extension Education (3 credit hours)
Consideration of the need for planning programs in education; objectives and evaluation of community programs; use of advisory group; organization and use of facilities.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

AEE 522 Occupational Experience in Agriculture (3 credit hours)
A major and critical element in all programs of vocational education is provision for appropriate student learning experiences in a real and simulated employment environment. Due to recent developments in education and agriculture, new and expanded concepts of occupational experience devised. Current research substantiates need and desire of teachers of agriculture for assistance in implementing new concepts. Also designed to develop depth of understanding of theoretical foundations underlying new developments in occupational experiences to stimulate individual growth and creativity in implementing further developments.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

AEE 523 Adult Education in Agriculture (3 credit hours)
Designed to meet needs of leaders in adult education. Opportunity to study issues in working with adult groups. Attention given to the problem of fitting educational program for adults into public school and other educational programs and to methods of
Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

AEE 524 Coordinating the High School Agricultural Education Program (3 credit hours)
Principles of program planning applied to educational programs about agriculture; theory and field experiences in planning, organizing, and evaluating secondary agricultural education programs; development of plans for conducting all aspects of the complete agricultural education programs.
Typically offered in Spring only

AEE 526 Information Technologies in Agricultural and Extension Education (3 credit hours)
Principles, theory and techniques of using information technologies to provide instruction to learners, both in person and at a distance, in formal and non formal educational settings.
Typically offered in Spring only

AEE 529 Curriculum Development in Agricultural and Extension Education (3 credit hours)
Design and development of data based curriculum and curriculum evaluation procedures in agricultural and extension education. Critique of curriculum development models, contemporary trends and issues, curriculum resources and accountability tools. Analysis of the use of national and state standards as well as local community needs in curriculum development.
Typically offered in Spring only
AEE 533/AEE 433  Leadership and Management of Volunteers in Agricultural and Extension Education  (3 credit hours)
This course is intended to prepare students to be effective managers of volunteer programs. Theory will be emphasized in the course because it is essential to be grounded in theory in order to apply it. Major topics of the course will include, but are not limited to: volunteer recruitment, training, evaluation and reward. Students will be required to be active in and outside of class sessions, including a 20-hour field experience. Students must provide their own transportation for field trips and outside of class activities. Cannot receive credit for both AEE 433 and 533.
Prerequisite: Junior standing
Typically offered in Fall and Spring

AEE 535  Teaching Agriculture in Secondary Schools  (3 credit hours)
Application of theoretical models and research on effective teaching in secondary agricultural education programs. teaching strategies, planning required, and instructional management for students with varying backgrounds. Evaluation of student learning and teacher evaluation of instruction.
Typically offered in Fall only

AEE 545  Methods of Change in Agricultural and Human Sciences  (3 credit hours)
Processes by which professional change agents in agricultural and extension education influence the introduction, adoption, and diffusion of planned change. This course requires admission to any program of the NC State University Graduate School such as full graduate status, graduate unclassified status, post-baccalaureate studies, evening degree programs, etc. It has no other prerequisites, requisites, or restrictions.
Restriction: Graduate Standing or PBS status.
Typically offered in Spring only

AEE 550  Leadership Theory  (3 credit hours)
Leadership is ubiquitous in our society. It remains one of the world's favorite buzz words. However, just because it's everywhere, doesn't mean everything labeled so, is leadership. This graduate course in leadership theory will require you to critically examine your ideas of leadership, and reflect on your own (and society's) notions of "what is leadership". In this class we will separate the skills you gain from going out and doing leadership (the do) and the theories that provide the foundations for leadership (the think). Many successful leaders learn their skills via practice; that is important. AEE 550, however, is a leadership education course where we study leadership theory. We will take those theories, long associated with the academic study of leadership, and deconstruct them using critical theory as our lens. Then, using the text as guide, reconstruct them in new ways to meet today's pressing challenges.
Typically offered in Fall only

AEE 560  Organizational and Administrative Leadership in Agricultural and Extension Education  (3 credit hours)
Organizational and administrative leadership concepts, skills and values in relation to agencies, organizations and institutions engaged in the administration of agricultural and extension education programs.
Prerequisite: Master student or PBS status
Typically offered in Spring only

AEE 565  Community Leadership  (3 credit hours)
The Community Leadership course will prepare graduate students for leadership roles within an array of community settings. The three core competencies for community leadership will be shared which include farming ideas, building and using social capital, and mobilizing resources. Tools associated with each of these competencies will be examined as well as the ways in which to apply these tools to various community situations. Leadership theories that have been learned in AEE 550 will also be discussed to show how to move from theory to practice. This is a course that will require student participation both during class sessions and outside of class where students will be engaged in a team project. The course will be offered in the spring of odd years.
Prerequisite: Graduate student status and AEE 550: Leadership Theory
Typically offered in Spring only

AEE 577  Evaluation in Agricultural and Extension Education  (3 credit hours)
Evaluation is an important part of many social science disciplines and grant projects. The intent of this course is to teach students how to plan and conduct a meaningful and useful evaluation. Students will gain knowledge and skills in planning evaluation.
Restriction: Graduate Standing or PBS status.
Typically offered in Spring only

AEE 578  Scientific Inquiry in Agricultural and Extension Education  (3 credit hours)
Philosophy, design, interpretation and practice of scientific research in agricultural and extension education, with a particular focus on the skills necessary to be an effective and critical "consumer" of research that is practiced within the field. Web based course.
Typically offered in Fall, Spring, and Summer

AEE 579  Research Design in Agricultural and Extension Education  (3 credit hours)
Design of Research in Agricultural and Extension education. Development of proposals for thesis research or competitive grants. Critical analyses of research in the field and proposed research.
Typically offered in Fall only

AEE 595  Special Topics in Agricultural and Extension Education  (1-6 credit hours)
Presentation of material not normally available in regular graduate course offerings or for offerings of new 500 level courses on a trial basis.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

AEE 601  Seminar  (1 credit hours)
Current topics and issues in agricultural and extension education. Selection and research of topics, presentation of seminars, and leading group discussions.
Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

AEE 610  Special Topics  (1-6 credit hours)
Presentation of material not normally available in regular graduate course offerings or for offerings of new 500 level courses on a trial basis.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer
AEE 620 Special Problems in Agricultural and Extension Education (1-6 credit hours)
Exploration of topics of special interest not covered by existing courses by individual students under faculty member's directions. Readings and independent study, problems or research not related to a thesis.

Typically offered in Fall, Spring, and Summer

AEE 641 Practicum In Agricultural and Extension Education (1-6 credit hours)
Faculty-supervised practicum in an educational, extension or agricultural industry setting.

Typically offered in Fall, Spring, and Summer

AEE 685 Master’s Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

AEE 690 Master’s Examination (1-9 credit hours)
For students in non-thesis master’s programs who have completed all other requirements of the degree except preparing for and taking the final master’s exam.

Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

AEE 693 Master’s Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

AEE 695 Master’s Thesis Research (1-9 credit hours)
Thesis research

Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

AEE 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master’s student
Typically offered in Summer only

AEE 699 Master’s Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

AEE 705 International Agricultural Development (3 credit hours)
This course provides an opportunity to learn about global agricultural and extension education issues, challenges and opportunities relating to agricultural development. The course emphasis is on building necessary knowledge and skills for analyzing global agricultural and extension education issues and formulating alternatives for agricultural development. This course has been designed to help graduate students understand agriculture and extension education with a global perspective.

Prerequisite: Graduate standing
Typically offered in Fall only

AEE 735 Effective Teaching in Agriculture and Life Sciences (3 credit hours)
Theory and practice of effective teaching in agricultural and life sciences. Emphasis on course planning, teaching and learning styles, instructional techniques, laboratory instruction, text construction, student evaluation, instructional technology, and faculty roles and responsibilities.

Prerequisite: Graduate standing
Typically offered in Fall only

AEE 777 Qualitative Research Methods in the Agricultural & Life Sciences (3 credit hours)
Qualitative research methods continue to gain popularity in the disciplines of agricultural & life sciences. It is becoming increasingly important for graduates to have a practical working knowledge of the development, implementation, and evaluation of these methodologies. Topics in the course will include but not be limited to: the foundation of qualitative research, data collection and analysis techniques, and review of qualitative research. Students are encouraged to have completed an introductory research methods course prior to enrolling. Introductory Research Methods course taken at the graduate level.

Typically offered in Spring only

AEE 809/YFCS 809 Colloquium in Agricultural and Human Sciences (1 credit hours)
This course will examine the richness and diversity of scholarship in agricultural and human sciences and its applications to professional practice in a colloquium setting. A primary purpose is to build capacities for individual, professional, and civic work as students apply their learning to develop scholarship and professionalism. The course explores advanced topics and research methods and supports students in presenting and defending their research and research proposals. In successive fall semesters, graduate students participate in three, one-credit colloquia that engage faculty and students from across the Department of Agricultural and Human Sciences. This course requires admission to any program of the NC State University Graduate School such as full graduate status, graduate unclassified status, post-baccalaureate studies, evening degree programs, etc.

Typically offered in Fall only

AEE 820 Special Problems in Agricultural and Extension Education (1-6 credit hours)
Exploration of topics of special interest not covered by existing courses by individual students under faculty member’s directions. Readings and independent study, problems or research not related to a thesis.

Typically offered in Fall, Spring, and Summer
AEE 841 Practicum in Agricultural and Extension Education (1-6 credit hours)
Faculty-supervised practicum in an educational, extension or agricultural industry setting.

Typically offered in Fall, Spring, and Summer

AEE 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

AEE 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

AEE 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

AEE 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Fall only

AEE 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Agricultural Economics (ARE)

ARE 104 Agricultural Business Management (3 credit hours)
Insights into the management skills of a successful agribusiness firm manager. A topical approach to analytical and planning techniques applicable to business decisions. Managerial concepts such as financial analysis, budgeting, investment analysis, capital acquisition, financial and risk management of agribusiness firms. HENDRICKSON

Typically offered in Fall, Spring, and Summer

ARE 106 Agri Business Law (3 credit hours)
The application of legal principles to agribusiness. Includes a review of our legal system contracts, real property, personal property torts, business organization, estate planning, and laws affecting agribusiness.

Typically offered in Fall and Spring

ARE 112 Agricultural & Agribusiness Marketing (3 credit hours)
Marketing concepts, techniques and management of the U.S. marketing system from agricultural production, agribusiness, and traditional business perspectives. Broad, basic knowledge of marketing objectives, the marketing environment, strategic planning, marketing information sources, consumer demographics and lifestyle characteristics, product planning, distribution planning, promotion planning, and price planning. PHILLIPS

Typically offered in Fall only

ARE 113 Principles of Salesmanship (3 credit hours)
"How To" course in selling. Understanding customer's behavior, establishing and maintaining customer rapport, and negotiating a sale. Developing sales skills through discussion, role playing and demonstrations. Emphasis on building self-confidence through selling exercises involving class participation, special assignments, and targeted presentations. WEEMS

Typically offered in Fall and Spring

ARE 114 Value Added Agriculture and Niche Marketing (3 credit hours)
Value Added Agriculture and Niche Marketing are ways to increase farm revenue without having to go off farm for employment. This course is designed to provide insights into the opportunities that are available to increase farm revenue, to see what other farms are currently doing with value added within the region, and to create a value added business plan for expanding farm offerings. Site visits are required components of this course. University transportation provided to all site visits. Student transportation (estimated at $30 per student and site visit (estimated at $7 each for 2 sites) fees apply.

Typically offered in Fall only

ARE 115 Agribusiness Accounting (3 credit hours)
Introduction to basic accounting principles and concepts applicable to an agribusiness firm. Exposure to journals, ledgers and financial statements. Topics of the accounting cycle, inventories, payrolls, accounts receivable, income taxes and the potential use of computers. RUSS

Typically offered in Fall, Spring, and Summer

ARE 121 Agricultural Finance (3 credit hours)
Agricultural Finance teaches students introductory concepts for financial management decisions in agricultural/farm businesses. Topics include building a financial control process, developing risk management strategies, and analyzing investment opportunities. Emphasis is on developing skills necessary to create a financial business plan.

Restriction: AGI Only
Typically offered in Fall, Spring, and Summer

ARE 132 Management of Personnel (3 credit hours)
Personnel problems of recruiting, selecting, training, paying, and motivating employees of an agribusiness firm. Improving organizational effectiveness, functioning of a production supervisor, resolution of conflicts and leadership development. PHILLIPS

Typically offered in Fall and Spring
ARE 133 Agricultural & Environmental Policy (3 credit hours)
History of agricultural and environmental policy, policy formation, agricultural programs, effects of agricultural production on the environment, benefits and costs of agricultural and environmental policy, state of the environment, environmental regulations and their enforcement, optimal level of pollution, incentive-based environmental regulation, outlook for agricultural and environmental policy, and the sustainability of agriculture and of the environment. RUSS

Typically offered in Fall, Spring, and Summer

ARE 141 Personal Financial Management (3 credit hours)
Economic analysis of personal decisions related to consumer purchases, time value of money, taxes, financial risk management, investment strategies, retirement planning and estate planning. Relationship of an individual's life cycle to budgeting and financial goals. Background information on wise use of credit, home purchase, life insurance, property insurance, health insurance and investment fundamentals. PHILLIPS

Typically offered in Spring only

ARE 194 International Agribusiness Management Study Abroad (1-6 credit hours)
This course is designed to maximize student potential for success by developing a globally and multi-culturally competent agricultural and agribusiness workforce. This course addresses these issues by providing opportunities for students to study abroad in various locations around the world, with different destinations offered each academic year. Credit hours are variable based on length of travel and classroom instruction pre- and post-travel consistent with NCSU policies and practices. Course may be repeated for credit to visit different destinations only. Significant expenses for travel are involved. Please see the instructor for specific program details.

Typically offered in Spring and Summer

ARE 201/ARE 201A Introduction to Agricultural & Resource Economics (3 credit hours)
Introduction to economic principles of marginal benefits and costs with application to consumer and producer decisions. Functions of market exchange systems in determining prices and quantities and creation of wealth. Property rights and opportunities for exchange. Role of government in dealing with agricultural and resource problems. Macroeconomic analysis including inflation, unemployment, money and banking system. Credit will not be given for both ARE 201 and either EC 201 or EC 205.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

ARE 201/ARE 201A Introduction to Agricultural & Resource Economics (3 credit hours)
Introduction to economic principles of marginal benefits and costs with application to consumer and producer decisions. Functions of market exchange systems in determining prices and quantities and creation of wealth. Property rights and opportunities for exchange. Role of government in dealing with agricultural and resource problems. Macroeconomic analysis including inflation, unemployment, money and banking system. Credit will not be given for both ARE 201 and either EC 201 or EC 205.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

ARE 215 Small Business Accounting (3 credit hours)

Prerequisite: ARE 201 or EC 201 or EC 205
Typically offered in Fall, Spring, and Summer

ARE 220 Marketing and Risk Management in the Pork Industry (1 credit hours)
A comprehensive overview of structure and trends in markets and marketing options available in the swine industry. Management of market risk with hedging or other contracts.

Prerequisite: ANS 150
Typically offered in Spring only

ARE 270 Principles of Agribusiness Entrepreneurship (3 credit hours)
Principles of Agribusiness Entrepreneurship is the first course of three in the Agribusiness Entrepreneurship course sequence. It teaches students the applied entrepreneurship skills needed to identify and create an opportunity in agribusiness and how to

Corequisite: ARE 201
Typically offered in Fall and Spring

ARE 290 Professional Development in Agricultural Business Management (3 credit hours)
This course focuses on establishing professional development foundations for incoming students in Agricultural Business Management. The material emphasizes on diversity in the field and workplace, career exploration, and preparation for internship and work applications. Topics include self-reflection, goal-setting, professional development, resume building, job shadowing, and identity exploration from local, global, and workplace perspectives. Non-scheduled class time for field trips or out-of-class activities are required one day per semester for this class. If transportation will pose a problem for a student, the department will provide transportation. This course is restricted to students in the Agricultural Business Management major or admission by departmental approval.

Restriction: Agricultural Business Management major or departmental approval.
Typically offered in Fall, Spring, and Summer

ARE 295 Special Topics in Agricultural & Resource Economics (200 Level) (1-6 credit hours)
An offering of new freshman to sophomore-level courses on trial basis with topics varying based on offerings. Repetition with different course content acceptable up to 4 times and for a total of 12 units.

Typically offered in Fall, Spring, and Summer
ARE 301/EC 301 Intermediate Microeconomics (3 credit hours)
Functioning of the market economy, role of prices in determining the allocation of resources, the functioning of the firm in the economy, forces governing the production and consumption of economic goods.
Prerequisite: MA 121 or MA 131 or MA 141 and EC 201 or EC 205 or ARE 201
Typically offered in Fall, Spring, and Summer

ARE 303 Farm Management (3 credit hours)
Analytical and planning techniques for making business decisions centered around farm business applications. Economic principles and management concepts such as budgeting, accounting, finance credit, investment analysis, business organization, risk, and taxes as related to practical problems of operating a farm business.
Prerequisite: ARE 201 or EC 201 or EC 205
Typically offered in Fall and Spring

ARE 304 Agribusiness Management (3 credit hours)
Management decision-making by food, fiber, horticulture, and forestry firms. Emphasis on current agribusiness topics such as information utilization, strategic planning, organization structures, competitor intelligence, pricing, leadership, crisis management, ethics, and human resource management. Business communications, agribusiness case studies, and a computerized management simulation game.
Prerequisite: ARE 201 or EC 201 or EC 205
Typically offered in Fall, Spring, and Summer

ARE 306 Agricultural Law (3 credit hours)
Legal principles of practical importance in an agricultural setting: the court system; tort, contract and real and personal property law; legal aspects of organizing an agribusiness; environmental and labor regulations affecting agriculture; income and estate taxation of agriculture. Credit for both ARE 306 and BUS 307 is not allowed
Prerequisite: ARE 201 or EC 201 or EC 205
Typically offered in Fall, Spring, and Summer

ARE 309 Environmental Law & Economic Policy (3 credit hours)
Current federal and state environmental laws and regulations and their common law foundations. Relationship of the law and its regulatory mechanisms to economic policy issues: externalities, pollution taxes, incentives, permit trading, and cost-benefit analysis. Major environmental topics including water and wetlands, solid and hazardous wastes, pesticides, clean air, endangered species and nuisance actions. Overview of the legal system.
Prerequisite: ARE 201 or EC 201 or EC 205
Typically offered in Fall, Spring, and Summer

ARE 311 Agricultural Markets (3 credit hours)
Prerequisite: ARE 201 or EC 201 or EC 205
GEP Social Sciences
Typically offered in Fall only

ARE 312 Agribusiness Marketing (3 credit hours)
Application of marketing and economic principles to decision making in contemporary agribusiness firms. Marketing strategies, marketing research and information, segmentation and targeting, marketing mix, and market plans within food, fiber, natural resource, and production input industries. Professional selling skills and knowledge. Off-campus field experience and visiting lecturers from the agribusiness industry.
Prerequisite: ARE 201 or EC 201 or EC 205
Typically offered in Fall, Spring, and Summer

ARE 321 Agricultural Financial Management (3 credit hours)
Prerequisite: ARE 201 or EC 201 or EC 205
Typically offered in Spring only

ARE 323 Agribusiness Finance (3 credit hours)
ARE 323 teaches the history of monetary systems, the development of business finance tools and banking, and detailed creation and use of business financial statements, including Income Statements, Balance Sheets, and Statements of Cash Flow, within the context of the agribusiness industry. Two Finance courses are offered in the Agribusiness Management Major: ARE 321 - Agricultural Financial Management, which focuses on the history of finance in agriculture and financial planning for farmers and similar independent agricultural enterprises; and ARE 323 - Agribusiness Finance, which focuses on finance for larger agribusinesses and for managers of agribusiness divisions in larger organizations.
Prerequisites: (ARE 201 or EC 201) and (ACC 200 or ACC 210 or equivalent Introductory Accounting Course)
Typically offered in Fall, Spring, and Summer

ARE 332 Human Resource Management for Agribusiness (3 credit hours)
General introduction to human resource management in agribusinesses. Skills for agribusiness owners for efficient productivity from employees in a legal and ethical manner. Topics on labor economics, human resource legislation, employee planning and recruitment, and migrant labor issues. Emphasis on techniques for training, motivating, leading, and disciplining employees.
Prerequisite: ARE 201 or EC 201 or EC 205
Typically offered in Fall, Spring, and Summer

ARE 336/EC 336 Introduction to Resource and Environmental Economics (3 credit hours)
Application of basic economic tools to understand and evaluate environmental/resource policies. Concepts such as property rights, non-market goods, allocation over time, externalities, and public goods. Current policy issues such as global climate change, evaluating natural resource damages from oil spills, reducing the costs of regulations, protecting estuaries, and dealing with non-point source pollution.
Prerequisite: ARE 201 or EC 201 or EC 205
GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring
ARE 404 Advanced Agribusiness Management (3 credit hours)
An advanced course in business planning that integrates the risk and uncertainty associated with production, marketing, and financial management strategies of agribusiness firms. Focuses on the fundamental components required to develop a strategic business plan and design a viable business strategy in the context of the firm’s market and its internal environment. Special attention is given to the application of economic theory and analysis to business decision-making processes. 80% of enrollment is restricted to Agricultural & Resource Economics students with the remaining 20% open for all other majors.
Prerequisite: (ARE 303 or ARE 304), ARE 321, and (ARE 311 or ARE 312)

ARE 425 Contracts and Organizations in Agriculture (3 credit hours)
This course deals with agricultural contracts and organizational structures in agriculture and food industries. The covered material relies on the economic theory to explain observed empirical phenomena. The approach also relies on the use case studies of different contractual arrangements observed in the U.S. agriculture. The content delivery consists of instructor’s lectures, guest lectures and students’ presentations. Grading is based on exams, presentations and a class project.
Prerequisite: ARE/EC 301 or equivalent or instructor’s permission

ARE 433 U.S. Agricultural Policy (3 credit hours)
Government economic policies and programs affecting agricultural inputs and farm products. Analysis of the rationale, objectives, and major types of agricultural programs and their effects on resource allocation and income distribution within agriculture and between agriculture and the rest of the economy.
Prerequisite: ARE(EC) 301

GEP Social Sciences
Typically offered in Fall and Spring
ARE 444 Ethics in Agribusiness  (3 credit hours)
Ethical behavior is a crucial issue in American business, especially after
umerous ethical lapses over the past decade, and for agribusiness
given claims of marketing unhealthy foods, development of genetically-
modified organisms, hiring of undocumented workers, and consolidation
into industrial production facilities. Students are taught ethical theories
and frameworks, used to discuss general ethical questions such as
death, theft, and lying, followed by the more specific agribusiness issues
mentioned above. Students will formulate their own opinions about these
issues, recognize and understand the opinions of others, and be able to
accurately and adequately communicate those opinions.

Typically offered in Fall and Spring

ARE 448 International Agricultural Trade  (3 credit hours)
Study of the economic forces that drive international trade in agriculture,
food, and natural resources. Economic principles, analytical techniques,
and empirical analysis are used to explain international trade and foreign
direct investment in the global marketplace.

Prerequisites: ARE 201 or EC 201 or EC 205 or equivalent.
Typically offered in Fall only

ARE 455 Agribusiness Analytics  (3 credit hours)
Agribusiness Analytics provides and overview and involved application
of analysis and common analytical methods in the agricultural industry.
Emphasis on methods to predict, evaluate, and otherwise inform
agribusiness decision makers.

Prerequisites: ST/BUS 350 or ST 311
Typically offered in Fall only

ARE 470 Agribusiness Entrepreneurship Clinical Skills Development  (3 credit hours)
Agribusiness Entrepreneurship Clinical Skills Development is the
third of three courses in the Agribusiness Entrepreneurship course
sequence. This course teaches students the clinical skills needed to
analyze questions faced by startups and other companies as they
pursue opportunities in agribusiness. Students provide counseling to
agribusiness developers in exchange for experience and an opportunity
to build their business networks. Students will create and execute action
plans with partner companies, conduct research, and develop a written
analysis and recommendations for specific questions posed by the
companies.

Prerequisite: ARE 270 and ARE 370
Typically offered in Fall and Spring

ARE 475 Food Policy  (3 credit hours)
This course will provide students a theoretical basis and empirical tools to
examine U.S. federal, state, and local food policies. Applications covered
will explore contemporary food policy issues such nutrition assistance
programs; regulations governing food safety, food transport and food
trade: alternatives to the conventional food system (i.e. local foods,
urban farming); health and nutritional labeling and claims; and the quickly
evolving policy and legal environment affecting food adulteration, food
fraud, and national food defense.

Prerequisites: ARE 301 or EC 201
Typically offered in Fall, Spring, and Summer

ARE 490 Career Seminar in Agriculture & Resource Economics  (1 credit hours)
Planning and preparing for career choices. Resume writing, networking,
interviewing, personality characteristics, and job searching. Visits
with employer representatives. Employer expectations and career
opportunities. Researching firms and employment opportunities. Oral and
written presentations.

Prerequisite: Sophomore standing
Typically offered in Spring only

ARE 492 External Learning Experience  (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic
framework that utilizes facilities and resources which are external to the
campus. Contact and arrangements with prospective employers must be
initiated by student and approved by a faculty adviser, the prospective
employer, the departmental teaching coordinator and the academic dean
prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

ARE 493 Special Problems/Research Exploration  (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic
framework that utilizes campus facilities and resources. Contact and
arrangements with prospective employers must be initiated by student
and approved by a faculty adviser, the prospective employer, the
departmental teaching coordinator and the academic dean prior to the
experience. Individualized/Independent Study and Research courses
require a Course Agreement for Students Enrolled in Non-Standard
Courses be completed by the student and faculty member prior to
registration by the department.

Prerequisite: ARE Sophomore standing
Typically offered in Fall, Spring, and Summer

ARE 494 Agribusiness Study Abroad  (1-6 credit hours)
Global trade is the largest growth area in American agribusiness, and
knowledge of international agribusiness markets is a primary qualification
desired from college graduates entering the workforce. This course
addresses these issues by providing opportunities for students to study
abroad in various locations around the world, with different destinations
offered each academic year. Credit hours are variable based on length
of travel and classroom instruction pre-and post-travel consistent with
NCSU policies and practices. Course may be repeated for credit to visit
different destinations only. Significant expenses for travel are involved.
Please see the instructor for specific program details.

GEP Global Knowledge
Typically offered in Spring only

ARE 495 Special Topics in Agricultural and Resource Economics  (1-6 credit hours)
Presentation of material not normally available in regular course offerings
or offering of new courses on a trial basis.

ARE 590 Special Topics in ARE  (1-99 credit hours)
Special Topics in ARE
Agricultural Institute (AGI)

AGI 100 Enhancing Academic Success (1 credit hours)  
This course is designed to introduce students to strategies for effective learning that will help them succeed at NC State University and in their future careers. Students will have the unique opportunity to participate in a class format that focuses on typical learning success strategies.  
Typically offered in Fall and Spring

AGI 101 Introduction to the Agricultural Institute (1 credit hours)  
Introduction to the collegiate experience; academic skills of successful students; curricula of the Agricultural Institute; career opportunities of graduates; introduction to computers.  
Requisite: Agricultural Institute Only  
Typically offered in Fall and Spring

AGI 120 Spanish For AG Stu (3 credit hours)  
This is an introductory conversational Spanish course specifically designed for agricultural students. The main goal of this course is to give students some basic grammatical and communication skills so that they will be able to interact with Spanish speaking people.  
Requisite: Agricultural Institute Only  
Typically offered in Fall only

AGI 191 Professional Development (1 credit hours)  
Professional Development is designed to introduce students to various skills (as identified by current research) that employers feel are important for prospective employers to have. This course will provide students the opportunity to develop and practice these skills.  
Typically offered in Fall, Spring, and Summer

AGI 192 AGI External Learning Experience (1-3 credit hours)  
Learning experience in one of the six majors in the Agricultural Institute that utilizes facilities and resources external to the campus. Students can choose from multiple external learning experiences. Students who complete an external learning experience will be able to interact with Spanish speaking people.  
Prerequisite: Agricultural Institute Only and AGI 191  
Typically offered in Fall, Spring, and Summer

AGI 193 AGI Special Problems and On-campus Learning (1-6 credit hours)  
Learning experience in one of the eight majors in the Agricultural Institute that utilizes facilities and resources on the campus. (Contact with the project supervisor must be initiated by student and approved by the faculty adviser and the Director of the project.)  
Prerequisite: Agricultural Institute Only  
Typically offered in Fall, Spring, and Summer

AGI 194 International Learning Experience in AGI (1-6 credit hours)  
Course offered as needed for international learning experiences in the Agricultural Institute involving international travel and immersion in an international culture. A written report is required and student must identify a faculty member to work with.  
Requisite: Agricultural Institute Only  
Typically offered in Spring only

AGI 195 Special Topics in the Agricultural Institute (1-4 credit hours)  
Timely topical courses or experimental course offerings in the Agricultural Institute.  
Requisite: Agricultural Institute Only  
Typically offered in Fall, Spring, and Summer

Agriculture and Life Sciences (ALS)

ALS 103 Freshman Transitions and Diversity in Agriculture & Life Sciences (1 credit hours)  
Introduction to scope and objectives of university education. Overview of curricula, academic requirements, and career opportunities in agriculture and life sciences. Overview of campus resources and support services. Discussion of expectations for academic and career success including professionalism, diversity, and inclusiveness. Restricted to CALS majors of freshman or sophomore status. Students will not receive credit for both ALS 103 and ALS 303.  
Prerequisite: CALS Majors with less than 30 Credit Hours  
GEP U.S. Diversity  
Typically offered in Fall and Spring

ALS 110 Academic and Career Skills Seminar (1 credit hours)  
Students learn about the career decision-making process through integration of self-knowledge. Emphasis is placed on Agriculture and Life Sciences careers. Students assess interests, values, skills and personal strengths while learning about a variety of campus and career resources.  
Prerequisite: Ag and Life Science Majors  
Typically offered in Fall and Spring

ALS 303 Transfer Transitions and Diversity in Agriculture & Life Sciences (1 credit hours)  
Introduction to scope and objectives of university education. Overview of curricula, academic requirements, and career opportunities in agriculture and life sciences. Overview of campus resources and support services. Discussion of expectations for academic and career success including professionalism, diversity, and inclusiveness. Restricted to CALS majors with 30 or more credit hours completed. Students will not receive credit for both ALS 103 and ALS 303.  
R: CALS Majors >30 credits  
GEP U.S. Diversity  
Typically offered in Fall and Spring

ALS 398 Agriculture and Life Sciences Honors Seminar (2 credit hours)  
A seminar/discussion honors course with emphasis on a team approach to scientific research into topics that link science with issues in society; exposure to leadership skills and bioethics; requirement of detailed written or oral reports; career development.  
Prerequisite: Enrollment by invitation for sophomores or juniors in CALS with GPA 3.35 or higher.  
Typically offered in Spring only
ALS 494  International Learning Experience in Agriculture and Life Sciences  (1-6 credit hours)
Course offered as needed for international learning experiences in agriculture and life sciences involving international travel and immersion in an international culture. Travel expenses may be incurred by the student. Departmental Approval Required. Students will need to complete a program application through the NC State Study Abroad Office. Students enrolled in the summer will be required to take a one credit hour lecture section of ALS 494 in the spring of the same year. Department approval required, enroll with instructor's permission.

GEP Global Knowledge
Typically offered in Fall, Spring, and Summer

ALS 495  Special Topics in Agriculture and Life Sciences  (1-3 credit hours)
Offered as needed to present material not normally available in regular departmental course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

ALS 496  International Research Experience  (3 credit hours)
This summer research experience will provide students with the opportunity to sharpen their research skills while working side-by-side with scientists at international research stations. Students will conduct lab and/or field research depending on their

Typically offered in Fall, Spring, and Summer

ALS 498  Honors Research or Teaching I  (1-3 credit hours)
Honors research or teaching for students in Agriculture and Life Sciences. First of a two-course sequence. Identification of a project and development of a proposal; literature search, planning, and work initiation. A maximum of 6 credits for ALS 498 & ALS 499 combined. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: ALS 398, GPA 3.35 or higher
Typically offered in Fall, Spring, and Summer

ALS 499  Honors Research or Teaching II  (1-4 credit hours)
Honors research or teaching for students in Agriculture and Life Sciences. Completion of work initiated in ALS 498. Analysis of results. Preparation and presentation of written and oral reports. A maximum of 6 credits for ALS 498 and ALS 499 combined.

Prerequisite: ALS 498, GPA 3.35 or higher
Typically offered in Fall, Spring, and Summer

ALS 602  Preparing for a Career in Agriculture and the Life Sciences  (1 credit hours)
This course provides graduate students with techniques, strategies, and opportunities to practice and develop skills beneficial to their professional development and transition from school to career. The course focuses on six competencies known to contribute to success in the workforce: teamwork and collaboration; oral communication; career management and self-development; giving and accepting feedback; global/intercultural fluency; and organizing, prioritizing, and delegating work. Students will examine their life trajectory to date and create a 5-year plan for personal and professional success; and be equipped with an understanding of the steps necessary to accomplish their professional goals.

Typically offered in Spring only

Animal Science (ANS)

ANS 101  Introduction to Livestock and Poultry Industries  (3 credit hours)
General introduction to nutrition, reproduction, breeding, management and description of marketing channels of animals and poultry. Equates live animal and carcass characteristics with market specifications. Factors of pre- and post-slaughter treatment are related to the shelf life of fresh and processed meats. MCCRAW/GREGORY

Requisite: Agricultural Institute Only
Typically offered in Fall only

ANS 102  Animal Feeds and Nutrition  (3 credit hours)
Basics of animal nutrition and feeding. Identification and classification of common feedstuffs, including relative nutritional value for livestock and poultry. General nutrition and changes in requirements as influenced by production and the animal's life cycle. Applied aspects of feeding and nutrition of livestock and poultry. Agricultural Institute Students Only (Class= 01 or 02).

Requisite: Agricultural Institute Only
Typically offered in Fall only

ANS 103  Beef Production  (3 credit hours)
Genetics, reproduction, nutrition, animal health, forage management and marketing channels as related to beef cattle enterprises.

Requisite: Agricultural Institute Only
Typically offered in Fall only

ANS 104  Swine Production  (4 credit hours)
Management principles associated with swine production. Primary emphasis on interactions of health, equipment, nutrition, reproduction and genetics during nurserly, finishing, farrowing and breeding phases of production. Management of farrowing, finishing and farrow to finish operations. Emphasis on management kills, computer applications and economics.

Requisite: Agricultural Institute Only
Typically offered in Fall only

ANS 105  Introduction to Companion Animal Science  (3 credit hours)
Companion animals are often considered family members. This course surveys the variation available in companion animals (dog breeds, cat breeds, fish, reptiles, amphibians, rabbits, pet pigs, ferrets, hamsters, gerbils, mice, rats, birds & newer pets such as hedgehogs, prairie dogs & sugar gliders) and then examines related human and animal issues in more depth. Biological explanations are stressed for understanding disease states and normal behaviors of companion animals. These explanations are discussed from the point of view of problem behaviors in the average home housing these animals. This course will help educate the students about companion animals so that both the animals and their human families will be happier and more productive members of society. ANS 105 will enable students to pick the pet or specific breed that is best for them so that pets and owners stay together. Restricted to Freshmen and Sophomores.

Restriction: Freshmen & Sophomores only
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer
**ANS 110 Introduction to Equine Science** (3 credit hours)
Introduction to Equine Science is a course designed for Freshmen and Sophomores of any major. There are no pre-requisites for this course. We will discuss terminology, impact of horses on history and society, breeds, uses, management, genetics, reproduction, health, nutrition, behavior, and business aspects of the horse industry. Restricted to Freshmen and Sophomores.

Prerequisite: Freshman standing or Sophomore standing
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

**ANS 150 Introduction to Animal Science** (3 credit hours)
Introduction to the principles and physiology of animal management, the contributions of animals and animal products to humanity, the application of science to animal production, and issues regarding animal production. The course includes biological aspects of animal science such as animal behavior, anatomical and physiological aspects of reproduction and nutrition, animal breeding and genetics, and human/animal interactions. Normal management and production techniques (including proper terminology) as well as social issues and current events related to livestock, equines, and companion mammals are discussed. Prerequisite: None. Course is 3 credits. Class meets Monday, Wednesday, and Friday 8:30 to 9:20 am in Fall and Spring. Internet only during the Summer. Fall semesters are restricted to new incoming Animal Science Freshmen. Open to all students in Spring and Summer.

Typically offered in Fall, Spring, and Summer

**ANS 151 Introduction to Animal Science Lab** (1 credit hours)
Hands-on experience and demonstrations with livestock and horses; identification of common management equipment and knowledge of proper use; animal tracts, organs, skulls, feeds, breeds, and other animal-related items or topics. The lecture (ANS 150) must be taken concurrently or have been passed previously with a C-minus or higher. This lab course is restricted to the following majors: Animal Science, Ag Extension, Ag Science, and Ag Education. Transportation is provided to the off-campus labs, and students will be returned to campus prior to the end of the scheduled lab period.

Corequisite: ANS 150; R: Animal Science or Ag Extension or Ag Science or Ag Education majors
Typically offered in Fall and Spring

**ANS 201 Techniques of Animal Care** (2 credit hours)
A laboratory course in the applied management of beef cattle, dairy cattle, equine, swine and small ruminants with required participatory assignments of common techniques utilized in livestock production. These techniques include but are not limited to castration, animal ID, and hoof trimming. Most of course will be held at the various Teaching Educational Units and will be held outdoors. Therefore, students should arrive for the course dressed appropriately for the lab activities and weather conditions of each day. Students will be working with animals, which comes with an inherent risk of injury. Students will be instructed on safety measures at the beginning of the semester and before each lab. Transportation will be provided to the scheduled course meetings but students will be required to provide their own transportation to the Teaching Educational Units for required assignments outside of class time.

Prerequisite: ANS 150 and ANS 151 (all ANS Majors) or ANS 101 (Ag Institute Livestock, Poultry Mgmt Program; Restriction: Junior or Senior Animal Science majors
Typically offered in Fall and Spring

**ANS 205 Physiology of Domestic Animals** (3 credit hours)
This course is designed to introduce students to mammalian physiology (structure and function) with emphasis on livestock species. Students will gain a basic understanding of body systems including circulatory, muscular, skeletal, digestive, and reproductive systems and functions of those systems with relevance to the whole animal and maintenance of homeostasis.

Prerequisite: (BIO 181 or BIO 183) and Sophomore standing
Typically offered in Fall, Spring, and Summer

**ANS 206 Anatomy of Domestic Animals Lab** (1 credit hours)
This lab course is designed for Animal Science majors to take with the ANS 205 lectures (Physiology of Domestic Animals). Students will learn to identify major anatomical and cellular structures from domestic animal (livestock) specimens through examin

Corequisite: ANS 205
Typically offered in Fall and Spring

**ANS 208/PB 208/AEE 208 Agricultural Biotechnology: Issues and Implications** (3 credit hours)
Trends and issues of agricultural biotechnology in today's society are addressed while covering the basic biological science behind the technology. Applications of and policy issues associated with plant, animal, and environmental biotechnology used in the agricultural industry are examined from an interdisciplinary approach.

Prerequisite: (BIO 105 or BIO 115 or BIO 181 or BIO 183) GEP Interdisciplinary Perspectives
Typically offered in Spring and Summer

**ANS 215/HS 215 Agricultural Genetics** (3 credit hours)
To provide an introduction to the science of genetics as applied to agriculture. Emphasis is given to qualitative and quantitative genetics. By the end of this course, students should be able to apply genetic concepts to efficiently solve problems and make predictions necessary for "real-life" agricultural situations.

Prerequisite: BIO 183 or equivalent or instructor's consent
GEP Natural Sciences
Typically offered in Fall only

**ANS 220 Reproductive Physiology** (3 credit hours)
Biological processes in reproduction and lactation with emphasis on domestic mammals such as cattle, sheep, horses, swine, dogs, and cats. Environmental and genetic factors that affect these processes. Identification, evaluation and solutions of problems in these physiological areas.

Prerequisite: ANS 205 or BIO 250 or ZO 250
Typically offered in Fall and Spring

**ANS 221 Reproductive Physiology Lab** (1 credit hours)
ANS 221 is a laboratory course that introduces students to the application of principles of reproduction and lactation in domestic mammals. Students must have either completed or concurrently be enrolled in ANS 220. This course is restricted to Animal Science majors (SAS, IAS).

Corequisite of ANS 220
Typically offered in Fall and Spring
ANS 225 Principles of Animal Nutrition (3 credit hours)
This online Principles of Animal Nutrition course is designed for non-Animal Science majors and off-campus students. It includes: feed classification, gastrointestinal tract anatomy of domestic mammals, nutrients and their functions, digestion and metabolism, feed regulations, and feeding/nutrition of cattle, small ruminants, horses, swine, poultry, dogs, cats, and rabbits. For on-campus students, ANS 225 counts toward the Animal Science minor but only counts as a Free Elective for Animal Science majors.

Typically offered in Summer only

ANS 230 Animal Nutrition (3 credit hours)
Introduction to nutrition, digestion, and absorption in domestic mammals. Major nutrient classes and their functions in the body, feed classification and chemical analysis, feed processing, and nutrient requirements.

Prerequisite: ANS 150 or BIO 183; ANS 205 is also recommended.

Typically offered in Fall and Spring

ANS 231 Animal Nutrition Lab (1 credit hour)
ANS 231 is a laboratory course that introduces students to the application of principles of nutrition and applied feeding of domestic mammals. Students must have either completed or concurrently be enrolled in ANS 230. This course is restricted to Animal Science Majors (SAS, IAS).

Corequisite: ANS 230
Typically offered in Fall and Spring

ANS 240/ANS 240A Livestock Merchandising (3 credit hours)
This course is designed to acquaint students with different methods for merchandising livestock and with strategies for adding value to products produced from livestock. Students will learn new ways to promote a farming operation. Required visits to Ani

Prerequisite: ANS 150; Restrictive Statement: Students must be Juniors or Seniors
Typically offered in Spring only

ANS 240A/ANS 240 Livestock Merchandising (3 credit hours)
This course is designed to acquaint students with different methods for merchandising livestock and with strategies for adding value to products produced from livestock. Students will learn new ways to promote a farming operation. Required visits to Ani

Prerequisite: ANS 150; Restrictive Statement: Students must be Juniors or Seniors
Typically offered in Spring only

ANS 260 Basic Swine Science (2 credit hours)
Basic disciplines and concepts involved in swine production including: industry structure, trends and statistics; production phases and buildings; genetic improvement; reproduction; nutrition; health and biosecurity; nutrient management; marketing, meat quality, and career opportunities in the swine industry.

Restriction: Non-ANS (Animal Science) students only. ANS students cannot take this course for credit.

Typically offered in Spring only

ANS 261 Swine Health and Biosecurity (1 credit hour)
Introduction and basic overview of the immune system, swine disease transmission and pathobiology, standard biosecurity protocols, identification of disease in pigs, basic treatment administration, and disease prevention.

Prerequisite: ANS 150 or equivalent
Typically offered in Spring only

ANS 262 Swine Breeding and Gestation Management (1 credit hour)
Management principles associated with breeding and gestation in swine. Emphasis on reproductive anatomy and physiology of boars and sows, development of replacement animals, semen production and evaluation, artificial insemination, and use of reproductive records. Extensive use of reproductive case studies.

Prerequisite: ANS 150 or equivalent
Typically offered in Spring only

ANS 263 Farrowing Management (1 credit hour)
Advanced integration and application of factors important in the proper care and management of swine during farrowing and lactation.

Prerequisite: ANS 150 or equivalent
Typically offered in Spring and Summer

ANS 264 Swine Nursery and Finishing Management (1 credit hour)
Overview of the critical management, housing, and financial considerations relevant to the successful operation of a swine nursery, grow-finish, or wean to finish enterprise.

Prerequisite: ANS 150 or equivalent
Typically offered in Spring and Summer

ANS 265 Contemporary Issues in the Swine Industry (1 credit hour)
Overview of current issues affecting pork production in the United States, including, but not limited to: environment, Swine welfare and profitability/market issues. Development of skills to promote animal agriculture when dealing with the media and general public.

Prerequisite: ANS 150 or equivalent
Typically offered in Spring only

ANS 266 Swine Environment Management (1 credit hour)
Course includes response of swine to thermal environment ventilation system design and analysis, heating and cooling, systems and examples of various designs for all phases of production. Troubleshooting and energy analysis will be included as well.

Prerequisite: ANS 150 or equivalent
Typically offered in Fall only

ANS 267 Swine Manure and Nutrient Management (1 credit hour)
Course includes manure production rates, manure handling systems, storage and manure management planning for land applications. Some odor mitigation technologies will be covered.

Prerequisite: ANS 150 or equivalent
Typically offered in Spring only
ANS 268 Employee Management for the Swine Industry (1 credit hour)
Effective employee management in swine production units. Principles, policies, and practices related to hiring, development and retention of employees, as well as fundamental organizational management.

Prerequisite: ANS 150 or equivalent
Typically offered in Fall only

ANS 269 Internship in the Swine Industry (1 credit hour)
Experiential learning in the swine industry through opportunities that provide hands-on experience and exposure to the scope of pork enterprises. Students can expect to apply principles and practices already learned, and add practical experience to their skill sets and knowledge base. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: ANS 150 or equivalent
Typically offered in Summer only

ANS 270 Pork Export Markets from a Swine Production Perspective (1 credit hour)
Introduction to global markets; cultural preferences and customs associated with the global swine industry. International trade regulations and potential impact of foreign animal diseases and bioterrorism affecting the U.S. swine industry.

Prerequisite: ANS 150 or equivalent
Typically offered in Summer only

ANS 271 Swine Nutrition (1 credit hour)
Principles involved with developing and implementing a swine feeding program, including fundamentals of feeding pigs, understanding nutrients used in pig diets, factors affecting nutrient recommendations, feeding systems for pigs, feed ingredients, and formulation of swine diets.

"Restriction: Restricted to non-ANS (Animal Science) students. ANS students cannot take the course for credit."
Typically offered in Fall only

ANS 281 Professional Development of PreVeterinary Track Students (1 credit hour)
This course introduces PreVeterinary track students to the scope of the veterinary profession and to current issues affecting veterinary professionals. The course will help students gain an understanding of the professional requirement of the veterinary profession.

Prerequisite: ZO 160 or BIO 125 or BIO 181 or BIO 183
Typically offered in Spring only

ANS 290 Professional Development for Animal Science Careers (2 credit hours)
This course will teach students how to navigate the career decision-making process to make an informed decision and discuss career options in the field of Animal Science. The course will also help students evaluate and develop their professional compete

Animal Science Majors Only
Typically offered in Fall and Spring

ANS 303 Principles of Equine Evaluation (2 credit hours)
Students will learn about and apply methods for evaluating conformation and function of performance and halter horses, soundness, breed standards, rules and regulations for evaluation, selection, and performance. Guest lecturers and field trips.

Prerequisite: ANS 150 or ANS 110
Typically offered in Spring only

ANS 304 Dairy Cattle Evaluation (2 credit hours)
The first half of this course covers basic aspects of dairy cattle breeds, dairy character, form and function including type traits and linear scoring of dairy cattle, interpreting and using judging scorecards, comparing/evaluating dairy cattle, and placing animals in a class. The second half of the course develops the student's ability to correctly evaluate dairy cattle classes, but more importantly to support their opinions through oral communication.

Prerequisite: ANS 150
Typically offered in Spring only

ANS 309 Livestock Evaluation (3 credit hours)
Students will be exposed to basic concepts associated with growth, development and value determination of livestock. Familiarization with official USDA grading standards for cattle, sheep, swine and goats is emphasized. Introduction to judging terminology, placing classes of livestock and justification through oral reasons.

Prerequisite: ANS 150
Typically offered in Spring only

ANS 322/FS 322/PO 322 Muscle Foods and Eggs (3 credit hours)
Processing and preserving fresh poultry, red meats, seafood, and eggs. Ante- and post-mortem events as they affect quality, yield, and compositional characteristics of muscle foods. Principles and procedures involved in the production of processed meat items.

Prerequisite: ANS 150 or ANS 110
Typically offered in Fall only

ANS 324/FS 324 Milk and Dairy Products (3 credit hours)
Introduction to the manufacture of dairy products. Dairy processing procedures from the farm, through the dairy plant, and to the consumer are studied. The course consists of 15 learning modules, three exams, and a project.

Prerequisite: BIO 181 or 183, CH 101
Typically offered in Fall only

ANS 330 Laboratory Animal Science (3 credit hours)
A sophomore to senior level course designed to cover the basics of laboratory animal science, a specialty dealing with the use of vertebrate animal species in intensive research. Some topics to be covered are: husbandry, facility management, animal health and welfare, diagnostics, surgical area management, research methods and administrative duties. Students will use the material for studying for the certification as a Laboratory Animal Technician via the American Association For Laboratory Animal Science (AALAS). A separate fee is required for certification; this fee is not covered by tuition for ANS 330. Must hold sophomore standing or higher.

Typically offered in Spring only
ANS 395 Animal Science Study Abroad (1-6 credit hours)
This course provides an international perspective on animal management, conservation and various animal-related industries by allowing students to study abroad in various locations around the world, with different destinations offered each academic year. Credit hours are variable based on length of travel and classroom instruction pre- and post-travel consistent with NCSU policies and practices. Course may be repeated for credit to visit different destinations only. Significant expenses for travel are involved. Please consult with the instructor or the Study Abroad Office for specific program details.

GEP Global Knowledge
Typically offered in Fall, Spring, and Summer

ANS 400 Companion Animal Management (3 credit hours)
Anatomy, physiology, nutrition, genetics, and health of companion animals including cats, dogs, rabbits, rats, mice, reptiles, amphibians, and fish. Problem solving and enterprise management skills in laboratories.

Prerequisite: ANS 105 and Junior standing
Typically offered in Spring only

ANS 402 Beef Cattle Management (3 credit hours)
ANS 402 integrates technical information from nutrition, reproduction, genetics, physiology, and animal welfare into management decisions that will enhance a beef cattle operation. Students will engage in beef cattle and environmental management and varied communication formats to explore relationships between sectors of the beef industry from cow-calf to the consumer.

Prerequisite: ANS 150, Junior standing
Typically offered in Spring only

ANS 403 Swine Management (3 credit hours)
Management principles associated with swine production. Emphasis on interactions of health, equipment, nutrition, reproduction and genetics during nursery, finishing, farrowing and breeding phases of production. Waste management practices and alternatives, development of marketing strategies and economic evaluation of management practices.

Prerequisite: ANS 150; Restrictive Statement: Students must be Juniors or Seniors
Typically offered in Fall only

ANS 404 Dairy Cattle Management (3 credit hours)
In ANS 404, students will develop a better understanding of dairy cattle management with an emphasis on the impact of decisions on productivity, health, profitability, and the future of the dairy enterprise.

Prerequisite: ANS 150, Junior standing
Typically offered in Spring only

ANS 408 Small Ruminant Management (3 credit hours)
Principles and practices of production, management, and marketing of sheep and goats. Role of genetics, nutrition, reproduction and animal health. Hands-on experience and field trips during labs.

Prerequisite: ANS 150, Junior standing
Typically offered in Fall only

ANS 410 Equine Breeding Farm Management (3 credit hours)
Equine anatomy, physiology, nutrition, genetics and health. Laboratory emphasis on reproductive management, breeding, problem solving, and management skills. Field trips required.

Prerequisite: ANS 110 and Junior standing
Typically offered in Spring only

ANS 411 Management of Growing and Performance Horses (3 credit hours)
This course is an overview of scientific applications used in management of growing and performance horses. Topics include: nutrition and feeding, disease prevention, exercise conditioning, and methods of evaluation and selection. Students required to provide their own transportation to labs. Must hold junior or senior standing.

Prerequisite: ANS 110
Typically offered in Fall only

ANS 415/NTR 415/PO 415/PO 515/NTR 515/ANS 515 Comparative Nutrition (3 credit hours)
Principles of nutrition, including the classification of nutrients and the nutrient requirements of and metabolism by different species for health, growth, maintenance and productive functions.

Prerequisite: ANS 225 or ANS 230 or CH 220 or CH 223 or CH 227
Typically offered in Fall, Spring, and Summer

ANS 425/FM 425/PO 425/NTR 525/FM 525/ANS 525/PO 525/NTR 425 Feed Manufacturing Technology (3 credit hours)
Feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture.

Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225
Typically offered in Fall, Spring, and Summer

ANS 440/ANS 540 Animal Genetic Improvement (3 credit hours)
Modern evaluation and selection procedures for domestic animals; selection goals, estimation of breeding values and performance testing; their impact on genetic changes.

Prerequisite: (ANS/HS 215 or GN 311) and (ST 311 or ST/BUS 350) and Junior standing
Typically offered in Fall and Summer

ANS 452/ANS 552/PHY 552/PHY 452 Comparative Reproductive Physiology and Biotechnology (3 credit hours)
Comparative approach to examining aspects of reproductive physiology in selected vertebrate species. Detailed examination of current reproductive biotechnologies and ethical issues associated with the application of reproductive biotechnologies. Credit

Prerequisite: ANS 220
Typically offered in Fall only

ANS 453/ANS 553 Physiology and Genetics of Growth and Development (3 credit hours)
Introduction to the basic concepts of growth with emphasis on domestic mammals. Growth of the major classes of animal tissues and regulation by endogenous and exogenous factors. Relationship to efficiency of animal production. Credit will not be give

Typically offered in Fall only
ANS 454/NTR 454/ANS 554  Lactation, Milk and Nutrition  (3 credit hours)
Nutritional properties of milk as a high-quality food with nutritional diversity. Principles of physiology, biochemistry and cell biology in the mammary gland. Procedures of milk production and milk collection for milk quality and nutrition. Human lactation vs. that of domestic animals. Impacts of biotechnology and food safety on dairy production. Credit will not be given for both ANS 454 and 554.
Prerequisite: ANS 230 or FS/NTR 400; BCH 451 or ZO 421
Typically offered in Spring only

ANS 480  Judging Team  (1 credit hours)
Students practice judging techniques for livestock, horses, or dairy animals, including ranking animals and providing oral reasons to defend the rankings. Students meet weekly with a coach to practice locally and will also travel to compete in one or two regional or national competitions. Each team (livestock, horse, dairy) is expected to raise funds to finance the trips. Students earn 1 credit for being on a team, and can earn up to 3 credits of Free Elective for ANS 480 by serving on the judging team for different species. Field trips that last several days are required. Departmental Approval Required. Course may be taken up to 3 times (once per species).
Prerequisite: ANS 303 or ANS 304 or ANS 309
Typically offered in Fall only

ANS 492  Professional Internship Experience in the Animal Sciences  (1-3 credit hours)
This course provides an opportunity for students to gain real-world experience relevant to their academic and career goals. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience. The experience must be arranged by the student and approved by the Department of Animal Science prior to the start of the experience. To gain approval, a student must submit the completed ANS 492 contract and have it approved by his/her experience supervisor, academic advisor and the ANS 492 coordinator. In addition to the work described in the contract, a student will complete a series of reflective assignments during and at the end of the experience.
Typically offered in Fall, Spring, and Summer

ANS 493  Research Experience in the Animal Sciences  (1-3 credit hours)
This course provides an opportunity for students to gain real-world experience in a scientific research program. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience. The experience must be arranged by the student and approved by the Department of Animal Science prior to the start of the experience. To gain approval, a student must submit the completed ANS 493 contract and have it approved by his/her experience supervisor, academic advisor and the ANS 493 coordinator. In addition to the work described in the contract, a student will complete a series of reflective assignments during and at the end of the experience.
Typically offered in Fall, Spring, and Summer

ANS 494  Teaching Experience in the Animal Sciences  (1-3 credit hours)
This course provides an opportunity for students to gain experience with some aspect of teaching, including: leading or facilitating lessons, producing educational resources, or education research. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience. The experience must be arranged by the student and approved by the Animal Science Department prior to the start of the experience. To gain approval, a student must submit the completed ANS 494 contract and have it approved by his/her research supervisor, academic advisor and the ANS 494 coordinator. If the experience involves education research, the research mentor is encouraged to require a research paper or poster presentation as part of the work expectations when appropriate. In addition to the work described in the contract, a student will complete a series of reflective assignments during and at the end of the experience.
Typically offered in Fall, Spring, and Summer

ANS 495  Special Topics in Animal Science  (1-3 credit hours)
Offered as needed to present material not normally available in regular course offerings or for offering of new courses on a trial basis.
Typically offered in Fall, Spring, and Summer

ANS 515/ANS 415/NTR 415/PO 415/PO 515/NTR 515  Comparative Nutrition  (3 credit hours)
Principles of nutrition, including the classification of nutrients and the nutrient requirements of and metabolism by different species for health, growth, maintenance and productive functions.
Prerequisite: ANS 225 or ANS 230 or CH 220 or CH 223 or CH 227
Typically offered in Fall, Spring, and Summer

ANS 525/PO 525/NTR 425/ANS 425/FM 425/PO 425/NTR 525/ FM 525  Feed Manufacturing Technology  (3 credit hours)
Feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture.
Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225
Typically offered in Fall, Spring, and Summer

ANS 530  Advanced Applied Animal Reproduction  (3 credit hours)
Current reproductive management techniques for each of the major mammalian livestock species. Enable students to develop reproductive decision making skills. Must hold graduate status.
Prerequisite: ANS 220
Typically offered in Spring only

ANS 531  Advanced Applied Animal Reproduction Lab  (1 credit hours)
Practical experience in routine reproductive management techniques discussed in ANS 530. Must hold graduate status.
Prerequisite: ANS 220, Corequisite: ANS 530
Typically offered in Spring only
ANS 540/ANS 440 Animal Genetic Improvement (3 credit hours)
Modern evaluation and selection procedures for domestic animals;
selection goals, estimation of breeding values and performance testing;
their impact on genetic changes.
Prerequisite: (ANS/HS 215 or GN 311) and (ST 311 or ST/BUS 350) and
Junior standing
Typically offered in Fall and Summer

ANS 550/NTR 550 Applied Ruminant Nutrition (3 credit hours)
Applied concepts in ruminant nutrition for the practicing agricultural
professional. Protein, energy, vitamin and mineral nutrition in relation
to the nutritional needs and practical feeding of beef cattle, dairy cattle,
sheep, and goats. New developments in feeding systems, feed additives
and the prevention and treatment of metabolic disorders. Emphasis on
solving problems in case studies. Permission given to undergraduates
Prerequisite: ANS 230 or ANS(NTR,PO) 415. Permission given to
undergraduates
Typically offered in Fall only

ANS 552/PHY 552/PHY 452/ANS 452 Comparative Reproductive
Physiology and Biotechnology (3 credit hours)
Comparative approach to examining aspects of reproductive physiology
in selected vertebrate species. Detailed examination of current
reproductive biotechnologies and ethical issues associated with the
application of reproductive biotechnologies. Credit
Prerequisite: ANS 220
Typically offered in Fall only

ANS 553/ANS 453 Physiology and Genetics of Growth and
Development (3 credit hours)
Introduction to the basic concepts of growth with emphasis on domestic
mammals. Growth of the major classes of animal tissues and regulation
by endogenous and exogenous factors. Relationship to efficiency of
animal production. Credit will not be give
Typically offered in Fall only

ANS 554/ANS 454/NTR 454 Lactation, Milk and Nutrition (3 credit hours)
Nutritional properties of milk as a high-quality food with nutritional
diversity. Principles of physiology, biochemistry and cell biology in the
mammary gland. Procedures of milk production and milk collection for
milk quality and nutrition. Human lactation vs. that of domestic animals.
Impacts of biotechnology and food safety on dairy production. Credit will
not be given for both ANS 454 and 554.
Prerequisite: ANS 230 or FS/NTR 400; BCH 451 or ZO 421
Typically offered in Spring only

ANS 561/NTR 561 Equine Nutrition (3 credit hours)
This course explores concepts in equine nutrition including digestive
physiology of horses, nutrient requirements for different classes of horses
and feed management. Ration evaluation and balancing, as well as
problem solving will be a core component to this course.
Prerequisite:NTR 500 or NTR/FS 501 or NTR/PO 515
Typically offered in Spring only

ANS 565/NTR 565 Advanced Canine and Feline Nutrition (3 credit hours)
This course is about the advanced principles of nutrition within canines
and felines. The course focuses on the unique gastro- intestinal tracts for
the two species as well as their specific nutrient requirements and how
the animal industry addresses th
Restriction: Graduate Student or Senior with 3.35 GPA; Prerequisite:
400-level Nutrition Course
Typically offered in Fall only

ANS 571/BCH 571 Regulation of Metabolism (3 credit hours)
Study of hormonal, enzymatic and molecular-genetic regulation of
carbohydrate and lipid metabolism; emphasis on mammalian species.
Prerequisite: BCH 451, GN 311, a course in physiology, cell biology
Typically offered in Fall only

ANS 575 Current Topics in Genomics and Proteomics in Animal
Science (3 credit hours)
The objective of this course is to provide students with an integrated
exposure to the major current concepts in genomics and proteomics.
Genomic and proteomic methods will be covered at a level that will allow
students to read and comprehend articles
Prerequisite: ANS 215 or GN 411
Typically offered in Spring only

ANS 590 Topical Problems in Animal Science (1-3 credit hours)
Selection or assignment of special problems in various phases of animal
science.
Typically offered in Fall and Spring

ANS 601 Animal Science Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty
members, graduate students and visiting lecturers.
Typically offered in Fall and Spring

ANS 603 Reproductive Physiology Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty
members, graduate students and visiting lecturers.
Typically offered in Fall and Spring

ANS 604 Animal Breeding and Genetics Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty
members, graduate students and visiting lecturers.
Typically offered in Fall and Spring

ANS 610 Topical Problems in Animal Science (1-6 credit hours)
Selection or assignment of special problems in various phases of animal
science.
Typically offered in Fall, Spring, and Summer

ANS 641 Practicum in Animal Science (1-3 credit hours)
Typically offered in Fall and Spring

ANS 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the
student in planning for the teaching assignment, observe and provide
feedback to the student during the teaching assignment, and evaluate the
student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall and Spring
Typically offered in Spring only
Prerequisite: GN 311 and ST 512
and selection procedures in producing superior genetic populations.

ANS 708/GN 708
Genetics of Animal Improvement (1-6 credit hours)
Emphasis on the utilization of basic principles of population and quantitative genetics in animal improvement. Factors affecting genic and genotypic frequencies and methods of estimating genetic and nongenetic variance, heritabilities and breeding values. The roles of mating systems and selection procedures in producing superior genetic populations.

Prerequisite: GN 311 and ST 512
Typically offered in Spring only

ANS 702/PHY 702
Reproductive Physiology of Mammals (3 credit hours)
Survey of reproductive strategies among vertebrates; in-depth coverage of mammalian reproductive physiology; gametogenesis, fertilization, embryonic and fetal development, parturition, puberty, neuroendocrine control mechanisms in male and female mammals.

Prerequisite: ZO 421
Typically offered in Fall and Spring

ANS 709
Energy Metabolism (3 credit hours)
Relationship of biochemical and physiological events within cell, tissue, organ and system with nutrient needs as sources of energy for productive animal life. Digestion, absorption and metabolism of energy sources. Processes of energy transformations within the body in relation to energetics, biological oxidation, anabolic and catabolic systems, metabolic control, partitioning and efficiency.

Prerequisite: BCH 553

ANS 713/GN 713
Quantitative Genetics and Breeding (3 credit hours)
Quantitative and population genetic theory of breeding problems; partitioning of genetic variance, maternal effects, genotype by environment interaction and genetic correlation; selection indexes; design and analysis of selection experiments; marker-assisted selection.

Prerequisite: GN 509, ST 512
Typically offered in Fall only

ANS 726/FOR 726/CS 726
Advanced Topics In Quantitative Genetics and Breeding (3 credit hours)
Advanced topics in quantitative genetics pertinent to population improvement for quantitative and categorical traits with special applications to plant and animal breeding. DNA markers - phenotype associations. The theory and application of linear mixed models, BLUP and genomic selection using maximum likelihood and Bayesian approaches. Pedigree and construction of genomic relationships matrices from DNA markers and application in breeding.

Prerequisite: ST 511, Corequisite: ST 512
Typically offered in Spring only

ANS 803
Reproductive Physiology Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

ANS 804
Animal Breeding and Genetics Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

ANS 810
Topical Problems in Animal Science (1-6 credit hours)
Selection or assignment of special problems in various phases of animal science.

Typically offered in Fall, Spring, and Summer
ANS 841 Practicum in Animal Science (1-3 credit hours)
Typically offered in Fall and Spring

ANS 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

ANS 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ANS 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ANS 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ANS 896 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

ANS 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ANT 253 Unearthing the Past: Introduction to World Archaeology (3 credit hours)
World-wide survey of origins of human society, technology and culture in Old Stone Age, and origins of agriculture, cities, and civilizations of the Bronze and Iron Age in Europe, Asia, Africa, and pre-Columbian Middle and South America.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall and Spring

ANT 254 Language and Culture (3 credit hours)
Focus among the aspects of human language and between aspects of language and culture. Topics such as: descriptive and comparative linguistics, structuralism, language and thought, sociolinguistics, bilingualism, culture change and linguistic changes.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

ANT 261/SOC 261 Technology in Society and Culture (3 credit hours)
Processes of social and cultural change with a focus on role of technological innovation. Cross-cultural emphasis. Workplace changes and societal risks in U.S. and non-U.S. societies associated with technological innovations. Special attention to the role of scientists and engineers in socio-cultural change. Topical case studies apply course concepts and principles. Core sociological and anthropological concepts, methods, theories.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Social Sciences
Typically offered in Fall, Spring, and Summer

ANT 295 Special Topics in Anthropology (1-3 credit hours)
Offered as needed to present 200-level subject materials not normally available in regular course offerings or for new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

ANT 310 Native Peoples and Cultures of North America (3 credit hours)
Native North American peoples and cultures including Eskimos and Aleuts. Theories of origin and selected prehistoric cultural manifestations. People and cultures at the time of European contact and post-contact cultural change. Contemporary problems

Prerequisite: ANT 252 or HI 365
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Summer

ANT 315 The Aztecs, Maya, and Their Predecessors: Archaeology of Mesoamerica (3 credit hours)
This course introduces the peoples and cultures of Mesoamerica from prehistoric times to the Colonial period. Themes include the peopling of the New World, the development of agriculture and social inequity, and the rise of states and empires. Covers the cultures of the Olmec, Maya, Zapotec, and Aztec as well as the ongoing importance of these cultures for the people of Mexico and Central America. Introduces primary archaeological and ethnohistoric sources and the anthropological approach to understanding people and cultures through their material remains.

Prerequisite: 3 credits of 200-level Anthropology, or HI 215, or HI 216
GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall only

Anthropology (ANT)

ANT 251 Physical Anthropology (3 credit hours)

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

ANT 252 Cultural Anthropology (3 credit hours)
Comparative study of contemporary human culture, social institutions and processes that influence behavior. The range of human cultural variation shown throughout the world, including the student's own cultural system.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall, Spring, and Summer
ANT 325 Andean South America (3 credit hours)
The societies, cultures, politics, economics and ecology of the Andean countries of South America (Peru, Bolivia, Ecuador, Chile, Colombia). Special attention is paid to the development of pre-Columbian Andean societies.
Prerequisite: ANT 252 or HI 215 or HI 216
GEP Global Knowledge, GEP Social Sciences
Typically offered in Spring only

ANT 330 Peoples and Cultures of Africa (3 credit hours)
African peoples and cultures, especially in sub-Saharan Africa; past and present social patterns of indigenous African populations from a cross-cultural perspective.
Prerequisite: ANT 252 or HI 275 or HI 276
GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall only

ANT 345 Anthropology of the Middle East (3 credit hours)
An introduction to the anthropology of Middle Eastern societies. Themes include religion and secularism, gender and sexuality, national identity and the state, memory and commemoration, violence and conflict, youth culture, and popular uprisings.
GEP Global Knowledge, GEP Social Sciences
Typically offered in Spring only

ANT 346 Peoples and Cultures of Southeast Asia (3 credit hours)
Southeast Asian peoples and cultures; past and present social patterns of selected mainland and insular Southeast Asian peoples; culture change; relations between minorities and dominant ethnic groups; development of nationalism.
Prerequisite: ANT 252
Typically offered in Fall only

ANT 351/FLJ 351 Contemporary Culture in Japan (3 credit hours)
Introduction to basic aspects of cultural practices in Japanese society, including education, work life, family relationships, everyday religious practices, aesthetic traditions, national identity, and gender. Students will develop an understanding of the interrelationships between language and culture.
Prerequisite: FLJ 101
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ANT 354 Peoples and Cultures of the Pacific (3 credit hours)
The Pacific Ocean contains thousands of inhabited islands. This course examines the millions of people and thousands of societies that live in the Pacific and its three subregional areas Melanesia, Micronesia and Polynesia. Course topics include the Pacific environment, peopling of the Pacific, regional cultural variation, social organization, Exchange systems, politics, conflict, modernization, globalization and global warming in the Pacific region.
Prerequisite: ANT 252
Typically offered in Spring only

ANT 370 Introduction to Forensic Anthropology (3 credit hours)
Provides a broad overview of forensic anthropology, an applied field of biological anthropology. Students will apply the science of biological anthropology to the legal process and humanitarian arena. Students will identify skeletal remains to determine age, sex, ancestry, stature, and unique features of a decedent. Course will address general identification techniques, but proficiency is not expected.
GEP Social Sciences
Typically offered in Fall and Spring

ANT 371 Human Variation (3 credit hours)
Survey of basic principles of population genetics with emphasis on mechanisms that shape human biological variation. Geographical variation. Analysis of laws of heredity exhibited in modern human populations via microevolution and adaptation. Historical
Prerequisite: ANT 251
GEP Global Knowledge
Typically offered in Fall only

ANT 374 Disease and Society (3 credit hours)
Survey of diseases that affect human beings and human societies past and present. Analysis of how diseases affect societies with different economies (gathering/hunting, pastoral, agricultural, industrial) and of different social complexity. Impact of diseases on human evolution.
Prerequisite: ANT 251 or ANT 252

ANT 389 Fundamentals of Archaeological Research (3 credit hours)
Overview of the objectives, field strategies, basics of laboratory analysis, and interpretive approaches to the archaeological record. Analysis and classification of lithics, shell, bone, ceramics, metal, soils, and perishable materials.
Prerequisite: ANT 253 or Instructor Permission
Typically offered in Summer only

ANT 395 Special Topics in Anthropology (1-3 credit hours)
Offered as needed to present 300-level subject materials not normally available in regular course offerings or for new courses on a trial basis.
Prerequisite: 3 credits of 200-level Anthropology
Typically offered in Fall, Spring, and Summer

ANT 411/ANT 511 Overview of Anthropological Theory (3 credit hours)
A detailed introduction to anthropological theory, interpretive styles and research techniques of major nineteenth and twentieth century anthropologists working within the analytic frameworks of their times, positions espoused by anthropologists in contemporary debates concerning the discipline's future. Students cannot receive credit for both AN 411 and AN 511.
Prerequisite: ANT 252 and ANT 310 or ANT 325 or ANT 330 or ANT 345 or ANT 346 or ANT 354
Typically offered in Spring only

ANT 412/ANT 512 Applied Anthropology (3 credit hours)
History, aims, methods and ethics of applied anthropology. Anthropological practice in government, industry, community development, education, and medicine. Analysis of consequences of development programs for culture change. Credit cannot be given for both 412 and 512.
Typically offered in Spring only
ANT 416/ANT 516 Research Methods in Cultural Anthropology (3 credit hours)
A systematic overview of cultural anthropological research methods including designing research projects, research techniques, field work methods, and cross-cultural comparison. Reviews relevant ethical questions and anthropologists' reports of their own field work.
Prerequisite: ANT 252 and one of the following: ANT 310, 325, 330, 345, 346, 351, or 354
Typically offered in Fall only

ANT 419 Ethnographic Field Methods (3 credit hours)
Ethnographic research methods as part of a summer field school abroad. Topics: research design, participant observation, field note writing, interviewing, sampling, coding, computers in ethnographic research, analysis and ethics.
Prerequisite: Six hours of cultural anthropology
Typically offered in Summer only

ANT 421/ANT 521 Human Osteology (3 credit hours)
Survey of all the bones of the human skeleton from an anthropological perspective, including their names, important features useful in recognizing fragmentary specimens from an archaeological context, and techniques for determining the side of the body they come from. Skeletal development and its relationship to skeletal abnormalities. Issues relating to the study of archaeological skeletons.
Prerequisite: ANT 251 and any ANT 300 Level
Typically offered in Fall only

ANT 422/ANT 522 Forensic Anthropology Crime Scene Investigation Field Methods (3 credit hours)
Introduction to the most commonly utilized field and crime scene recovery methods for human remains including probing, gridding, mapping, excavation, and evidence collection. Students are responsible for transportation to the mock crime scene located on Centennial Campus. Students may not receive credit for both ANT 422 and ANT 522.
Typically offered in Summer only

ANT 424/ANT 524 Bioarchaeology (3 credit hours)
Survey of approaches used by bioarchaeologists to understand past lifeways through the study of excavated human remains, and the theories that inform those approaches. Analysis and critique of the ways in which bioarchaeologists use skeletal and mortuary data to reconstruct health and disease patterns, mortality rates, diet, degree of interpersonal violence, and social structure among humans from the distant past.
Prerequisite: ANT 421
Typically offered in Spring only

ANT 427 Bioarchaeological Fieldwork (3 credit hours)
An introduction to the bioarchaeology of the local region, and an overview of the objectives, field strategies, ad laboratory methods used by bioarchaeologists to prepare and study human remains from archaeological cemeteries. Includes laboratory work on field osteology and processing of skeletal remains. Provides an understanding of how bioarchaeologists proceed from excavation of osteological remains to preparation and analysis. Course is offered as part of an NCSU Study Abroad Program. All costs associated with the course, except for textbooks, are paid via the Study Abroad Program fee.
Prerequisite: ANT 421
Typically offered in Summer only

ANT 428/ANT 528 Human Paleopathology (3 credit hours)
Survey of diseases that manifest on the human skeleton. Analysis and identification of these diseases from a clinical perspective through all life stages from radiographic analysis, macroscopic analysis, and photographic analysis.
Prerequisite: ANT 251
Typically offered in Spring only

ANT 431/ANT 531 Tourism, Culture and Anthropology (3 credit hours)
Anthropological approach to tourism studies with emphasis on cross-cultural aspects of international tourism. Attention to impact of mass tourism as compared to alternative tourism; environmental and economic impact of tourism; impact of international
Prerequisite: Three hours of cultural anthropology
Typically offered in Fall and Summer

ANT 433/ANT 533 Anthropology of Ecotourism and Heritage Conservation (3 credit hours)
Introduction to how cultures and societies view, utilize, interpret, manage and conserve environmental and cultural heritage resources; includes examination of theory and concepts of place, identity, sacred heritage, ecotourism, wildlife management as well as the cultural politics and practices of environmentalist and heritage management. Some limited travel to NC heritage sites required at student expense.
Prerequisite: ANT 252 and one of the following: ANT 310, 325, 330 or 346
Typically offered in Spring only

ANT 444/WGS 444/ANT 544/WGS 544 Cross-Cultural Perspectives on Women (3 credit hours)
Comparison of women in a variety of societies: western and non-western; hunting and gathering to industrialized. Cross-cultural perspective on the similarity and diversity of women's statuses and roles. Effect of gender on social position
Prerequisite: ANT 252 and one of the following: ANT 310, 325, 330 or 346
Typically offered in Spring only

ANT 450/ANT 550 Culture, Ecology, and Sustainable Living (3 credit hours)
Examines the myriad ways that culture serves to mediate the human-environmental equation. Focus is given to different belief systems, subsistence strategies, technological achievements, and policy formulations. Topics covered include cultural ecology, gender and the environment, land tenure, development, ethnoscirope and cognitive ecology, subsistence and social organization, historical and political ecology, environmentalism, and environmental policy issues.
Prerequisite: One of the following: ANT 310, 325, 330 or 346

ANT 460/ANT 560 Urban Anthropology (3 credit hours)
Anthropological study of cities. Examination of cross-cultural patterns of behavior in urban areas and adaptive strategies that urban dwellers employ. Introduction to major theoretical and methodological approaches relevant to an understanding of context
Prerequisite: ANT 252 and one of the following: ANT 310, 325, 330 or 346
Typically offered in Fall only
ANT 461/ANT 561  Wealth, Poverty and International Aid  (3 credit hours)
Examines notions of wealth and poverty in a variety of cultural settings, as well as ideas of whether and how people categorized as poor or rich might alter their status. These findings are applied to case studies of current international aid organizations that carry out poverty relief.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall only

ANT 464/ANT 564  Anthropology of Religion  (3 credit hours)
Examination of various anthropological perspectives on the role of religion in social life, and discussion of theoretical and methodological issues pertaining to the study of ritual and belief.

Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346
Typically offered in Spring only

ANT 471/IS 471/IS 571/ANT 571  Understanding Latino Migration  (3 credit hours)
This collaborative, hands-on class examines what ultimately drives migration and how families, communities, and policy-makers respond to migration in ways that can keep the process going. Focusing on emigration from Mexico, Guatemala, Honduras, and El Salvador, the course reviews the historical foundation for today's migration with attention to migration to North Carolina.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Social Sciences
Typically offered in Summer only

ANT 475/ANT 575  Environmental Archaeology  (3 credit hours)
Archaeological investigation of human-environmental interactions and human impacts on ancient environments. Focuses on the causes of environmental change (climate, human activity) and the implications for understanding human nature, predicting future problems, and addressing current crises. Topics include reconstructing paleoclimate, the extinction of megafauna, anthropogenic landscapes, environmental degradation and the collapse of ancient states, sustainability and the Anthropocene.

Prerequisites:ANT 253 and one 300-level anthropology course
Typically offered in Fall and Spring

ANT 483/ANT 583  Theories of Archaeological Research  (3 credit hours)
Covers the theories that inform archaeological research in the effort to locate and interpret material evidence about past human activities. Topics include the history of archaeology, theories of archaeological practice and interpretation, ethics, and working with stakeholders. Relies on case studies and major syntheses and critiques of current theoretical debates. Cases focus on the origins of social complexity, human-environmental interactions, and critical perspectives on inequality, race, class, gender, and ethnicity. Students may not receive credit for both ANT 483 and ANT 583.

Prerequisite: ANT 251 or 253 and 330-credit ANT
Typically offered in Fall only

ANT 495  Special Topics in Anthropology  (3 credit hours)
Detailed investigation of a topic in anthropology. Topic and mode of study determined by faculty member(s).

ANT 496  Anthropology Internship  (6 credit hours)
Supervised observation and experience in work settings appropriate to anthropological perspectives. Study of the relationships between internship setting and relevant anthropological theory, methods and research. Weekly seminars, individual conferences and an integrative report. Students are responsible for arranging their own transportation to internship sites. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: ANT 412, ANT 416; Senior standing in Anthropology (B.A.)
Typically offered in Fall and Spring

ANT 498  Independent Study in Anthropology  (1-6 credit hours)
Independent study of a topic in anthropology. Topic and mode of study determined by faculty member(s) and student(s). Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: Six hours of ANT
Typically offered in Fall, Spring, and Summer

ANT 501  Proseminar: Introduction to Graduate Studies in Anthropology  (3 credit hours)
Introduction to anthropological research process; introduction to anthropology faculty; research proposal design; career planning; professional development; campus resources.

R: Anthropology Graduate students
Typically offered in Fall only

ANT 511/ANT 411  Overview of Anthropological Theory  (3 credit hours)
A detailed introduction to anthropological theory, interpretive styles and research techniques of major nineteenth and twentieth century anthropologists working within the analytic frameworks of their times, positions espoused by anthropologists in contemporary debates concerning the discipline's future. Students cannot receive credit for both ANT 411 and ANT 511.

Prerequisite: ANT 252 and ANT 310 or ANT 325 or ANT 330 or ANT 345 or ANT 346 or ANT 354
Typically offered in Spring only

ANT 512/ANT 412  Applied Anthropology  (3 credit hours)
History, aims, methods and ethics of applied anthropology. Anthropological practice in government, industry, community development, education, and medicine. Analysis of consequences of development programs for culture change. Credit cannot be given for both 412 and 512.

Typically offered in Spring only

ANT 516/ANT 416  Research Methods in Cultural Anthropology  (3 credit hours)
A systematic overview of cultural anthropological research methods including designing research projects, research techniques, field work methods, and cross-cultural comparison. Reviews relevant ethical questions and anthropologists' reports of their own field work.

Prerequisite: ANT 252 and one of the following: ANT 310,325,330, 345, 346, 351, or 354
Typically offered in Fall only
ANT 521/ANT 421 Human Osteology (3 credit hours)
Survey of all the bones of the human skeleton from an anthropological perspective, including their names, important features useful in recognizing fragmentary specimens from an archaeological context, and techniques for determining the side of the body they come from. Skeletal development and its relationship to skeletal abnormalities. Issues relating to the study of archaeological skeletons.
Prerequisite: ANT 251 and any ANT 300 Level
Typically offered in Fall only

ANT 522/ANT 422 Forensic Anthropology Crime Scene Investigation Field Methods (3 credit hours)
Introduction to the most commonly utilized field and crime scene recovery methods for human remains including probing, gridding, mapping, excavation, and evidence collection. Students are responsible for transportation to the mock crime scene located on Centennial Campus. Students may not receive credit for both ANT 422 and ANT 522.
Typically offered in Summer only

ANT 524/ANT 424 Bioarchaeology (3 credit hours)
Survey of approaches used by bioarchaeologists to understand past lifeways through the study of excavated human remains, and the theories that inform those approaches. Analysis and critique of the ways in which bioarchaeologists use skeletal and mortuary data to reconstruct health and disease patterns, mortality rates, diet, degree of interpersonal violence, and social structure among humans from the distant past.
Prerequisite: ANT 421
Typically offered in Spring only

ANT 528/ANT 428 Human Paleopathology (3 credit hours)
Survey of diseases that manifest on the human skeleton. Analysis and identification of these diseases from a clinical perspective through all life stages from radiographic analysis, macroscopic analysis, and photographic analysis.
Prerequisite: ANT 251
Typically offered in Spring only

ANT 529 Advanced Methods in Forensic Anthropology (4 credit hours)
Advanced methods in forensic anthropology-an applied field of biological anthropology. Application of the science of biological anthropology to the medicolegal process. Identification of skeletal remains to determine age, sex, ancestry, stature, and unique features of a decedent. Analysis of human skeletal remains. Identification techniques addressed and proficiency expected. Students must provide their own transportation to the laboratory site.
Prerequisite: Graduate Standing
Typically offered in Spring only

ANT 531/ANT 431 Tourism, Culture and Anthropology (3 credit hours)
Anthropological approach to tourism studies with emphasis on cross-cultural aspects of international tourism. Attention to impact of mass tourism as compared to alternative tourism; environmental and economic impact of tourism; impact of international
Prerequisite: Three hours of cultural anthropology
Typically offered in Fall and Summer

ANT 533/ANT 433 Anthropology of Ecotourism and Heritage Conservation (3 credit hours)
Introduction to how cultures and societies view, utilize, interpret, manage and conserve environmental and cultural heritage resources; includes examination of theory and concepts of place, identity, sacred heritage, ecotourism, wildlife management as well as the cultural politics and practices of environmentalist and heritage management. Some limited travel to NC heritage sites required at student expense.
Prerequisite: ANT 252
Typically offered in Spring only

ANT 544/WGS 544/ANT 444/WGS 444 Cross-Cultural Perspectives on Women (3 credit hours)
Comparison of women in a variety of societies: western and non-western; hunting and gathering to industrialized. Cross-cultural perspective on the similarity and diversity of women's statuses and roles. Effect of gender on social position.
Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346
Typically offered in Spring only

ANT 550/ANT 450 Culture, Ecology, and Sustainable Living (3 credit hours)
Examines the myriad ways that culture serves to mediate the human-environmental equation. Focus is given to different belief systems, subsistence strategies, technological achievements, and policy formulations. Topics covered include cultural ecology, gender and the environment, land tenure, development, ethnoscientific and cognitive ecology, subsistence and social organization, historical and political ecology, environmentalism, and environmental policy issues.
Prerequisite: One of the following: ANT 310,325,330 or 346

ANT 560/ANT 460 Urban Anthropology (3 credit hours)
Anthropological study of cities. Examination of cross-cultural patterns of behavior in urban areas and adaptive strategies that urban dwellers employ. Introduction to major theoretical and methodological approaches relevant to an understanding of conves
Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346
Typically offered in Fall only

ANT 561/ANT 461 Wealth, Poverty and International Aid (3 credit hours)
Examines notions of wealth and poverty in a variety of cultural settings, as well as ideas of whether and how people categorized as poor or rich might alter their status. These findings are applied to case studies of current international aid organizations that carry out poverty relief.
GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall only

ANT 564/ANT 464 Anthropology of Religion (3 credit hours)
Examination of various anthropological perspectives on the role of religion in social life, and discussion of theoretical and methodological issues pertaining to the study of ritual and belief.
Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346
Typically offered in Spring only
ANT 571/ANT 471/IS 471/IS 571 Understanding Latino Migration (3 credit hours)
This collaborative, hands-on class examines what ultimately drives migration and how families, communities, and policy-makers respond to migration in ways that can keep the process going. Focusing on emigration from Mexico, Guatemala, Honduras, and El Salvador, the course reviews the historical foundation for today's migration with attention to migration to North Carolina.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Social Sciences
Typically offered in Summer only

ANT 575/ANT 475 Environmental Archaeology (3 credit hours)
Archaeological investigation of human-environmental interactions and human impacts on ancient environments. Focuses on the causes of environmental change (climate, human activity) and the implications for understanding human nature, predicting future problems, and addressing current crises. Topics include reconstructing paleoclimate, the extinction of megafauna, anthropogenic landscapes, environmental degradation and the collapse of ancient states, sustainability and the Anthropocene.

Prerequisites: ANT 253 and one 300-level anthropology course
Typically offered in Fall and Spring

ANT 583/ANT 483 Theories of Archaeological Research (3 credit hours)
Covers the theories that inform archaeological research in the effort to locate and interpret material evidence about past human activities. Topics include the history of archaeology, theories of archaeological practice and interpretation, ethics, and working with stakeholders. Relies on case studies and major syntheses and critiques of current theoretical debates. Cases focus on the origins of social complexity, human-environmental interactions, and critical perspectives on inequality, race, class, gender, and ethnicity. Students may not receive credit for both ANT 483 and ANT 583.

Prerequisite: ANT 251 or 253 and 3 cred 300-level ANT
Typically offered in Fall only

ANT 585 Skeletal Biology in Anthropology (3 credit hours)
Skeletal biology is the study of human skeletal remains; understanding past populations' demographics, health and disease, physical activity, diet, and biological relatedness to other groups, past and present. Must hold graduate standing.

ANT 587/HI 587 Cultural Resource Management (3 credit hours)
Theoretical and practical overview of U.S. federal and state laws, institutions, and practices related to the inventory, evaluation, preservation, protection, and overall management of cultural resources; history and philosophical bases of Cultural Resource Management (CRM); professional ethics; indigenous and other stakeholder interests in CRM; and comparative national regulations outside the U.S. and the international heritage management and organizations. Graduate standing in history required.

Typically offered in Spring only

ANT 595 Special Topics in Anthropology (1-6 credit hours)
In depth exploration of specialized topics in Anthropology. Also used to test and develop new courses.

Prerequisite: Graduate Standing

ANT 598 Independent Study in ANT (1-3 credit hours)
Independent study of a topic in anthropology. Topic and mode of study determined by faculty member(s) and student(s).

Typically offered in Fall, Spring, and Summer

ANT 610 Special Topics in Anthropology (1-6 credit hours)
Provision for in-depth investigation of some particular topic in anthropology. Reflection of current student needs and interests through variations in course content and mode of study. Determination of topics by faculty member(s) and student.

ANT 693 Masters Supervised Research (1-9 credit hours)
Instruction in research, and research under the mentorship of a member of the Graduate Faculty. Restricted to Masters Students in Anthropology.

Prerequisite: Graduate Standing
Typically offered in Fall, Spring, and Summer

ANT 695 Masters Research (1-9 credit hours)
Thesis research conducted under the supervision of student's thesis committee chair or other graduate faculty member. Restricted to Masters Students in Anthropology.

Prerequisite: Graduate Standing
Typically offered in Fall, Spring, and Summer

ANT 696 Summer Thesis Res (1 credit hours)
Typically offered in Summer only

ANT 699 Masters Thesis Preparation (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, and other requirements for the masters degree, and are writing and defending their thesis. Restricted to Masters Students in Anthropology.

Prerequisite: Graduate Standing
Typically offered in Fall, Spring, and Summer

ANT 810 Special Topics in Anthropology (1-6 credit hours)
Provision for in-depth investigation of some particular topic in anthropology. Reflection of current student needs and interests through variations in course content and mode of study. Determination of topics by faculty member(s) and student.

Typically offered in Fall, Spring, and Summer

Applied Ecology (AEC)

AEC 295 Special Topics in Applied Ecology (1-3 credit hours)
Special topics and experimental offerings in Applied Ecology including developmental courses offered on a trial basis. Intended for students at an intermediate level of training in Biological Sciences.

Prerequisite: BIO 181
Typically offered in Fall, Spring, and Summer

AEC 360/ PB 360 Ecology (4 credit hours)
The science of ecology, including factors which control distribution and population dynamics of organisms, structure and function of biological communities, and energy flow and nutrient cycling in ecosystems; contrasts among the major biomes; and principles governing ecological responses to global climatic and other environmental changes.

Prerequisite: C- or better in BIO 181
Typically offered in Spring only
AEC 380  Water Resources: Global Issues in Ecology, Policy, Management, and Advocacy  (3 credit hours)
This course will take a broad look at global issues associated with water resources, including the ways that people interact with water (how we use, degrade, conserve, and advocate for water and water rights). And how these interactions shape our lives. Woven throughout the course is the fact that science (ecology), policy (resource management), and cultural perspectives interact (sometimes in cooperation and sometimes in conflict) on many topics related to water. Students will explore water resource issues from the perspectives of ecology, natural resource management, and different cultures. The course is appropriate for students with interests in the life and social sciences.
Prerequisite: BIO 181
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Summer only

AEC 400  Applied Ecology  (3 credit hours)
Global climate change, over-fishing, habitat loss, altered nutrient cycles, and the spread of invasive species are among the world's pressing global environmental issues. Solutions to these problems are complex, but firmly rooted in the fundamental tenets of ecological theory. The field of applied ecology is premised on using these fundamental ecological principles to help solve the environmental challenges we face. This course will provide an overview of the field of applied ecology, based on a series of 12 individual case studies. Working from the individual to global level, the course will provide a broad perspective on the field of applied ecology.
Prerequisite: PB/BIO 360
Typically offered in Fall only

AEC 419/AEC 519  Freshwater Ecology  (4 credit hours)
The course explores the structure and function of streams, lakes, and wetlands, including physical, chemical and biological controls of productivity and species composition of aquatic plants and animals and effects of pollution on organisms and water quality. The laboratory emphasizes modern, hands-on techniques for answering fundamental and applied questions. One local weekend field trip required. Credit in both AEC 419 and AEC 519 is not allowed.
Prerequisite: C- or better in BIO/PB 360
Typically offered in Fall only

AEC 420  Introduction to Fisheries Science  (3 credit hours)
Role of fish in aquatic ecosystems, fish biology, fish ecology, fisheries management and conservation. Emphasis on aquatic ecosystems and food webs, life history and ecology of important sport and commercial fishes, population and community dynamics, and theory and practice of fisheries management and conservation. Case studies from freshwater, estuarine and marine systems.
Prerequisite: C- or better in BIO/PB 360
Typically offered in Spring only

AEC 423  Introduction to Fisheries Sciences Laboratory  (1 credit hours)
General anatomy and identification of common freshwater, estuarine and marine fish, functional morphology, age and growth analyses, fish health and diets. Computer analyses of bioenergetic and population dynamics.
Corequisite: FW/BIO 420
Typically offered in Spring only

AEC 424  Marine Fisheries Ecology  (3 credit hours)
This course covers the life history, stock concept, fishing gears, stock assessment approaches, fish-habitat relationships, socio-economics, and management of marine fishes. Several field trips to state and federal agency laboratories and fish houses/docks are used to emphasize fish sampling, biological sample processing, and gear design. This course is part of the semester at CMAST program and requires students to be on site in Morehead City, NC.
Prerequisite: BIO 181
Typically offered in Spring only

AEC 441  Biology of Fishes  (3 credit hours)
Behavior, evolution, physiology and ecology of fishes, emphasizing their adaptations for life in streams, lakes, and oceans.
Corequisite: AEC 442 Biology of Fishes Laboratory
Typically offered in Fall only

AEC 442  Biology of Fishes Laboratory  (1 credit hours)
Field and laboratory exercises with the common fish species and communities of North Carolina. Field trips to local streams and lakes plus weekend trips to coastal, estuarine, and mountain habitats.
Corequisite: AEC 441
Typically offered in Fall only

AEC 460  Field Ecology and Methods  (4 credit hours)
Field Ecology and Methods will expose senior students with interests in Ecology and Evolution to the diverse field approaches used to address ecological questions. The course considers and implements a variety of field approaches ranging from microcosm learning experience in applied ecology within an academic framework with facilities and resources on or off campus. Contact and arrangements with prospective supervisors must be done by the student. Prior approval by faculty advisor and minor coordina
Prerequisite: C- or better in ST 311 and BIO 360
Typically offered in Fall only

AEC 492  External Learning Experience in Applied Ecology  (1-3 credit hours)
Learning experience in applied ecology within an academic framework with facilities and resources on or off campus. Contact and arrangements with prospective supervisors must be done by the student. Prior approval by faculty advisor and minor coordi
Prerequisite: BIO 181 (Variable, depending on instructor)
Typically offered in Fall, Spring, and Summer

AEC 493  Internal Learning Experience in Applied Ecology  (1-3 credit hours)
Internal learning experience in applied ecology within an academic framework with facilities and resources on campus. Contact and arrangements with prospective supervisors must be done by the student. Prior approval by faculty advisor and minor coordi
Prerequisite: BIO 181 (Variable, depending on instructor)
Typically offered in Fall and Spring

AEC 495  Advanced Special Topics in Applied Ecology  (1-3 credit hours)
Special topics and experimental offerings in Applied Ecology including developmental courses offered on a trial basis. Intended for students at an advanced level of training in Biological Sciences.
Prerequisite: BIO 181
Typically offered in Fall, Spring, and Summer
**AEC 501** Ornithology (4 credit hours)
The biology of birds. Lecture topics include evolution, functional morphology, physiology, ecology and behavior. Field and museum laboratories emphasize particular aspects of morphology, ecology and behavior, as well as taxonomy and identification. One coastal weekend field trip required.
Prerequisite: BIO 181, BIO 183, and (BIO 250 or BIO/PB 360)
Typically offered in Fall only

**AEC 502** Introduction to Biological Research (2 credit hours)
The course provides a philosophical background for the field of ecology, then transitions to practical aspects of the field including a focus on grant proposal development, how to read and review papers and grant proposals, and how to give a presentation at a scientific meeting. A series of outside speakers will provide a broad perspective on the resources and opportunities available for graduate students at North Carolina State University. An emphasis will be placed on peer collaboration and feedback, developing professional relationships that will be important throughout the graduate tenor of this cohort of students.
Typically offered in Fall only

**AEC 503** Foundations of Ecology (2 credit hours)
This course covers major concepts, themes, and theories in ecology, including population, community and ecosystem ecology, and evolutionary ecology. Students are introduced to the core skill of critically evaluating scientific papers. The format of the course is readings from the primary literature and student-lead discussions. This course is focused toward first- and second-year graduate students, especially those in preparation for their preliminary exam.
Prerequisite: Graduate standing
Typically offered in Spring only

**AEC 509/ENT 509** Biology of Aquatic Insects (3 credit hours)
Life history descriptions and identification of aquatic insects. Emphasis on behavioral and physiological adaptations to diverse habitats and the role of insects in aquatic ecosystem function and as indicators of water quality. The course includes 3-4 Saturday collecting trips to a local pond and streams in the mountains, piedmont and coastal plain. Collecting trips are not required, but are strongly encouraged.
Typically offered in Spring only

**AEC 510** Machine Learning Approaches in Biological Sciences (2 credit hours)
A wide range of high-throughput technologies are now being used to generate data to answer an ever-increasingly diverse set of questions about biological systems. The next great challenge is integrating data analysis in a systems biology approach that utilizes novel supervised machine learning methods, which accommodate heterogeneity of data, are robust to biological variation, and provide mechanistic insight. The course will not focus on detailed mathematical models, but instead on how these machine learning tools may be used to analyze biological data, in particular gene and protein expression.
Restriction: Graduate standing; Senior Undergraduates with permission from instructor
Typically offered in Fall only

**AEC 515/FW 515** Fish Physiology (3 credit hours)
The biology of fishes: physiology, anatomy, endocrinology, behavior and genetics. Designed especially for graduate students in fisheries. Several trips to research laboratories taken.
Typically offered in Fall only

**AEC 519/AEC 419** Freshwater Ecology (4 credit hours)
The course explores the structure and function of streams, lakes, and wetlands, including physical, chemical and biological controls of productivity and species composition of aquatic plants and animals and effects of pollution on organisms and water quality. The laboratory emphasizes modern, hands-on techniques for answering fundamental and applied questions. One local weekend field trip required. Credit in both AEC 419 and AEC 519 is not allowed.
Prerequisite: C- or better in BIO/PB 360
Typically offered in Fall only

**AEC 524** Aquaculture Laboratory (1 credit hours)
Methods and techniques of cultivating aquatic organisms. Field trips and reports on local hatcheries and facilities required. (Three to four overnight field trips taken on week days to coastal areas, state hatcheries, and private hatcheries; students responsible for shared room costs and their meals. Four field trips also taken on laboratory day within driving range of Raleigh.)
Prerequisite: BO 360 or ZO 260 or Graduate standing or Senior standing
Corequisite: ZO 586
Typically offered in Spring only

**AEC 560** Fish Physiology (3 credit hours)
The biology of fishes: physiology, anatomy, endocrinology, behavior and genetics. Designed especially for graduate students in fisheries. Several trips to research laboratories taken.
Typically offered in Fall only

**AEC 592** Special Topics in Applied Ecology (1-6 credit hours)
Special Topics in Applied Ecology. Topics will vary.
Typically offered in Fall, Spring, and Summer

**AEC 624** Advanced Fisheries Science (2 credit hours)
This is a seminar style course where students and faculty discuss readings in advanced fisheries science. The course is offered to students at CMAST (live) and on main campus (using Zoom or related online meeting software). Transportation is not required.
Typically offered in Fall only

**AEC 630** Special Topics in AEC (1-6 credit hours)
Special Topics in AEC
Typically offered in Fall, Spring, and Summer

**AEC 710** Sampling Animal Populations (3 credit hours)
Statistical methods applicable to sampling of wildlife populations, including capture-recapture, removal, change in ratio, quadrant and line transect sampling. Emphasis on model assumptions and study design.
Prerequisite: ST 512
Typically offered in Fall only
AEC 718 Community Ecology (3 credit hours)
Animal community structure and function. Effects of competition, predation, coevolution and disturbance on community composition. Emphasis on ecological and evolutionary controversies from empirical and theoretical approaches.

Prerequisite: BO 360 or ZO 260, BO(ZO) 760; BO(ZO) 365
Typically offered in Spring only

AEC 726/FW 726 Quantitative Fisheries Management (3 credit hours)
Current methods for assessment and management of exploited fish populations, including sampling methods, data analysis and modeling. A required research paper or project.

Typically offered in Fall only

AEC 756 Ecology Of Fishes (3 credit hours)
Physiological ecology of fishes emphasizing energetics, production and adaptations to aquatic mediums. Ecological classification of fishes and theory of resource partitioning in freshwater, estuarine and marine realms.

Typically offered in Fall only

AEC 761 Conservation and Climate Science (3 credit hours)
Conservation Science applies principles from ecology, genetics, and other biological disciplines and social sciences to the conservation of biological diversity. This course will train students in techniques in population ecology such as population viability analysis; community ecology and theories of biodiversity; and reserve selection algorithms. The course will also expose and trains students to understand climate science and using climate data for ecological studies. The class will examine threats to biodiversity such as habitat fragmentation and loss, climate change, and invasion by exotic species. These issues will be considered within the context of economic, social, and legal constraints. Graduate status or permission of instructor.

Typically offered in Fall only

AEC 770 Advanced Topics In Ecology I (3 credit hours)
Development of subject matter in major fields of ecology through seminars and lectures and principles illustrated by laboratory exercises and field trips. Microenvironment, population biology, community ecology, ecosystems and nutrient cycling.

Typically offered in Spring only

Architecture (ARC)

ARC 140 Experiencing Architecture (3 credit hours)
An introductory course intended to provide non-majors with a foundation in the basic concepts of architecture. Provides a general understanding of contemporary issues and theory in architecture, concerns about green architecture and sustainability, architecture practice and the role architecture plays in the design of cities.

GEP Visual and Performing Arts
Typically offered in Spring and Summer

ARC 141 Introduction to Architectural History (3 credit hours)
World architectural history of sacred and secular buildings and buildings with emphasis before the modern era. For non-Architecture majors only. Does not count toward Architecture degrees.

R: For non-Architecture majors only.
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall and Spring

ARC 162 An Introduction to Architecture (3 credit hours)
The purpose of architecture examined through its practices, theories and key principles. Lectures, projects, and readings expose students to the diverse world of ideas, creative work and practical considerations which make up the discipline of architecture.

Prerequisite: D 104 and BED-A students; Corequisite: D 105
Typically offered in Spring only

ARC 201 Architectural Design: Environment (6 credit hours)
Investigation of the relationships between environment and built form. Solar orientation, topography, vegetation, and constructed context in relationship to user needs as parameters for justifying design proposals. Particular emphasis on architectural conventions of communication.

Prerequisite: D 105; BED-A students only; Corequisite: ARC 211
Typically offered in Fall only

ARC 202 Architectural Design: Form (6 credit hours)
Investigation of relationships between idea and form. Composition and precedent as parameters for generating, developing, and justifying architectural form. Particular emphasis on electronic media in drawing and modeling.

Prerequisite: ARC 201 and BED-A students
Typically offered in Spring only

ARC 211 Natural Systems and Architecture (3 credit hours)
Restricted to students in BEDA Program. Relationship between natural and architectural systems. Exploration of the implications of natural forces - sun, wind and daylight- on architecture. Energy-conscious architectural design and site planning strategies to fulfill thermal comfort requirements of people in designed environments.

Prerequisite: D 105
Typically offered in Fall only

ARC 232 Structures and Materials (3 credit hours)
An introduction to construction materials and building structures. Explorations of materials’ properties, aesthetics, environmental impact, and performance. Quantitative and qualitative analysis of structural building elements. Course integrates lecture and laboratory. Off-campus field trips are included (students may need to coordinate transportation).

Typically offered in Spring only

ARC 241 History of World Architecture (3 credit hours)
History of the built environment (buildings, urban planning, and associated arts) in western and non-western cultures, ranging from dawn of civilization to dawn of modern era, including high-style architecture, vernacular buildings, and traditional forms.

Typically offered in Fall only
ARC 242 History of Western Architecture (3 credit hours)
History of western architecture (including some landscape architecture and city planning) from the beginnings of the Renaissance in early 15th century to late 19th century in the United States.
Prerequisite: ARC 241 or Consent of Instructor
Typically offered in Spring only

ARC 251 Digital Representation (3 credit hours)
Project based methodological investigation of digital representation in architecture including: two- three- and four-dimensional media. Purchase of laptop and necessary software required.
Prerequisite: BED-A students or Master of Arch, Track 3 students
Typically offered in Spring only

ARC 289 Architectural Travel Study I (3 credit hours)
The study of cities, architectural sites, buildings, building complexes, and architectural elements conducted independently by students as part of a planned travel-study tour. Includes advance research and approval of proposed study topic and itinerary. Students will document study through sketches, analytical notations, and a summary paper. Departmental Approval Required
Prerequisite: ARC 141 and ARC 142
Typically offered in Fall and Spring

ARC 292 Special Topics in Architecture (1-3 credit hours)
Topics of current interest in Architecture. Normally used to develop new courses.
Typically offered in Fall, Spring, and Summer

ARC 301 Architectural Design: Tectonics (6 credit hours)
An introduction to the fundamentals of building systems on architectural design. Emphases on building assemblages, vertical-load structural systems, circulation, and passive heating, cooling, and ventilation. Particular emphasis on physical models. Limited to BED-A Students. Junior Standing. Students are required to purchase project materials.
Prerequisite: ARC 202 and ARC 211 and ARC 232; Corequisite: ARC 331 and ARC 432
Typically offered in Fall only

ARC 302 Architectural Design: Technology (6 credit hours)
An investigation of building technical systems as fundamental elements of the design process with emphasis on lateral load resisting structural strategies, environmental control/energy, enclosure assembly detail, and their architectural implications. Particular emphasis on physical models. Restricted to BED-A students, Junior standing. Students are required to purchase materials for projects.
Prerequisite: ARC 301 and ARC 331 and ARC 432
Typically offered in Spring only

ARC 331 Architectural Structures I (3 credit hours)
Structural design process. Combined role of imposed loads and architectural function in shaping the form of the building. Interaction of elements in structural systems containing beams, columns, trusses, space frames, slabs, arches, vaults, domes, cables, cable networks, fabrics and diaphragms. Case studies emphasized.
Prerequisite: ARC 232
Typically offered in Fall only

ARC 332 Architectural Structures II (3 credit hours)
Prerequisite: ARC 331
Typically offered in Spring only

ARC 401 Architectural Design: Urban (6 credit hours)
An architectural design studio intended to explore and integrate design issues of all types within an urban environment. Emphasis will be placed on both formal and technical issues of urban sites including transportation and land use planning, phasing of projects over time, relationships to other structures, and the application of development codes, regulations, and urban design principles to the fabric of the city.
Prerequisite: ARC 302 and BED-A student
Typically offered in Fall only

ARC 402 Architectural Design: Advanced (6 credit hours)
Advanced architectural design studios in which projects of many types and scales are employed to investigate a range of educational, theoretical and professional studies. Particular emphasis on independent research and exploration of design issues and their implications as defined by faculty.
Prerequisite: ARC 401 and BED-A students
Typically offered in Spring and Summer

ARC 403 Architectural Design Fundamentals: Environment (6 credit hours)
An introductory architectural design studio for M. Arch, Track 3 students investigating the relationship between environment and built form. Solar orientation, climate, topography, vegetation, and constructed context in relationship to user needs as parameters for design proposals. Particular emphasis on design fundamentals and conventions of architectural communication.
Prerequisite: Masters of Architecture students; Co-requisite: ARC 211
Typically offered in Fall only

ARC 404 Architectural Design Fundamentals: Form (6 credit hours)
An introductory architectural design studio for M. Arch. Track 3 students investigating relationships between idea and form. Composition and precedent as parameters for generating, developing, and justifying architectural form. Particular emphasis on electronic media in drawing and modeling.
Prerequisite: Masters of Architecture Track 3 students; ARC 403; Co-requisite: ARC 251
Typically offered in Spring only

ARC 405 Architectural Design Fundamentals: Technology (6 credit hours)
An introductory architectural design studio for M. Arch. Track 3 students in which the technical systems of building - structure, environmental control/energy, materials, enclosure, and circulation; their fabrication and assembly; and their capacity to affect form and tectonic expression are explored as fundamental elements of the design process. Particular emphasis on physical models.
Prerequisite: Master of Architecture students; ARC 404; Co-requisite: ARC 331 and ARC 432
Typically offered in Fall only
ARC 414 Environmental Control Systems (3 credit hours)
Studies in light, heat, moisture, air motion, and sound in architectural environments. Mechanical, electrical and/or electronic equipment for illumination, heating, cooling, ventilation, vertical transportation and communication in buildings. Water and waste, fire protection and safety, and acoustic systems in architecture.
Prerequisite: ARC 211
Typically offered in Spring only

ARC 432 Architectural Construction Systems (3 credit hours)
Building construction systems related to architectural design. Historical and current building practices. Implications for design and systems selection. Case studies. Field trips are required.
Prerequisite: ARC 232
Typically offered in Fall only

ARC 441 History of Contemporary Architecture (3 credit hours)
A survey and critical examination of modern architecture from its origins in 19th-century philosophy and technology to the most recent developments in world architecture.
Prerequisite: ARC 241, ARC 242; BED-A students, Bachelor of Architecture students, or Masters of Architecture students
Typically offered in Fall only

ARC 442 History of NC Architecture (3 credit hours)
Survey of NC Architecture from 17th-century settlement to World War II. Coverage of a wide range of building types and development patterns.
Prerequisite: ARC 241, ARC 242

ARC 450 Architectural Drawing (3 credit hours)
Introduction to hand drawing skills, techniques, and concepts necessary to use drawing for visual thinking (and visual communication) particularly in the development of design ideas and understanding of architecture. Restricted to Masters of Architecture Track III students.
Corequisite: ARC 451
Typically offered in Summer only

ARC 451 Digital Drawing and Modeling (3 credit hours)
Introductory course to digital communication tools as an integral part of the architectural design process. This course challenges students to develop diverse two and three-dimensional drawing and modeling skills through project-based exercises that engage various digital visualization and layout software. Purchase of laptop and necessary software required. Summer 5 week course. Restricted to Master of Architecture, Track III students.
Co-requisite: ARC 450
Typically offered in Spring and Summer

ARC 490 Architecture International Studio (6 credit hours)
Exploration of architectural problems and development of design solutions in an international setting. Studio projects focused on current conditions found in the host culture, profession, and community.
Prerequisite: ARC 302, Participation in off-campus program.
Typically offered in Fall only

ARC 492 Special Topics in Architecture (1-3 credit hours)
Topics of current interest in Architecture. Normally used to develop new courses.
Typically offered in Fall, Spring, and Summer

ARC 495 Independent Study in Architecture (1-3 credit hours)
Special projects in architecture developed under the direction of a faculty member on a tutorial basis. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by th
Prerequisite: BED-A students with Junior standing and a GPA greater than or equal to 3.0.
Typically offered in Fall, Spring, and Summer

ARC 500 Architectural Design: Professional Studio (6 credit hours)
A comprehensive and integrative architectural design studio for M.Arch students involving the execution of a project in sufficient depth to understand the opportunities and discipline resulting from the inclusion of building.
Prerequisite: M.Arch Track 1 and Track 3 student, ARC 405 or BEDA Degree (or equivalent)
Typically offered in Fall and Spring

ARC 501 Professional Architecture Studio I (6 credit hours)
Design studio investigations aimed at the development of an understanding of the major issues confronting the contemporary architect and at the expanding of problem solving abilities in architectural design.
Prerequisite: BEDA degree
Typically offered in Fall only

ARC 502 Professional Architecture Studio II (6 credit hours)
Design investigation aimed at the development of an understanding of the major issues confronting the contemporary architect and at the expanding of problem solving abilities in architectural design. This is an individualized, final project studio.
Prerequisite: ARC 501
Typically offered in Fall only

ARC 503 Advanced Architectural Design (Series) (6 credit hours)
Advanced studies in architectural design. Projects concerning various aspects of building design, urban design and community design in comprehensive and integrative manner.
Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

ARC 520 Sustainable Architecture (3 credit hours)
This survey course provides students with a solid knowledge base in the numerous aspects of sustainable design touching not only upon strategies, but also various philosophies behind sustainability and the green building movement. This course examines the impact of the built environment on natural systems and questions what it truly means to build responsibly. Lectures, discussions, guest speakers, and field trips create a critical foundation for green building considerations to be references in design at a variety of scales. Restricted to M. Arch, B. Arch, and BEDA seniors. Non-architecture majors by instructor's permission.
Architecture or Environmental Design in Architecture Majors Only
Typically offered in Summer only
**ARC 521 Daylighting and Passive Energy Systems for Architecture** (3 credit hours)
An investigation of building energy systems and simulation techniques with emphases on thermal envelope, solar geometry, daylighting, passive heating & cooling, and building systems integration. The theoretical considerations will be accompanied by hands-on exercises using various simulation tools. Restricted to M.Arch, B.Arch, and BEDA Senior Students. Non-Architecture majors by instructor's permission.

*Typically offered in Fall only*

**ARC 522 Building Energy Efficiency & Renewable Energy** (3 credit hours)
This course will discuss and develop strategies for the design of sustainable buildings. The two primary topics addressed are: 1) energy efficiency and 2) renewable energy. The students will learn and discuss ways to improve energy efficiency in buildings. The renewable energy technologies, such as solar and geothermal, are explored to discuss the applicability of those in the building design.

*Typically offered in Fall only*

**ARC 523 Building Energy Modeling and Simulation** (3 credit hours)
This course deals with the fundamentals of building sciences in terms of energy systems. Energy modeling and simulation technologies are used to predict and analyze the energy performance of buildings. The students calculate the energy consumption of heating, cooling, lighting, and equipment by hand to understand the energy & thermal behavior of buildings and then compare and analyze them with those calculated by energy modeling and simulation programs.

Prerequisite: ARC 414

*Typically offered in Fall only*

**ARC 524 Building Energy Optimization** (3 credit hours)
This course introduces energy optimization technologies in buildings using computer simulation. The EnergyPlus program, a whole-building computational energy simulation tool developed by USDOE, is used. The maximum energy savings potential of Energy Efficiency Measures (EEMs) are identified and implemented for the energy optimization process. Students obtain a great deal of information about a building's potential for energy savings, well before the first brick is even laid.

Prerequisite: ARC 523

*Typically offered in Spring only*

**ARC 525 Sustainability Over the Life of a Building** (3 credit hours)
Focuses on strategies and metrics for " greening" existing buildings. Sustainability over the Life of a Building will explore the criteria and documentation needed to certify a building at NC State in the LEED for Existing Buildings: Operations and Maintenance (EBOM) rating system. This course will emphasize the importance of interdisciplinary work while working toward sustainability goals. Over the course of the semester, students will research various criteria and thresholds for the LEED EBOM system. Through this in-depth process, students will synthesize core knowledge about LEED credits to better understand opportunities for strategies in green buildings. Over the course of the semester, students will research various criteria in-depth which are needed for LEED Existing Building Certification, not only becoming familiar with the rating system itself, but also the foundation for each of the addressed LEED credits, as well as context for decisions made in the realm of green buildings.

This is a graduate-level seminar open to all NCSU master's degree students but can be open to advanced standing undergraduate students with instructors' approval. No prerequisites.

*Typically offered in Fall only*

**ARC 526 Health and Sustainability in the Built Environment** (3 credit hours)
Explores opportunities in the design and aligned fields for facilitating higher sustainability and health targets, associated thresholds, and certification achievements in the built environment. Building rating systems are reviewed that address categories such as social equity, carbon neutrality, material toxicity, nourishment, fitness, mind, justness, and more. Reaching beyond the standards of current green building practice and public policy, the class will explore methods and case studies using cutting-edge building certification frameworks to target carbon neutral, net-zero, and health-promotive design. Student teams will be working on specific projects with professional firms for their final projects.

This is a graduate-level seminar open to all NCSU master's degree students but can be open to advanced standing undergraduate students with instructors’ approval. No prerequisites.

*Typically offered in Spring only*

**ARC 530 Tectonics and Craft** (3 credit hours)
Studies of construction and material form in architecture. Case studies of select examples of contemporary architecture that exemplify the technique and craft of modern construction. Analysis of functional, tectonic, and experiential aspects of building methods within the context of economics and culture. Examination of assembly as a determinant of building form.

Prerequisite: Architecture Majors, ARC 432

*Typically offered in Fall only*

**ARC 534 Design of Architectural Details** (3 credit hours)
Using detail patterns based on function, constructability, and aesthetics, students analyze existing successful building details, diagnose problems in existing buildings, and design details for their own projects. Restricted to Bachelors and Masters students in Architecture.

*Typically offered in Spring only*
ARC 535 Experiments in Architecture Prototypes (3 credit hours)
Examination of significant architecture prototypes of the Modern Movement. Seminar will investigate the effectiveness of prototypes in proposing solutions to technological, social, and environmental issues such as housing, education, and sustainability. Students will explore the possibilities of prototype design and construction in contemporary practice. Field trips required.
Prerequisite: ARC 232 or equivalent
Typically offered in Summer only

ARC 536 Materials for Design (3 credit hours)
Contemporary buildings that have insightfully integrated design intention and materials are analyzed using the case study method. Each student uses an iterative analytical process to probe deeply and specifically to find each building's key lessons regarding materials. Key drawings and photographs will be graphically presented, with a narrative summarizing findings regarding the project's general design intentions and its technical embodiment. Restricted to MArch, BArch, and BEDA Students.
Typically offered in Fall only

ARC 537 Digital Materials Translations (3 credit hours)
This seminar combines architectural material research with instruction in advanced digital design software. Students will examine specific materials to determine attributes, and then use parametric, NURBS-based software, and CNC machinery to propose new material applications. The course is limited to College of Design students unless instructors grant permission.
Prerequisite: (ARC 251 or ARC 451 or equivalent) and (ARC 232 or equivalent)
Typically offered in Fall only

ARC 538 Manufacturing Architecture (3 credit hours)
Focuses on customized repetitive manufacturing for architecture components. Specifically includes repetitive processes that make repeated uses of tooling (e.g. molds, patterns, or jigs) to form components. We will investigate repetitive manufacturing processes and architectural case studies. Limited to MArch, BArch, and BEDA students, senior standing.
Prerequisite: Architecture Majors, ARC 432
Typically offered in Fall only

ARC 540 Architectural Theory (3 credit hours)
This course provides an introduction to the major themes and associated figures of architectural theory. It focuses on 20th and 21st century texts with a particular emphasis on historicism, phenomenology, structuralism and post-structuralism. Each week there is assigned reading from a range of texts, including extra-disciplinary writers. Lectures and discussions serve to identify principal themes, connect to contemporary issues, and establish relevancy to architectural design. Restricted to MArch, BArch, and BEDA Seniors. Non-architecture majors by instructor's permission.
Typically offered in Spring only

ARC 541 Architecture, Culture, and Meaning (3 credit hours)
This course focuses on architecture as a cultural artifact and provides an overview of the interrelationship of architectural form, organization, symbolism, use and meaning. A broad range of examples from a variety of cultures, religions, and historical periods are covered (including "non-Western"), illustrated by detailed case studies. Syncretic, holistic and homological approaches to understanding the meaning and significance of architecture are emphasized. Phenomenological and hermeneutical methods of interpretation are introduced and pertinent philosophical traditions discussed. Restricted to M.Arch., B.Arch., and BEDA seniors. Non-architecture majors by instructor's permission.
Typically offered in Fall only

ARC 542 Sacred Architecture (3 credit hours)
This course focuses on the meaning and cultural significance of sacred architecture, including its environmental and socio-political contexts, and doctrinal and liturgical influences. The course is structured according to the world's principal faiths and presented comparatively and holistically. There is a particular emphasis on the communicative roles of architecture and the symbolism and ritual use of sacred places. Contemporary theoretical methodologies are introduced and applied as means establish relevancy to contemporary issues and architectural design. Restricted to graduate students.
Typically offered in Fall only

ARC 543 Analysis of Precedent (3 credit hours)
Investigation of architectural elements, relationships and ordering ideas through comparative graphic analysis of buildings designed by architects. Emphasis on buildings as physical artifacts.
Prerequisite: Grad. standing
Typically offered in Spring only

ARC 544 American City Planning History (3 credit hours)
An examination of the history of American cities, their founding, plans, and development with emphasis on the colonial era to the late 19th century. Broad study of the larger historical trends in city planning balanced by readings focused on major cities (New York, Chicago, Los Angeles) and smaller ones (Savannah, New Orleans). Major issues include street patterns, parks, and public buildings and spaces; and the roles of government and private citizen groups. Restricted to graduate students in the MArch, seniors in the BArch, and seniors in the BEDA programs; or by permission of the instructor.
Prerequisite: ARC 241 and ARC 242 and ARC 441 or permission of instructor.
Typically offered in Fall only

ARC 545 Methods of Interpretation in Architectural History (3 credit hours)
This seminar surveys the materials, methods, and texts of architectural history as an analytical discipline of the built environment. A broad selection of readings will trace the evolution of the discipline and will position architectural history in relation to such fields as architecture, art history, urban and social history, anthropology, literature, cultural studies, urban planning, and architectural theory. The course is restricted to graduate students and serves as one of the alternate required courses for the Concentration in the History and Theory of Architecture.
P: ARC 241 and ARC 242 and ARC
Typically offered in Fall only
ARC 546 Theory of Building Types (3 credit hours)
Theoretical implications and practical applications of typology in architecture. Analysis and documentation of selected building types in their historical evolution. Graphical identification of type characteristics.
Prerequisite: Two ARC studios
Typically offered in Fall only

ARC 548 Vernacular Architecture (3 credit hours)
Readings in theories of vernacular architecture. Case studies of selected examples of vernacular architecture of the world: architectural analysis of utilitarian, tectonic, and perceptual aspects of buildings and urban fabrics against the background of place and culture. Examination of influences of various vernacular traditions on contemporary practice.
Prerequisite: M.Arch student without an undergraduate degree in architecture must have completed ARC 211, ARC 241, ARC 232
Typically offered in Fall only

ARC 551 The Practice of Architecture (3 credit hours)
A lecture course examination of the practice of architecture through a lecture course, with emphasis upon both normative and emerging procedures in the private architectural firm. Special attention upon the role and function of the practicing architect, legal and regulatory conditions, the nature of professional services, office management and project management processes.
Typically offered in Fall and Spring

ARC 552 Legal Issues in Architecture (3 credit hours)
The main principles of law affecting the profession of architecture as it is influenced by contracts, torts, agency, property, and environmental restrictions.
Prerequisite: Architecture Majors, ARC 561
Typically offered in Fall only

ARC 553 Public Interest Design Seminar: Case Studies and Current Issues (3 credit hours)
This course evaluates and appraises design in the public interest as a critical and growing element of design disciplines. We explore how design can positively contribute to the social, economic, and environmental well-being of US and global communities. We study current innovations and review successful examples of projects and practice. In addition to lectures by the professor, presentations are made by professionals and experts in public interest design.
The class is open to Architecture Graduate Students in the College of Design. Other NCSU students may enroll by permission of Instructor. Typically offered in Spring only

ARC 570 Anatomy of the City (3 credit hours)
A morphological investigation of cities throughout urban history, with emphasis on formal principles of spatial organization. Part one: examination of the descriptive properties of cities in terms of interdisciplinary concepts and principles. Part two: examination of the organizational characteristics of urban space.
Typically offered in Fall only

ARC 571 Urban House (3 credit hours)
This seminar is intended to investigate the interrelationships between the form of housing and the demands of a rapidly changing society. Reference is made to the physical, economic, social, cultural, and economic factors that influence housing design.
Prerequisite: Graduate standing
Typically offered in Spring only

ARC 572 Regional Infrastructures (3 credit hours)
This seminar provides students with a solid knowledge base about current urban issues and design theory surrounding the contemporary networked metropolis. Through lectures, discussions, and workshops the course examines how infrastructural systems might be expanded in order to catalyze additional environmental, social, and economic processes. Students research specific infrastructural systems (conducting food, water, or energy) at a systems-defined regional scale to better understand the characteristics of 21st century American cities and speculate on new opportunities for architects and landscape architects to practice. Restricted to M. Arch, B. Arch, BEDA seniors, and M. LArch.
Restricted to: M. Arch, B. Arch, BEDA seniors, and M. LArch
Typically offered in Spring only

ARC 574 Place and Place Making (3 credit hours)
Examination of the definitions, concepts and emergent research findings useful in explaining the human sense of place through seminar-lecture course. Particular emphasis upon those physical aspects and relationships influencing this sense of place and affording some designer control.
Prerequisite: Graduate standing
Typically offered in Fall only

ARC 576 Community Design (3 credit hours)
Processes through which citizens shape and manage built environment. Strategic planning, visioning process, community action, and mediation will be discussed and illustrated with case study examples from architecture, landscape architecture and planning. Analysis and assessment from case studies of participation techniques such as charrette, study circles, and visual appraisal.
Typically offered in Fall only

ARC 577 Sustainable Communities (3 credit hours)
Typically offered in Fall only

ARC 581 Project Preparation Seminar (3 credit hours)
Quantitative and qualitative conditions, considerations and determinants as preparation for architectural design. Emphasis on research methods, data collection and interpretation, theoretical discourse, site analysis, programming and architectural precedent. Required enrollment in B.Arch.
Typically offered in Spring only

ARC 589 Architectural Travel Study II (3 credit hours)
Independent study while traveling. Submission of sketchbook/journal and paper upon return. Research on topic of concentration and approval of itinerary in advance required. Graphic documentation and critical evaluation of buildings and urban spaces. Requires
Typically offered in Fall, Spring, and Summer
ARC 590 Special Topics in Architecture (1-6 credit hours)
Topics of current interest by faculty in the Department of Architecture. Subjects under this number normally to test and develop new courses.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ARC 598 Final Project Studio In Architecture (6 credit hours)
Final project for graduate students supervised by members of their graduate advisory committee. Requires department approval.

Prerequisite: 18 hrs. of ARC 503 and ARC 697
Typically offered in Fall and Spring

ARC 610 Special Topics in Architecture (1-6 credit hours)
Special Topics in Architecture

ARC 630 Independent Study (1-3 credit hours)
Development of research and projects in various aspects of architecture under the direction of architecture faculty member on tutorial basis. Requires a faculty sponsor and departmental approval.

Prerequisite: Master's student
Typically offered in Spring only

ARC 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall and Spring

ARC 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall and Spring

ARC 696 Summer Thesis Res (1 credit hours)

ARC 697 Final Project Research in Architecture (1-6 credit hours)
Investigation of selected problems and projects in architecture of particular interest to graduate students under the direction of a faculty member on a tutorial basis. Credits and content vary to meet the scope of the project proposal.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ARC 896 Summer Dissert Res (1 credit hours)

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Art and Design (ADN)

ADN 111 Introduction to Two-Dimensional Design (3 credit hours)
An introduction to the fundamentals of design studies through two dimensional problems. The basic elements and concepts of design explored as abstract and applied problems through design issues. Provides non-design students an introduction to design principles.

Typically offered in Fall, Spring, and Summer

ADN 112 Introduction to Three-Dimensional Design (3 credit hours)
An introduction to the fundamentals of design studies through three-dimensional problems. The basic elements and concepts of design explored as abstract and applied problems through the design issue. Provides non-design students a working knowledge of design principles.

Typically offered in Fall and Spring

ADN 200/DS 200 A Survey of Design Studies (3 credit hours)
This course will introduce students to a variety of perspectives and lenses through which to examine and evaluate design in the world. Students will consider design studies through theory and criticism of design, as well as applied to business administration, museum studies, and environmental studies. In addition, students will be encouraged to find evidence of and define design studies in areas that are uniquely suited to their individual areas of interest. As an advised elective, this course is required for Design Studies majors who are sophomores in their major.

Typically offered in Fall only

ADN 202 Design Studio: Art & Design in Context (6 credit hours)
Emphasis on fundamental Art & Design visual language through investigative problem solving.

Prerequisite: D 104, D 105, or permission of department, ADN majors only
Typically offered in Spring only

ADN 203 Art + Design Sophomore Studio II (3 credit hours)
The Art + Design Sophomore Studio series includes four required courses of three-credit hours each to be completed in the sophomore year. ADN 202 and ADN 203 are offered in the fall semester. ADN 204 and ADN 205 are offered in the spring semester. The A + D Sophomore Studio series explores as abstract and applied problems through design issues.

Prerequisite: ADN 201, or permission of department, ADN majors only
Typically offered in Fall only

ADN 204 Art + Design Sophomore Studio Spring (6 credit hours)
The Art + Design Sophomore Studio series includes two required courses of six-credit hours each to be completed in the sophomore year. ADN 202 is offered in the fall semester. ADN 204 is offered in the spring semester. The Art + Design Sophomore Studio series explores as abstract and applied problems through design issues.

Typically offered in Spring only

ADN 212 Photography I (3 credit hours)
Introduction to the processes and visual skills necessary for the beginning photographer. Darkroom experimentation, pinhole camera, basic rudiments of camera use, film development and printing. Exploration of issues related to the quality of visual communication.

Typically offered in Fall and Spring
ADN 219 Digital Imaging I (3 credit hours)
Introduction to exploring, creating, and modifying images through the use of computers. Emphasis is on creativity, experimentation, and intuitive image-making using various computer techniques.

Prerequisite: D104 or ADN 111
Typically offered in Fall and Spring

ADN 220 Digital Illustration I (3 credit hours)
Hands-on exploration of digital drawing, painting, and image editing techniques with the use of pressure sensitive digital drawing tablets and image editing software; Development of ability to design and communicate convincing 3-dimensional forms and environments using 2D digital techniques with an emphasis on gesture, shape, volume, intuitive perspective, color, and light; Application of design process and research to generate images for visual concept development; Examination of relationships between historic and contemporary conventions for traditional and digital image-making.

Typically offered in Fall and Spring

ADN 221 Digital Illustration II (3 credit hours)
Hands-on exploration of digital drawings, painting, and image editing techniques with the use of pressure sensitive digital drawing tablets and image editing software; Development of ability to integrate multiple visual elements to illustrate narratives and create illusionistic environments. Emphasis shot design, linear perspective, light, color, texture, and atmosphere; Application of design process and research to generate images for visual concept development and mood; Examination of relationship between historic and contemporary illustration, compositing, and matte painting techniques.

Prerequisite: ADN 220
Typically offered in Fall and Spring

ADN 224 Digital Motion (3 credit hours)
Hands-on exploration of motion, animation principles, and keyframing strategies; Development of animated experiments and sequences that focus on convincing and exaggerated movement, physics, and acting; Introduction to range of key animation software and techniques. Restricted to Art and Design Majors Only

Typically offered in Spring only

ADN 226 Sequential Imaging (3 credit hours)
Hands-on development of story-boards, story-reels, and animatics to plan and examine visual sequences; Development of freehand sketching techniques; Exploration of drawing and image-making as a tool for visual and conceptual development; Examination of traditional and contemporary visual storytelling techniques and conventions; Exploration of common strategies for developing narrative structure. Restricted to Art and Design Majors Only.

Typically offered in Fall only

ADN 227 Introduction to Printing and Surface Design (3 credit hours)
Design and production of screen printed, painted and pattern-dyed fabrics. Development of design abilities (color use, pattern generation) and technical skills (screen printing, painting, use of fabric dyes). Production of fabric samples, studies, yardage, and/or end products. Awareness of industrial processes.

Prerequisite: C- or better in D104, ADN 111, or ADN 112
Typically offered in Fall and Spring

ADN 273 Fibers Materials and Processes (3 credit hours)
Introduction to historical and contemporary hand processes used by the textile designer. Students will learn a variety of textile techniques utilizing traditional and experimental methods. Emphasis will be on technical exploration and development.

Prerequisite: ADN 111 or ADN 112 or D 105
Typically offered in Fall and Spring

ADN 274 Basic Woven and Constructed Textiles (3 credit hours)
Hands-on introduction to structures and techniques of hand weaving and related off-loom textile structures. Focus on basic hand weaving techniques, including plain weave, twills and satins, acquired through threading the loom and weaving with a variety of materials. Off-loom techniques explore a variety of structures made with simple hand tools. Projects focus on materials choice; color experimentation and control; pattern manipulations; scale and balance; and the design process as applied to hand constructed textile artifacts.

Typically offered in Fall only

ADN 275 Survey of Fibers in Art and Design (3 credit hours)
This course introduces the student to the vast world of fibers within the Art-Design community and industry. Students will learn the basics of fiber construction and terminology and explore the specialties within the fibers world (including costume design, fashion, fiber art, textile design, etc.). College of Design students only.

Design Students Only
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

ADN 276 Soft Construction I: Sewing (3 credit hours)
Students will gain a fundamental understanding of traditional sewing and construction techniques using both hand and machine methods. Students may incur additional costs for project supplies. Please note that seats in this course are reserved for College Students Only.

Prerequisite: Design Majors
Typically offered in Fall only

ADN 281 Drawing I (3 credit hours)
A beginning descriptive drawing experience which teaches students to see, analyze, and transcribe observed subject matters. The transcription incorporates formal drawing issues (line, form, texture) with traditional and contemporary material space exploration.

Prerequisite: Design Majors and Design Minors
Typically offered in Spring only

ADN 288 History of Art + Design: 1918 to the Contemporary World (3 credit hours)
A survey of the History of Art and Design, 1918 to the present, focused on innovative work done in the areas of advertising, animation, comic books & graphic novels, fine arts, and emerging practices in the 21st Century, including Virtual Reality and User Experience design. Attention is paid to evolving definitions of visual culture and their critiques utilizing art historical frameworks to introduce students to methodological approaches in the field.

Typically offered in Spring only

ADN 292 Special Topics in Art + Design (1-3 credit hours)
Topics of current interest in the School of Design. Used to develop new courses.

Typically offered in Fall and Spring
ADN 311 Art + Design Laboratory I (3 credit hours)
Study of creative and contextual skills that relate to Art & Design areas of focus.
Prerequisite: ADN 111, ADN 112
Typically offered in Fall and Spring

ADN 312 Photography II (3 credit hours)
Continuation of an advanced level of the skills and techniques developed in Basic Photography. Purpose is to develop use of camera as a perceptive tool to increase awareness and sensitivity of visual imagery.
Prerequisite: ADN 212
Typically offered in Fall and Spring

ADN 319 Animation I (3 credit hours)
An intensive introduction to animation which integrates traditional hand generated animation, digital techniques and technology. Students will explore animation's fundamental principles of linear formats, sequenced movement and time-based imaging.
Prerequisite: ADN 219
Typically offered in Fall and Spring

ADN 371 Soft Construction II: Sculptural Geometry (3 credit hours)
Students will learn advanced problem solving skills through the creation of the basic set of fashion patterns and the integration of design details. Students may incur additional costs for project related supplies. This course requires field trips as po
Prerequisite: Design Majors and Design Minors
Typically offered in Fall and Spring

ADN 372 Surface Embellishment (3 credit hours)
Hands-on experimentation with classic hand, machine, and digital stitching techniques on fabric; personal exploration of non-traditional materials and applications at different scales; and examination of historic and contemporary stitching through visits to the Gregg Museum and directed library and internet research.

Typically offered in Fall and Spring

ADN 373 Survey of the Fashion Industry and Design (3 credit hours)
Students will be introduced to the fashion industry, fashion history, creative process, behind the scenes, and presentation skills. Please note that 50% of seats are reserved for College of Design or Art + Design Minor (v) students only.
Typically offered in Spring only

ADN 384 Painting I (3 credit hours)
Introduction to the principles of painting through class projects that expose students to different painting materials and techniques. Students learn to build a stretcher, size and prime a canvas as well as other rigid painting surfaces. Acrylic and oil paint used; projects assigned and open themes.
Prerequisite: D 104 or both ADN 111 and ADN 112.
Typically offered in Fall only

ADN 418 Contemporary Issues in Art and Design (3 credit hours)
Explore a range of issues about contemporary art and design ideologies. Concentration on selected readings which provide a platform for discussion of various ideas, approaches, perspectives and practices in the contemporary fields of art and design.
Prerequisite: DS 100 and DS 200 and ADN 202 and ADN 400; Requisite: Junior Standing in ADN or Design Studies
Typically offered in Fall and Spring
ADN 419 Creative Technology Studio I (3 credit hours)
Intensive hands-on investigation of the tools, techniques, and processes for the development of interactive multi-media projects. Media teams will emphasize shaping an idea into a well thought-out design that works as an interactive experience.

Prerequisite: D 105, ADN 219
Typically offered in Fall and Spring

ADN 423 Digital Modeling (3 credit hours)
Hands on introduction to 3D digital modeling tools and techniques for artists and designers who want to expand their skill sets to include 3D practices. The course has applications in several disciplines including: animation, illustration, surface design, and concept development. Explores the use of surface textures, lighting, and compositing. Examines strategies for using 3D tools to create prototypes for physical objects, integrate 3D elements into 2D images, and create models for animation. Restricted to Art and Design Majors Only.

Typically offered in Fall only

ADN 428 Art and Design: Theory and Practice (3 credit hours)
Conceptual basis for developing a personal philosophy regarding the practice of art and design. Theory based history of diverse cultures and forces of change: political, economic, religious, social, intellectual and philosophical as they affect the fields of art and design.

Prerequisite: Senior Level (6 studios), Art and Design Major
Typically offered in Fall only

ADN 460 Creative Technology Studio II (6 credit hours)
An intensive study of advanced image-making processes, software, and various computer platforms used in the creation of multimedia. In a studio mode, students will place emphasis on creating interactive interface systems with audio and special effects.

Prerequisite: ADN 219 and ADN 400
Typically offered in Fall and Summer

ADN 470 Fibers and Surface Design Studio (6 credit hours)
Practice of widely varying textile techniques with the solving of practical and conceptual design problems. Textile end products are designed and produced at full scale in appropriate materials. Focus includes weaving, knitting, printing and dyeing of fabrics, and a wide variety of fabric construction and embellishment processes. Textile history is an ongoing part of the study. Emphasis on synthesis of techniques and ideas.

Prerequisite: Grade of C- or better in (ADN 400 or ARC 202 or ID 202 or GD 202)
Typically offered in Fall and Spring

ADN 472 Advanced Surface Design (3 credit hours)
Advanced problems in the design and production of hand-printed and pattern-dyed fabrics. Experimentation with advanced color application techniques. Exploration of pattern and image production on fabric and development of design abilities in textilemedi

Prerequisite: D 104, ADN 272
Typically offered in Fall and Spring

ADN 473 Advanced Three-Dimensional Fibers Forms and Structures (3 credit hours)
Advanced explorations of three-dimensional textiles forms and structures including works small and large scale installations and sculptures, planar structures in space, and textiles that interact with interior or exterior architecture, the body, or public or site-specific spaces. Technical focus on construction, joining mixed materials, armatures, integration of found materials, and both traditional and experimental structures and applications. Use of hand and power tools.

Prerequisite: ADN 273 or equivalent
Typically offered in Fall and Spring

ADN 474 Advanced Digital Hand Weaving (3 credit hours)
Introduction to use of the computer as a tool for designing, drafting, and hand weaving, using simple software packages. Hand weaving on 24-harness computer assisted looms, 8 harness hand looms, and TC-1 digital hand jacquard loom. 4 to 24 harness woven structures including twill, satin, shadow weave, double weave, woven shibori, dyed warps, and other weave structures. Focus on designing, technical skills, and solving technical problems.

Typically offered in Fall and Spring

ADN 475/ADN 575 Pre-Industrial World Textiles (3 credit hours)
Research on and discussion of hand-made textiles of the world, introducing major textile traditions from Africa, Asia, Europe, North and South America. Focus on geographic and cultural contexts, developments in making, and design characteristics, including impact of 20th century fiber art movements. Seminar format.

Prerequisite: Sophomore standing
Typically offered in Spring only

ADN 480 Intermediate Studio (6 credit hours)
Studio format offering upper level undergraduates the opportunity to intensively study general design issues (form, color, structure, proportions, scale, etc.) through individual study in drawing, painting, sculpture, photography, or printmaking.

Prerequisite: Grade of C- or better in (ADN 400 or ARC 202 or ID 202 or GD 202)

ADN 481 Drawing II (3 credit hours)
An intermediate-level drawing course that further develops the designer's graphic, analytic, observational, and conceptual skills.

Prerequisite: ADN 281
Typically offered in Fall and Spring

ADN 484 Painting II (3 credit hours)
An intermediate-level painting course that through slide lectures, class projects, and assigned readings exposes students to contemporary painting art movements. Special emphasis given to the formal and interpretative analysis of a painting. Acrylic and oil paint are used; Projects have assigned and open themes.

Prerequisite: D 105 or both ADN 111 and ADN 112.
Typically offered in Fall and Spring

ADN 486 Sculpture II (3 credit hours)
An intermediate-level sculpture course that further develops the designer's analytic, observational, and conceptual skills.

Prerequisite: ADN 386
Typically offered in Fall only
ADN 490 Art and Design International Studio (6 credit hours)
Define Art and Design problems and develop design solutions in an international setting. Studio projects related to design, culture, and traditional and contemporary art forms. Focus on artifact making through direct studies. Taught off campus.
Prerequisite: Junior standing, Design Majors, Approval Study Abroad Office
Typically offered in Fall, Spring, and Summer

ADN 491 Special Seminar in Art + Design (1-3 credit hours)
Seminars on subjects of current interest in art + design.
Typically offered in Fall and Spring

ADN 492 Special Topics in Art + Design (1-3 credit hours)
Topics of current interest in Design & Technology. Used to develop new courses.
Typically offered in Fall and Spring

ADN 493 Art and Design Senior Lecture (3 credit hours)
ADN 493 is a capstone course for seniors in Art and Design. The course prepares and equips students with the necessary tools and communication skills to present themselves professionally as competent practitioners. Students are required to integrate their academic knowledge and skills into a personal capstone project. The project is the focus of the final examination.
Prerequisite: ADN 219, ADN 281, completion of a 400 level studio; Corequisite: ADN 202 or ADN 400 or ADN 460 or ADN 470, or ADN 480
Typically offered in Fall only

ADN 494 Internship in Art + Design (1-6 credit hours)
Supervised field experience in design offices, galleries, museums and other organizations. Maximum of 6 credit hours. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.
Prerequisite: Junior standing; 3.0 GPA or better
Typically offered in Fall, Spring, and Summer

ADN 495 Independent Study in Art + Design (1-6 credit hours)
Special projects in art and design developed under the direction of a faculty member on a tutorial basis. Maximum 6 credit hours. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.
Prerequisite: Junior standing in Design with 3.0 in Design or better
Typically offered in Fall and Spring

ADN 496 The Business of Art and Design (3 credit hours)
A distance education elective course (ADN & DS) that introduces students to the mechanics of gainfully applying their fine and applied arts and/or design education. The course is not discipline specific. The business of design, principles of branding, project management, entrepreneurship and business development are explored through case studies, virtual class forums, independent and group assignments, and assigned readings. The course engages students in the development and management of design business planning, models, and philosophies with emphasis on social responsibility. Through coursework, students foster interpersonal, group, and leadership competencies.
Typically offered in Spring only

ADN 500 Graduate Seminar I: Software, Platforms + Environments (3 credit hours)
This course will introduce first semester Art + Design graduate students to historical and foundational theories of design and media studies-specifically related to platforms, environments and networks-to better understand the myriad ways these ideas have impacted artistic and design-based practice.
Restriction: Art + Design Graduate Students Only. Non-majors by permission of the instructor
Typically offered in Fall only

ADN 501 Graduate Seminar: Art + Design as Future Making (3 credit hours)
This graduate-level Art + Design seminar looks at theories and methods that are impacting experimental media art in contemporary practice as well as how these contemporary practices might inform future art and design-making practices. Topics in the course expose students to a wide breadth of ideas, with the opportunity to dive more deeply into concepts that are personally and professionally intriguing. Topics include: speculative and participatory art + design; biomimicry; artificial intelligence; and technology and ethics. Methods include examining idea sources, process, documentation, critiquing, speaking, and writing about visual concepts.
Restriction: Graduate Students in Art + Design or permission of the instructor. This is a requirement for all Master of Art + Design Students.
Typically offered in Fall and Spring

ADN 502 Advanced Visual Laboratory (3 credit hours)
ADN 502 is a general title of Advanced Visual Laboratories under the supervision of an Art and Design faculty member to provide intensive experimental work in various phenomena and disciplines related to design.
Typically offered in Fall and Spring

ADN 560 Graduate Studio I: Immersive and Experimental Narratives (6 credit hours)
Graduate Studio in Art and Design that introduces students to multiple modes of creating immersive and experiential narratives through platforms and methods such as animation and motion design, augmented reality, virtual reality, mixed reality and computational art and design.
Restriction: Art + Design Graduate Student or permission of the instructor
Typically offered in Fall only

ADN 561 Graduate Studio II: Exploring the HyperReal: Materiality, Reality and Speculation (6 credit hours)
This graduate studio will explore elements of Speculative Design that use design fiction, future casting and critical design principles to examine the past, present and future of experimental design and media experiences. Students will explore different elements of materiality and how experiences are shaped by the tangible, haptic and immersive nature of technology and media.
Typically offered in Spring only
ADN 570  Graduate Studio III: Final Project Definition  (6 credit hours)
This course will provide structure to the final project development for Master of Art + Design Students. Throughout the course, students will be working independently, with instructor guidance and mentorship to develop unique, novel projects that explore new forms of immersive narrative and interactive experiences and push technical boundaries and platforms. Guest lectures and workshops may be brought into the studio throughout the semester.

Restriction: Art + Design Graduate Student or permission of the instructor

Typically offered in Fall and Spring

ADN 571  Fibers and Surface Design Seminar  (3 credit hours)
Seminar on current professional issues in fibers and surface design, focusing on theory, history, critical analysis, and philosophy. Reading, discussion, presentations, research, and writing about contemporary and historical thought in the field.

Prerequisite: ADN 503
Typically offered in Spring only

ADN 575/ADN 475  Pre-Industrial World Textiles  (3 credit hours)
Research on and discussion of hand-made textiles of the world, introducing major textile traditions from Africa, Asia, Europe, North and South America. Focus on geographic and cultural contexts, developments in making, and design characteristics, including impact of 20th century fiber art movements. Seminar format.

Prerequisite: Sophomore standing
Typically offered in Spring only

ADN 581  Final Project Research  (3 credit hours)
Directed research to prepare background documentation for the final project, including historical and contemporary context, formation of project parameters, statement of goals, and documentation/project outline.

Typically offered in Fall and Spring

ADN 588  Independent Study in Art & Design  (1-3 credit hours)
Independent study in art and design under the supervision of a specific Art & Design faculty member. Restricted to graduate students in Art & Design with consent of the supervising faculty. May not be taken in the first semester of graduate study

Prerequisite: ADN 503; and ADN 570
Typically offered in Fall, Spring, and Summer

Typically offered in Fall and Spring

ADN 585  Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master’s student
Typically offered in Spring only

ADN 688  Non-Thesis Masters Continuous Registration - Half Time Registration  (1 credit hours)
For students in non-thesis master’s programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master’s exam, etc.

Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

ADN 689  Non-Thesis Master Continuous Registration - Full Time Registration  (3 credit hours)
For students in non-thesis master’s programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master’s exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master’s student
Typically offered in Fall and Spring

Arts Studies (ARS)

ARS 251  The Arts of a World Capital: London  (3 credit hours)
Multidisciplinary course introducing students to the architecture and museums and the musical, dance, and theatrical performances of London. Historical and social context of these works of art. The infrastructure in London that makes its unusual artistic vitality and quality possible. Taught in London.

GEP Global Knowledge, GEP Humanities, GEP Visual and Performing Arts
Typically offered in Summer only

ARS 252  The Arts of Vienna 1900  (3 credit hours)
Interdisciplinary study of art, architecture, music and theater in turn-of-the-century Vienna and of the political and scientific thinking that surrounded these arts. Taught in Vienna.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Summer only

ARS 257/STS 257  Technology in the Arts  (3 credit hours)
The interaction between technology and the arts with an emphasis on developments in Western art of the twentieth century. Historical and emerging issues include: sound and film recordings, the addition of sound to films, the impact of films and television on theater, the impact of radio, computer applications to music, the visual arts, and literature.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring
ARS 258 Mathematics and Models in Music (3 credit hours)
Use of mathematics and models in the composition of western music of various time periods with an emphasis on the twentieth century. Critical analysis of trivial and non-trivial uses of mathematics; differentiation between mathematics as an analytical tool and mathematics as a compositional tool. Survey of models including geographical, grammatical, and graphic.

Typically offered in Spring only

ARS 259 The Arts and Politics (3 credit hours)
Interactions between the arts and politics. Specific instances and types of political art from the past and the present. Patronage, censorship, propaganda, art in times of war, the artist's options and powers, aesthetics and criticism.

GEP Visual and Performing Arts
Typically offered in Fall only

ARS 306/MUS 306 Music Composition with Computers (3 credit hours)
Survey of the theory and history of computer music, compositional algorithms, digital synthesis techniques, composition of at least one computer music work -- a computer-assisted composition for traditional instruments, a piece for computer music on tape, a real-time piece, or a piece that combines tape and instrument(s).

Prerequisite: Some knowledge of music or computer science (e.g. CSC 200)

GEP Visual and Performing Arts
Typically offered in Fall and Spring

ARS 346/AFS 346 Black Popular Culture (3 credit hours)
A multidisciplinary examination of contemporary black cultural expression in film, music, art, and the media. Emphasis on race, class, gender, and political discourse. This class may be scheduled with a small percentage of seats held for IDS Students Only.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

ARS 351 Arts, Ideas and Values (3 credit hours)
An examination of the way works of art embody a particular understanding of what is real and what is worthwhile and shape their viewers' ideas and values. Case studies approach.

GEP Visual and Performing Arts
Typically offered in Spring only

ARS 353 Arts and Cross-Cultural Contacts (3 credit hours)
Study of works of art that allude to or combine two or more traditions. Examples from film, dance, music, theater and visual arts. Analysis of the role of the exotic in art. The role of arts of multiple traditions in inaugurating new artistic movements, such as Ming landscape painting. Impact of electronic media on contemporary multicultural arts, such as Nepali pop.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall and Spring

ARS 354 The Arts and the Sacred (3 credit hours)
The support and critique of religion through the arts. Study of religious symbolism embodied in works of art from a number of traditions and genres. The interrelationship between art and religion, history, culture, spirituality, and ritual.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

ARS 414 Interdisciplinary Arts Seminar (3 credit hours)
Creation and presentation of new interdisciplinary works of art. Theory and history of such works including discussion of mixed media, multimedia and intermedia. In-class presentations and critiques. Eventual presentation of finished works in appropriate venues. Additional expenses will be incurred for Arts Now Series events

Typically offered in Fall only

ARS 494 Topics in Arts Studies (3 credit hours)
Multi-arts course focusing on selected works of art in various media, related by theme, place or date. Capstone course for students with an extensive background in one of the arts. Topics may vary.

Prerequisite: Junior standing and 15 hours in either dance, design, film studies, music, theater, or visual arts.

Typically offered in Fall and Spring

ARS 498 Independent Study in Arts Studies (1-3 credit hours)
Independent study or project directed by a faculty member in the student's area of interest. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student

Prerequisite: Nine hours of course work in Arts Studies

Typically offered in Fall, Spring, and Summer

Arts Village (AVS)

AVS 100 Arts Village Forum (1 credit hours)
Direct experience with multiple arts events at the university and across the Triangle area. Through pre- and post-event presentations, discussions, and written responses, students will gain a deeper awareness of a wide variety of artistic structures, meaning, interpretation, and values. Transportation to off-campus arts events will be provided. For Arts Village Students only.

Typically offered in Fall and Spring
Biochemistry (BCH)

BCH 101/MB 101 Introduction to Microbiology and Biochemistry Laboratory Practices (3 credit hours)
Curricular bridge between high school and college for high school and transitional students. A “hands on” introduction to fundamentals in Microbiology and Biochemistry. Bacterial isolation, identification and growth using aseptic technique, microscopy, and metabolic analysis. Experiments with DNA isolation and analysis, protein isolation, and purification, and enzyme kinetics. Lectures and readings on background, theory and applications of these techniques. Field trips to university and industry research laboratories. This course is part of the Summer College in Biotechnology and Life Sciences (SCIBLS) as well as other pre-college, transitional and early-college programs and is offered as a 4 week intensive course. Applicants should have completed high school courses in biology and chemistry. Students must have completed no more than 30 credit hours. Departmental approval is required for current NCSU students.

Typically offered in Summer only

BCH 103 Introduction to Biochemistry (1 credit hours)
Introduction to curriculum and career requirements for biochemistry and being a successful student at NCSU. Emphasis is placed on curricular requirements, interactions with faculty and students in the Department of Molecular and Structural Biochemistry, introduction to key resource programs on campus, exposure to research opportunities and ongoing career planning. Enrollment is limited to new or transfer Biochemistry majors with less than 45 hours.

Typically offered in Fall only

BCH 220 Role of Biotechnology in Society (3 credit hours)
Role of Biotechnology in Society is an introductory science course that takes a semi-technical look at the emerging role of biotechnology in human society. Expectations are that students will gain an appreciation for biotechnology and gain the ability

Prerequisite: BIO 181, CH 101

GEP Interdisciplinary Perspectives

Typically offered in Summer only

BCH 330 Physical Biochemistry (3 credit hours)
This course provides a descriptive survey of the concepts of physical chemistry with emphasis on their use in applications designed to characterize and manipulate biological molecules and systems. Topics are drawn from thermodynamics (bonding, protein folding energies, linkage, spectroscopic and differential scanning calorimetric binding measurements), kinetics (enzymatic catalysis, perturbation techniques), statistical mechanics (distributions, ensembles, molecular mechanical & dynamics calculations), electrochemistry, hydrodynamics (diffusion, friction, electrophoresis, viscosity, sedimentation, organism size and shape), quantum mechanics (wave functions operators, uncertainty principle, dipoles, orbitals and resonance energy coupling), and spectroscopy (absorbance and light scattering, fluorescence, nuclear and electronic paramagnetic resonance, MR imaging and x-ray diffraction).

Prerequisite: CH 201 or CH 203 and (BCH 351 or BCH 451) and (MA 231 or MA 242) and (PY 208 or PY 212)

Typically offered in Spring only

BCH 351 General Biochemistry (3 credit hours)
This course is an introduction to the basic principles of biochemistry. It emphasizes biochemical structures, properties, and functions, including enzyme kinetics and major metabolic processes. It can serve as a prerequisite for BCH 452 with permission of the department. This course is designed for those students who are not majoring in Biochemistry and do not require a more comprehensive introduction to biochemistry. It is not intended for graduate students. Credit is not allowed for both BCH 351 and BCH 451. Prerequisites CH 223 (or CH 227) and BIO 183 are required. CH 201 (or CH 203) is strongly recommended, but not required.

Prerequisite: CH 223 (or CH 227), BIO 183

Typically offered in Fall, Spring, and Summer

BCH 451 Principles of Biochemistry (4 credit hours)
Introduction to and survey of the fundamental principles of biochemistry, emphasizing the chemistry of living organisms, chemical structures, and interactions of and between biomolecules.

Prerequisite: CH 101 (or CH 103), CH 102 (or CH 104), CH 201 (or CH 203), CH 202 (or CH 204), CH 221 (or CH 225), CH 222 (or CH 226), CH 223 (or CH 227), CH 224 (or CH 228), and BIO 183

Typically offered in Fall, Spring, and Summer

BCH 452 Introductory Biochemistry Laboratory (2 credit hours)
Laboratory experiences in this course are designed to compliment the first semester undergraduate biochemistry course, BCH 451. Basic skills to be mastered include the use of volumetric equipment, spectrophotometers, chromatography, and electrophoresis. You will also learn to assay small quantities of biological materials and analyze data. You will learn to manipulate biochemical materials from three of the four major subgroups: proteins, nucleic acids and carbohydrates. You will determine structural elements at a number of analytical levels and learn how to think about their functional capabilities. We will emphasize theoretical information, while discussing how the techniques work. The explanations discuss how the techniques work. We focus on how consecutive methods are interconnected to form process chains.

Prerequisite: CH 101 (or CH 103), CH 102 (or CH 104), CH 201 (or CH 203), CH 202 (or CH 204), CH 221 Organic Chemistry I (or CH 225), CH 222 (or CH 226), CH 223 (or CH 227), CH 224 (or CH 228), BIO 183 and BCH 451 (may serve as corequisite or prerequisite).

Typically offered in Fall and Spring

BCH 453/BCH 553 Biochemistry of Gene Expression (3 credit hours)

Prerequisite: BCH 451, Corequisite: GN 311, MB 351

Typically offered in Fall and Spring

BCH 454 Advanced Biochemistry Laboratory (4 credit hours)
Hands on experience with the techniques of molecular biology and protein purification. Cloning and expression of a eukaryotic gene in bacteria will be performed followed by purification of the eukaryotic gene product. Microanalysis of DNA, RNA and protein.

Prerequisite: BCH 451 & BCH 452; Corequisite: BCH 453

Typically offered in Fall and Spring
**BCH 455/BCH 555  Proteins and Molecular Mechanisms  (3 credit hours)**
Principles of protein structure and function, protein folding, enzymology, ligand binding, protein transport, and metabolic pathways.
Prerequisite: BCH 451, BCH 453/553
Typically offered in Fall and Spring

**BCH 492  External Learning Experience  (1-6 credit hours)**
A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and academic dean prior to the experience.
Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

**BCH 493  Special Problems in Biochemistry  (1-6 credit hours)**
A learning experience in agriculture and life sciences within an academic framework that utilizes campus facilities and resources. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.
Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

**BCH 495  Special Topics in Biochemistry  (1-5 credit hours)**
Offered as needed to present materials not normally available in regular BCH departmental courses or for new BCH courses on a trial basis.
Prerequisite: Junior standing.
Typically offered in Fall, Spring, and Summer

**BCH 552  Experimental Biochemistry  (3 credit hours)**
An advanced laboratory to give students practical experiences in purification and quantitative characterization of enzymes and nucleic acids. Studies with carbohydrates and membrane lipids. Credit may be applied toward biotechnology minor.
Prerequisite: BCH 452: BCH 453
Typically offered in Fall and Spring

**BCH 553/BCH 453  Biochemistry of Gene Expression  (3 credit hours)**
Prerequisite: BCH 451, Corequisite: GN 311, MB 351
Typically offered in Fall and Spring

**BCH 555/BCH 455  Proteins and Molecular Mechanisms  (3 credit hours)**
Principles of protein structure and function, protein folding, enzymology, ligand binding, protein transport, and metabolic pathways.
Prerequisite: BCH 451, BCH 453/553
Typically offered in Fall and Spring

**BCH 560  Molecular Biology for Teachers  (3 credit hours)**
Introduction to molecular biology for teachers. Emphasis will be on developing basic laboratory skills applicable to middle or high school biology classes. Teachers will develop their own labs during the last week of class. This is an intensive three-week class, five hours per day. Students should have at least one biotechnology course before enrolling in this course. Prior secondary school teaching experience preferred.
Typically offered in Summer only

**BCH 571/ANS 571  Regulation of Metabolism  (3 credit hours)**
Study of hormonal, enzymatic and molecular-genetic regulation of carbohydrate and lipid metabolism; emphasis on mammalian species.
Prerequisite: BCH 451, GN 311, a course in physiology, cell biology
Typically offered in Fall only

**BCH 590  Special Topics in Biochemistry  (1-6 credit hours)**
The study of topics of special interest by small groups of students instructed by members of the faculty.
Prerequisite: BCH 451
Typically offered in Fall, Spring, and Summer

**BCH 601  Macromolecular Structure  (1 credit hours)**
Introduction to the current understanding and methods used for the study of structures, thermodynamics and conformational dynamics of proteins, nucleic acids and membranes.
Prerequisite: BCH 453 or BCH 553; a course in physical chemistry highly recommended
Typically offered in Fall only

**BCH 610  Special Topics  (1-6 credit hours)**
The study of topics of special interest by small groups of students instructed by members of the faculty.
Prerequisite: BCH 451
Typically offered in Fall, Spring, and Summer

**BCH 615  Special Topics In Biochemistry  (1-6 credit hours)**
Critical study of special problems and selected topics of current interest in biochemistry and related fields.
Prerequisite: Graduate standing in BCH
Typically offered in Fall, Spring, and Summer

**BCH 670  Laboratory Rotations  (1 credit hours)**
Performance of highly directed research by biochemistry students in one or more laboratories of student's choice prior to beginning thesis research. Each laboratory experience lasts 5 weeks and given 1 hr. of credit. No more than 4 credits earned in BCH
Prerequisite: BCH 451
Typically offered in Fall and Spring

**BCH 685  Master's Supervised Teaching  (1-3 credit hours)**
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall and Spring
BCH 690 Master's Examination  (1-9 credit hours)
For students in non-thesis master's programs who have completed all other requirement of the degree except preparing for and taking the final master's exam.
Prerequisite: Master's student
Typically offered in Spring only

BCH 693 Master's Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BCH 695 Master's Thesis Research  (1-9 credit hours)
Thesis research
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BCH 696 Summer Thesis Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master's student
Typically offered in Spring only

BCH 699 Master's Thesis Preparation  (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BCH 701 Macromolecular Structure  (3 credit hours)
Introduction to the current understanding and methods used for the study of structures, thermodynamics and conformational dynamics of proteins, nucleic acids and membranes.
Prerequisite: BCH 453 or BCH 553; a course in physical chemistry highly recommended
Typically offered in Fall only

BCH 703 Macromolecular Synthesis and Regulation  (3 credit hours)
Biochemistry of DNA replication, transcription, RNA processing and translation. Development of key concepts, techniques and applications relating to mechanisms and regulation of these processes by analysis of primary literature.
Prerequisite: BCH 453 or BCH 553
Typically offered in Fall only

BCH 705 Molecular Biology Of the Cell  (3 credit hours)
Regulation of cellular processes, membrane structure and function, signal transduction, protein trafficking/sorting, secretion, photosynthesis and nitrogen fixation.
Prerequisite: BCH 701 or BCH 703
Typically offered in Spring only

BCH 710 Biological Scanning Electron Microscopy  (2 credit hours)
On demand. Theory and application of scanning electron microscopy, including specimen preparation, microscope alignment and operation, performance evaluation, interpretation of problems and darkroom technique. (Limited to 8 students with prior approval of instructor.)
Prerequisite: Graduate standing with some biological background
Typically offered in Spring only

BCH 751 Biophysical Chemistry  (3 credit hours)
Fundamental and practical aspects of biological macromolecular structure, thermodynamics, hydrodynamics, kinetics and spectroscopy with emphasis on mechanisms in functionally important structural transformations.
Prerequisite: BCH 451; one sem. of physical chemistry
Typically offered in Fall only

BCH 760 Protein Crystallography and Macromolecular Modeling  (3 credit hours)
Basic principles and practice of protein crystallography and the application of molecular dynamics to evaluate structural models. The computer lab provides hands-on experience in structure determination, refinement, model building, and molecular dynamics using CHARMM.
Prerequisite: BCH 455 or BCH 555 or equivalent
Typically offered in Fall only

BCH 761/GN 761/PB 761 Advanced Molecular Biology Of the Cell  (3 credit hours)
An advanced graduate class involving integrated approaches to complex biological questions at the molecular level, encompassing biochemistry, cell biology and molecular genetics. The course will focus on an important, current area of research in eukaryotic biology using the primary scientific literature, and will involve class discussions, oral presentations, and a written research proposal.
Typically offered in Spring only

BCH 763 Biochemistry Of Hormone Action  (3 credit hours)
Study of well-defined models of steroid and protein hormone action via lectures, assigned readings and discussions. Students add breadth to the course and depth to their own understanding by searching the literature and writing or lecturing about a particular hormone of their own choosing.
Prerequisite: BCH 705 or GN 757
Typically offered in Spring only

BCH 768/GN 768 Nucleic Acids: Structure and Function  (3 credit hours)
An advanced treatment involving integrated approaches to biological problems at the molecular level, encompassing biochemistry, cell biology and molecular genetics. Broad, multidisciplinary approaches to solving research problems in biology and the critical study of primary scientific literature, the development of a research proposal, oral presentations and class discussions.
Prerequisite: BCH 701 and 703
Typically offered in Spring only
**BCH 770 Enzyme Kinetics and Mechanisms** (3 credit hours)
An advanced course in enzyme kinetics and mechanisms with particular emphasis on experimental design and interpretation. The first half of the course covers the derivation and application of single and multisubstrate kinetic equations, inhibition and pre-steady state kinetics. The second half of the course covers fundamental chemical and physical principles of enzyme catalysis and specificity.
Prerequisite: BCH 451 and BCH 455/555 or equivalent.
Typically offered in Spring only

**BCH 801 Seminar in Biochemistry** (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.
Typically offered in Fall and Spring

**BCH 810 Special Topics** (1-6 credit hours)
The study of topics of special interest by small groups of students instructed by members of the faculty.
Prerequisite: BCH 451
Typically offered in Fall, Spring, and Summer

**BCH 815 Advanced Special Topics** (1-6 credit hours)
Critical study of special problems and selected topics of current interest in biochemistry and related fields.
Prerequisite: Graduate standing in BCH
Typically offered in Spring only

**BCH 870 Laboratory Rotations** (1 credit hours)
Performance of highly directed research by biochemistry students in one or more laboratories of student's choice prior to beginning thesis research. Each laboratory experience lasts 5 weeks and given 1 hr. of credit. No more than 4 credits earned in BCH
Prerequisite: BCH 451
Typically offered in Fall and Spring

**BCH 885 Doctoral Supervised Teaching** (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

**BCH 890 Doctoral Preliminary Examination** (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

**BCH 893 Doctoral Supervised Research** (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

**BCH 895 Doctoral Dissertation Research** (1-9 credit hours)
Dissertation research
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

**BCH 896 Summer Dissertation Research** (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Summer only

**BCH 899 Doctoral Dissertation Preparation** (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

## Biological and Agricultural Engineering (BAE)

**BAE 100 Introduction to Biological Engineering** (1 credit hours)
Technical topics and career options in Biological Engineering with concentrations in Agricultural, Bioprocess, and Environmental Engineering are introduced. Information is provided about career services, internships, and study abroad and co-op opportunities in these areas. Students develop a plan of work.
Typically offered in Spring only

**BAE 123 Light Equipment Technology** (3 credit hours)
Principles of operation and maintenance of powered turf, garden, and landscape equipment. Small engines, power transmission systems, equipment maintenance, and operator safety.
Requisite: Agricultural Institute Only
Typically offered in Spring only

**BAE 133 Agricultural Tractors and Machinery** (4 credit hours)
Principles of tractor engines, power trains, and hydraulics. Tractor operation, service and testing. Machinery management involving tractor and implement selection based on power and field requirements and on economics of ownership and operation. Implements for crop production to include tillage, planting, chemicals and harvesting. Set-up, operation and maintenance of implements. Calibration of planting and chemical equipment. Tractor and machinery safety. VEAL
Requisite: Agricultural Institute Only
Typically offered in Fall only

**BAE 200 Computer Methods in Biological Engineering** (2 credit hours)
Students develop computer-based problem solving techniques to solve introductory problems in Biological Engineering. Emphasis is on developing solution algorithms and implementing these with spreadsheets and computer programming.
Prerequisite: Grade of C or better in MA 141 and Corequisite: E 115
Typically offered in Fall and Summer
BAE 202 Introduction to Biological and Agricultural Engineering Methods (4 credit hours)
Introduction to experimental design methodology, basic engineering design and problem solving methodology for Biological Engineering. Visualization skills, computer-aided 3-D solid modeling of parts, 3-D assembly of solid part geometries, computation of mass properties, 2-D engineering drawings, engineering design process, safety, tools and fabrication processes and design, and hands-on shop fabrication of semester project.

Prerequisite: E 115
Typically offered in Spring only

BAE 203 Introduction to AutoCAD Civil 3D for Environmental & Ecological Engineers (2 credit hours)
Introduction to the use of AutoCAD Civil 3D for Environmental & Ecological Engineering applications. Basic drawing, managing survey data, surfaces, alignments, profiles, corridors, grading, pipe networks, plan production, GIS interface, GIS data types and sources, importing data, creation and export of objects in GIS formats. BE majors will be given priority in enrollment.

Prerequisite: BAE 200
Typically offered in Spring only

BAE 204 Introduction to Environmental and Ecological Engineering (2 credit hours)
Introduction to the principles and applications related to environmental and ecological engineering. Topics include watershed hydrology, nutrient cycling, sources of environmental pollution, and the impact to ecosystems. An overview of different methods employed in these two disciplines to remediate and protect natural resources. Special emphasis on how soil, water, microbial, and plant interactions occur in ecosystems and how they are used to develop treatment technologies.

Prerequisite: BAE 200 and (BIO 181 or BIO 183); Corequisite: BAE 203 and SSC 200
Typically offered in Spring only

BAE 302 Transport Phenomena (3 credit hours)
Theory and application of heat and mass transfer in biological, food, and agricultural systems. Topics include fluid flow, conduction, convection, radiation, psychrometrics, and refrigeration.

Prerequisite: MAE 201 and MA 341 and Corequisite: BAE 200 and MAE 208 and CE 282 or MAE 308
Typically offered in Fall and Summer

BAE 305 Biological Engineering Circuits (4 credit hours)
Fundamentals of analog and digital circuit analysis and design as applied to biological engineering instrumentation systems. Analysis and design of AC and DC circuits using Ohms and Kirchhoff's laws, the node voltage method, Thvenin and Norton's theorem, Laplace Transforms, resistance, capacitance, inductance, operational amplifiers, and frequency response, analog filter design, diode, transistors, biological signal acquisition, binary math and logical operators, digital circuit design, circuit simulation tools and techniques. Laboratory exercises supplement the topics presented in class lectures.

Prerequisite: MA 242, PY 208
Typically offered in Fall only

BAE 321 Bioprocessing Engineering Fundamentals (3 credit hours)
For Engineering and non-Engineering students interested in processing, biotechnology and related disciplines, it is important to have an understanding of the basic principles behind process analysis, design and scale up. This course will provide an introduction to the interdisciplinary approach and engineering concepts behind the development of useful food, chemical, energy, nutraceutical and pharmaceutical products through transformation of biological materials (bioprocessing). Some of the relevant topics covered include the fundamentals behind units, dimensions and engineering properties, stoichiometry, data analysis and statistics, mass and energy balances, rheology, mixing, heat and mass transfer, reaction kinetics and unit operations.

"Corequisite: MAE 201"
Typically offered in Fall only

BAE 322 Introduction to Food Process Engineering (3 credit hours)
Introductory principles and practices of handling and preserving food products. Coverage includes the design and analysis of handling systems for discrete and continuous flow material handling systems, the selection and specification of automatic controls, food preservation principles and considerations relevant to the design of food handling systems, and the principles and practices of drying and storing grain.

Prerequisite: BAE 302; MAE 308 or CE 282; MAE 301 or CHE 315
Typically offered in Spring only

BAE 325 Introductory Geomatics (3 credit hours)
Theory and practice of plane and satellite-based surveying. Includes distance measurement, differential leveling, profile leveling, topographic surveying, and record keeping. Introduction to tapes, levels, total stations, surveying software, the global positioning system, GPS receivers and methods (stand-alone, DGPS, RTK), data collection, data processing, and applications.

Prerequisite: Junior standing
Typically offered in Fall only

BAE 361 Analytical Methods in Engineering Design (3 credit hours)
Engineering problem solving through studies of topics in engineering design. Analysis of linkages, analysis and design of machine structures and components, analysis and design of power transmission components, three-dimensional modeling, and finite element analysis.

Prerequisite: BAE 202 and MAE 208 and MA 341 and Corequisite: CE 225 or MAE 214
Typically offered in Fall only

BAE 371 Fundamentals of Hydrology for Engineers (3 credit hours)
Hydrology and erosion principles. Designing structures and selecting practices to control land runoff, erosion, sediment pollution and flooding.

Prerequisite: BAE 200 and BAE 203; Corequisite: SSC 200 and CE 282 or MAE 308
Typically offered in Fall and Summer
BAE 376 Watershed Assessment and Water Quality Protection (3 credit hours)
Application of methods to describe and protect quality. Identification of water quality problems based on physical, chemical, and biological species and intended use. Water quality sampling equipment, and sample collection strategies and methods. Macroinvertebrate sampling and interpretation. Presentation of water quality data and information. Identification of structural and non-structural best management practices (BMPs) to mitigate degradation of watersheds and ecological systems.

"Corequisite: ST 370"
Typically offered in Spring only

BAE 401/BAE 501 Sensors and Controls (3 credit hours)
Basic concepts of sensors and controls for biological systems. Study of transducers and circuits utilized in biological and agricultural engineering applications. Demonstration of concepts of error, accuracy and precision, linearity and other instrument characteristics by electronic models. Provision of hands-on experience for reinforcing lecture concepts in laboratories. Credit will not be given for both BAE 401 and BAE 501.

Prerequisite: BAE 305
Typically offered in Spring only

BAE 425/BAE 525 Industrial Microbiology and Bioprocessing (3 credit hours)
Introduction to the structure and functions of microbial cells and their cultivation and utilization in Biological engineering processes. Topics covered include Fermentation systems and downstream processing methods. Enzyme kinetics, production and application. Biomanufacturing of fuels, industrial chemicals, food additives and food products such as beer, wine, cheese and yogurt, Microbial biomass production, Introduction to environmental biotechnology including wastewater treatment and bioremediation. Field trip is an essential educational component of the course and is are required. Credit will not be given for both BAE 425 and BAE 525.

Prerequisite: Junior or higher standing in CALS or COE; MB 351
Typically offered in Spring only

BAE 435/BAE 535 Precision Agriculture Technology (3 credit hours)
Overview of technology available for implementation of a comprehensive precision agriculture program. Topics include computers, GPS, sensors, mechanized soil sampling, variable rate control system, yield monitors, and postharvest processing controls. Applications of precision agriculture in crop planning, tillage, planting, chemical applications, harvesting and postharvest processing. Credit may not be received for BAE 435 and BAE 535.

Prerequisite: Junior standing or Senior standing
Typically offered in Spring only

BAE 451 Engineering Design I (2 credit hours)
Design concepts of engineering problems are reviewed, including objectives, specifications, manufacturing, prior art and analysis. Reverse engineering, national and international standards, quality control, intellectual law and engineering ethics are covered. Team projects from agricultural, bio-processing and environmental/ecological engineering are executed through problem definition, proposal development, design, and testing. Field trips are required.

Prerequisite: (CE 225 or MAE 214) and (BAE 202 or BAE 203) and BAE 302 and BAE 401 and either (BAE 321 or BAE 322 or BAE 361 or BAE 371) Restrictive Statement: Must be within 36 credit hours of completing the BE degree.
Typically offered in Fall only

BAE 452 Engineering Design II (2 credit hours)
Continuation of BAE 451; Project analysis, design, scheduling, construction, tests, presentations and reports. Teamwork development, soft skills and the function of engineering design in society are covered. Field trips are required.

Prerequisite: BAE 451; Restrictive Statement: Must be within 36 hours of completing the BE degree.
Typically offered in Spring only

BAE 462 Machinery Design and Applications (3 credit hours)
Machinery design for effective use of energy and labor in agricultural production. Engine cycles, power transmission, hydraulics, traction, combined stresses, finite element analysis, computer-aided-engineering, and engineering economics. Machinery design of agricultural field equipment and other agricultural machinery systems.

Prerequisite: BAE 361
Typically offered in Fall only

BAE 472/BAE 572 Irrigation and Drainage (3 credit hours)
Design, management and evaluation of irrigation and drainage systems; concepts and processes of system design. Credit will not be given for both BAE 472 and BAE 572.

Prerequisite: BAE 371
Typically offered in Fall only

BAE 473/BAE 573/SSC 573/SSC 473 Introduction to Hydrologic and Water Quality Modeling (3 credit hours)
Concepts in basic hydrologic, erosion and chemical transport used in modeling. Evaluation of typical hydrologic and water quality models on watershed systems. Project examples using state-of-the-art models. Credit will not be given for both BAE 473 and BAE 573.

Prerequisite: BAE 371
Typically offered in Fall only
BAE 474 Principles and Applications of Ecological Engineering (3 credit hours)
Governing principles of ecological engineering and the advanced biological, chemical, and physical conditions that determine the design of biological systems. Emphasis on 1) stream and wetland ecosystem restoration and 2) natural treatment systems for groundwater, stormwater, and wastewater such as riparian buffers, bioretention cells, and stormwater wetlands. A class field trip is required during non-scheduled time.
Prerequisite: BAE 203 and BAE 204 and BAE 371 and at least one of the following, MB 351 or PB 321 or PB 360 or SSC 332; Corequisite: BAE 451
Typically offered in Spring only

BAE 478/BAE 578 Agricultural Waste Management (3 credit hours)
This course covers principles of managing, handling, treating and applying animal and poultry manures and organic byproducts from an engineering perspective. Topics include waste characterization, descriptions of systems and technology, land application principles, preparation of waste management plans, biochemical/biological processes, and potential impacts to the environment. Assignments include homework, quizzes, projects, and discussion that emphasize problem solving and analysis.
Prerequisite: AEC/PB 360 or PB 321 or SSC 332 or MB 351
Typically offered in Fall only

BAE 481 Structures & Environment (3 credit hours)
Principles of environmental control and structural analysis are combined with biological principles for the design of structures. Topics include structural analysis, load estimation, material selection, fasteners, physiological reactions of animals and plants to their environment, applications of heat transfer and psychrometrics in calculating ventilation requirements, heating or cooling loads.
Prerequisite: BAE 302; CE 225 or MAE 314
Typically offered in Spring only

BAE 488 Postharvest Engineering (3 credit hours)
An introduction to the engineering aspects of the proper postharvest handling of fresh produce. Topics addressed include cleaning, grading, sorting, cooling, storing, packaging, transport, and marketing. Issues relating to food safety will be integrated throughout all the course content. A class field trip is required during non-scheduled time.
Prerequisite: BAE 302 or MAE 310
Typically offered in Spring only

BAE 492 External Learning Experience (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.
Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

BAE 493 Special Problems in Biological and Agricultural Engineering (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes campus facilities and resources. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.
Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

BAE 501/BAE 401 Sensors and Controls (3 credit hours)
Basic concepts of sensors and controls for biological systems. Study of transducers and circuits utilized in biological and agricultural engineering applications. Demonstration of concepts of error, accuracy and precision, linearity and other instrument characteristics by electronic models. Provision of hands-on experience for reinforcing lecture concepts in laboratories. Credit will not be given for both BAE 401 and BAE 501.
Prerequisite: BAE 305
Typically offered in Spring only

BAE 502 Instrumentation for Hydrologic Applications (3 credit hours)
Basic theory of instruments and measurements. Physical parameters of interest, available methods and sensors for assessment. Sensor characteristics. Dataloggers and sensor-datalogger communications. Data transfer, management, and processing. Emphasis on hydrologic and water quality research applications. Course offered by Distance Education only.
Prerequisite: MA 341, BAE 401 or ECE 331, ST 370 or ST 511
Typically offered in Spring only

BAE 525/BAE 425 Industrial Microbiology and Bioprocessing (3 credit hours)
Introduction to the structure and functions of microbial cells and their cultivation and utilization in Biological engineering processes. Topics covered include Fermentation systems and downstream processing methods. Enzyme kinetics, production and application. Biomanufacturing of fuels, industrial chemicals, food additives and food products such as beer, wine, cheese and yogurt, Microbial biomass production. Introduction to environmental biotechnology including wastewater treatment and bioremediation. Field trip is an essential educational component of the course and is are required. Credit will not be given for both BAE 425 and BAE 525.
Prerequisite: Junior or higher standing in CALS or COE; MB 351
Typically offered in Spring only
BAE 528 Biomass to Renewable Energy Processes (3 credit hours)
This course will introduce fundamental principles and practical applications of biomass-to-renewable energy processes, including anaerobic digestion of organic wastes for biogas and hydrogen production, bioethanol production from starch and lignocellulosic materials, biodiesel production from plant oils, and thermoconversion of biomass and waste materials. Restricted to engineering seniors and graduate students in COE, CALS, PAMS or CNR.
Prerequisite: Introductory Organic Chemistry or Biochemistry
Typically offered in Fall only

BAE 535/BAE 435 Precision Agriculture Technology (3 credit hours)
Overview of technology available for implementation of a comprehensive precision agriculture program. Topics include computers, GPS, sensors, mechanized soil sampling, variable rate control system, yield monitors, and postharvest processing controls. Applications of precision agriculture in crop planning, tillage, planting, chemical applications, harvesting and postharvest processing. Credit may not be received for BAE 435 and BAE 535.
Prerequisite: Junior standing or Senior standing
Typically offered in Spring only

BAE 536 GIS Applications in Precision Agriculture (1 credit hour)
Exploration of geographic information systems (GIS) and its applications in precision agriculture. Topics will include file structure and formatting, interfacing with precision agriculture equipment, georeferencing maps, merging and clipping farm data, data field calculations, designing management zones, variable rate prescriptions, and basic data analysis.
Prerequisite: GIS 410 or GIS 510 or BAE 435 or BAE 535
Typically offered in Spring only

BAE 550 Aerosol Science and Engineering (3 credit hours)
This course is designed for students who have a desire to work in the area of air quality. It will provide students with fundamental knowledge of aerosol properties, behavior and physical principles, and with hands-on experience in applying this knowledge to aerosol/PM measurements and control.
Prerequisite: MA 341
Typically offered in Fall only

BAE 561 Agricultural Air Quality (3 credit hours)
This course will prepare students to identify agricultural air pollutants and their sources, understand the on-farm and off-farm impacts of these pollutants, measure these pollutants, characterize and model the fate of these pollutants, and select and/or design cost-effective remediation measures. This course is restricted to seniors in engineering and MEAS, and graduate students in CALS, PAMS, and CNR.
Prerequisite: MA 341
Typically offered in Spring only

BAE 565 Environmental and Agricultural Analytics and Modeling (3 credit hours)
This course provides students with a fundamental and practical understanding of data science and modeling approaches for environmental and agricultural systems analysis. The course is organized into three modules: (1) data retrieval, management, documentation, and visualization; (2) process-based modeling; and (3) data mining through statistical analysis and machine learning. Rather than develop a strong knowledge base in a specific methodology, students will gain broad and introductory understanding of a range of contemporary quantitative approaches and learn to think critically about the use of data analytics and models.
Prerequisite: Introductory statistics (e.g. ST 515) and experience coding in R (e.g. BAE 555)
Typically offered in Spring only

BAE 572/BAE 472 Irrigation and Drainage (3 credit hours)
Design, management and evaluation of irrigation and drainage systems; concepts and processes of system design. Credit will not be given for both BAE 472 and BAE 572.
Prerequisite: BAE 371
Typically offered in Spring only

BAE 573/SSC 573/SSC 473/BAE 473 Introduction to Hydrologic and Water Quality Modeling (3 credit hours)
Concepts in basic hydrologic, erosion and chemical transport used in modeling. Evaluation of typical hydrologic and water quality models on watershed systems. Project examples using state-of-the-art models. Credit will not be given for both BAE 473 and BAE 573.
Prerequisite: BAE 371
Typically offered in Spring only

BAE 574 DRAINMOD: Theory and Application (3 credit hours)
This course presents the theory of water movement and storage in poorly drained soils and applies the drainage/water management model DRAINMOD to a wide range of problems. Technical issues related to evaluation, design and management of drained soils and to wetland hydrology are analyzed. A series of problem sets provides experience in using the model, and demonstrates how the model may be applied to describe the complex interactions of multiple processes affecting hydrology of shallow water table soils.
Prerequisite: One of the following: BAE 471, BAE 472, BAE 573, BAE 771, or SSC 511
Typically offered in Spring only

BAE 575 Design of Structural Stormwater Best Management Practices (3 credit hours)
The design of structural stormwater Best Management Practices (BMPs) used in the urban and suburban environments is reviewed, including stormwater wetlands, bio-retention areas, sand filters, innovative wet ponds, green roofs, permeable pavement, and reinforced grass swales. The course is application oriented and includes a pair of field trips.
Prerequisite: BAE 471 or CE 383
Typically offered in Spring only
BAE 576  Watershed Monitoring and Assessment  (3 credit hours)
Water measurement and structure sizing. Identification of water quality problems and water quality variable selection. Monitoring design, water quality sampling equipment, and sample collection and analysis. Statistical analysis and presentation of water quality data.
Prerequisite: [AES323 (SSC323/BAE323) or BAE471 or FOR429 (NR420) or CE586, and ST311 or ST361 or ST511
Typically offered in Fall only

BAE 577  Wetlands Design and Restoration  (3 credit hours)
Fundamental understanding of hydrology, soils and ecology of natural wetland systems will be developed to serve as the basis for designing wetland systems for water treatment and restoring degraded natural wetland systems. Stormwater and wastewater treatment wetland design and implementation concepts will be emphasized. Wetland restoration will also be studied with emphasis on current wetland regulations, design, and implementation techniques. Engineered wetland concepts will be supplemented with relevant case studies. Basic understanding of biology, soils, hydrology, and soil and water engineering is required.
Typically offered in Spring only

BAE 578/BAE 478  Agricultural Waste Management  (3 credit hours)
This course covers principles of managing, handling, treating and applying animal and poultry manures and organic byproducts from an engineering perspective. Topics include waste characterization, descriptions of systems and technology, land application principles, preparation of waste management plans, biochemical/biological processes, and potential impacts to the environment. Assignments include homework, quizzes, projects, and discussion that emphasize problem solving and analysis.
Prerequisite: AEC/PB 360 or PB 321 or SSC 332 or MB 351
Typically offered in Fall only

BAE 580  Introduction to Land and Water Engineering  (3 credit hours)
This distance course introduces students to concepts of the hydrologic cycle, water quality, precipitation, evapotranspiration, infiltration, watershed delineation, surface runoff and open channel flow. Students will apply these concepts to an engineering design problem. This course is designed for non-engineering distance graduate students and lifelong education students and students from engineering disciplines outside of BAE. It will not substitute for BAE 471. The course is only open to students with senior standing or higher.
Prerequisite: MA 241
Typically offered in Fall only

BAE 581  Open Channel Hydraulics for Natural Systems  (3 credit hours)
Theory and applications of hydraulics to open channels with an emphasis on natural streams and rivers. Course will introduce and develop principles of flow regimes (subcritical/critical/supercritical), and types (uniform flow, gradually varied and rapidly varied flow). Application will include hydraulics of flow measuring devices, step-backwater analysis and rating curve development, and flood studies using hydraulic models. A lab-scale flume will be used to illustrate concepts. Laptops will be used in class to learn and apply HEC-RAS (water surface profiles model). CE 382 or equivalent required. CE 381 recommended.
Prerequisite: CE 282 or equivalent. CE 381 recommended.
Typically offered in Fall only

BAE 582  Risk and Failure Assessment of Stream Restoration Structures  (1 credit hours)
This course defines uncertainty and risk pertaining to stream restoration structures and identifies and quantifies sources of such. Students will review various in-stream structures and, using an example study of the rock cross vane as a guide, will investigate a structure of their choice applying the concepts of risk and uncertainty. Modules include: Introduction to structures and definitions; Types and modes of failure; Uncertainty in Stream Restoration Design; Probability of failures, cost of failures; and Failure modes and effects.
Prerequisite: CE 382 or MAE 308 or equivalent
Typically offered in Spring only

BAE 583  Stream Corridor 3 Es: Ecohydraulics, Engineering and Ethics  (3 credit hours)
Overview of stream ecological and functional processes that structure stream corridors. Explore human interactions with streams including stream restoration structures and watershed scale practices that impact hydraulic, hydrologic, chemical, sedimentary and biotic functions. Discuss failure and risk analysis, policy and rights, and ethical use of our freshwater resources. As we move from a microscopic study of stream benthos to global-scale water concerns, students will develop a fluency in communicating human impacts on streams. Independent visits by students to a local stream required.
Restriction: Graduate or Senior Standing
Typically offered in Spring only

BAE 584  Introduction to Fluvial Geomorphology  (3 credit hours)
This distance course provides an introduction to applied fluvial geomorphology as it relates to natural physical stream processes. Students will learn about watershed hydrology, stream gage data analysis, bankfull stage identification, hydraulic geometry relationships, stream channel assessment and classification, stream stability and channel evolution.
Prerequisite: BAE 471 or BAE 580
Typically offered in Fall only

BAE 585  Integrating AutoCAD Civil 3D and GIS  (1 credit hours)
Basics of the AutoCAD Civil 3D user interface, drawing tools, importing and handling of survey data, generation of surfaces. GIS data sources and formats. Accessing and using GIS data for Civil 3D design purposes. Creation of GIS objects within Civil 3D and exporting to GIS formats.
Typically offered in Fall only

BAE 587  Biogeochemical processes for Ecological engineering and Environmental Sciences  (3 credit hours)
The course provides the advanced theoretical knowledge of biogeochemical processes at play in man-made and natural filter systems, such as wetlands and other buffer systems, alleviating common pollutants associated with non-point source pollution, both in rural and suburban watersheds. Particular emphasis is put on the fate of excess nitrogen in these systems. This emphasis serves as a model for describing ecological engineering principles and quantifying processes at play for all pollutants. 20 students max. This course puts together biological, chemical, biochemical, and hydrological knowledge in one ensemble. Minimum proficiency in each of these is necessary to be able to follow the class with ease.
Typically offered in Fall only
BAE 590  Special Problems  (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in biological and agricultural engineering.
Prerequisite: Senior standing or Graduate standing in Biological and Agricultural Engineering

BAE 591  Master’s Research Methods I  (1 credit hours)
This is the first in a series of research methods courses for MS students majoring in Biological and Agricultural Engineering. Students will develop research questions to be answered by their thesis project and produce a literature review focusing on those questions. Students will also observe formal seminar presentations, providing critiques and participating in discussions of proper seminar delivery. This course is restricted to MS students majoring in BAE.
Typically offered in Fall only

BAE 592  Master’s Research Methods II  (1 credit hours)
This is the second in a series of research methods courses for MS students majoring in Biological and Agricultural Engineering. Students will develop a research proposal for their thesis work and will present the proposal in a final seminar. This course
Prerequisite: BAE 591
Typically offered in Spring only

BAE 593  Introduction to Research Communications  (1 credit hours)
This course introduces graduate students to the process of reading, analyzing, and communicating, in writing and multiple presentation formats, the findings of scientific literature searches. Students will progress from superficial reading to critical analysis of literature and will present their analyses in written, poster, presentation, and video formats. Related issues in research and professional communication will be discussed.
Prerequisite: Graduate Students in BAE Only
Typically offered in Fall only

BAE 600  Special Topics  (1-6 credit hours)
A study of topics in the special fields of interest of graduate students under the direction of the graduate faculty.
Prerequisite: Graduate standing
Typically offered in Fall only

BAE 610  Special Problems  (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in biological and agricultural engineering.
Prerequisite: Senior standing or Graduate standing in Biological and Agricultural Engineering
Typically offered in Fall and Spring

BAE 685  Master’s Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master’s student
Typically offered in Fall only

BAE 690  Master’s Examination  (1-9 credit hours)
For students in non-thesis master’s programs who have completed all other requirements of the degree except preparing for and taking the final master’s exam.
Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

BAE 693  Master’s Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master’s student
Typically offered in Fall only

BAE 695  Master’s Thesis Research  (1-9 credit hours)
Thesis research.
Prerequisite: Master’s student
Typically offered in Summer only

BAE 696  Summer Thesis Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master’s student
Typically offered in Fall and Spring

BAE 699  Master’s Thesis Preparation  (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master’s degree and are writing and defending their thesis.
Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

BAE 771/SSC 771  Theory Of Drainage--Saturated Flow  (3 credit hours)
Discussion of physical concepts and properties of fluids and porous media in relation to soil-water movement. Derivation and discussion of the fundamental laws and equations governing saturated flow in porous media. Analysis of mathematical solutions of
Prerequisite: MA 301
Typically offered in Fall only

BAE 785/FS 785  Food Rheology  (3 credit hours)
Principles and methods for measuring rheological properties. Theories of elastic, viscous, viscoelastic and viscoplastic behavior and relationships to food texture and commodity damage during harvest, handling and processing. Influence of time, composition and processing.
Prerequisite: FS 231 or MAE 314
Typically offered in Fall only

BAE 790  Special Topics  (1-6 credit hours)
Special topics in BAE.
BAE 791 Doctoral Research Methods I (1 credit hours)
This is the first in a series of research methods courses for PhD students majoring in Biological and Agricultural Engineering. Students will develop PhD level research questions to be answered in their dissertation project and will produce a PhD level literature review on those questions. Students will also observe seminars, providing critiques and discussions of proper seminar delivery. This course is restricted to PhD students majoring in BAE

Typically offered in Fall only

BAE 792 Doctoral Research Methods II (1 credit hours)
This is the second in a series of research methods for PhD students majoring in Biological and Agricultural Engineering. Students will develop a research proposal appropriate for their dissertation project and will present the proposal in both a practi

Prerequisite: BAE 791
Typically offered in Spring only

BAE 801 Seminar (1 credit hours)
Elaboration of subject areas, techniques and methods peculiar to professional interest through presentations of personal and published works; opportunity for students to present and critically defend ideas, concepts and inferences. Discussions to point up analytical solutions and analogies between problems in biological and agricultural engineering and other technologies, and to present relationship of biological and agricultural engineering to socio-economic enterprise.

Prerequisite: Graduate standing in BAE
Typically offered in Fall and Spring

BAE 810 Special Topics (1-6 credit hours)
A study of topics in the special fields of interest of graduate students under the direction of the graduate faculty.

Typically offered in Fall only

BAE 820 Special Problems (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in biological and agricultural engineering.

Prerequisite: Senior standing or Graduate standing in Biological and Agricultural Engineering
Typically offered in Fall and Spring

BAE 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

BAE 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

BAE 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

BAE 895 Doctoral Dissertation Research (1 credit hours)
Dissertation research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

BAE 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

BAE 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertation.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Biological Sciences (BIO)

BIO 105 Biology in the Modern World (3 credit hours)
Concepts in biology taught from the perspective of civically engaging issues or problems. Themes and topics of wide interest, such as climate change, stem cells and cloning, antibiotic resistance, evolution, and human health. Lecture and the corresponding laboratory are designed to deepen an appreciation for the connections between science and "real-world" issues. For non-science majors. Students cannot receive credit for both BIO 105 and (BIO 181 or BIO 183).

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

BIO 106 Biology in the Modern World Laboratory (1 credit hours)
Laboratory experience in biological principles to complement BIO 105. For non-science students. Students may not receive credit for both BIO 106 and (BIO 181 or BIO 183).

Corequisite: BIO 105; May not receive credit for both BIO 106 and (BIO 181 or BIO 183)
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

BIO 140 Survey of Animal Diversity (3 credit hours)
Classification and phylogeny of animals; patterns of diversification in body design and relationship between body design and the environment; study of selected animal assemblages. Students may not receive credit for both BIO 140 and (BIO 350 or BIO 402)

GEP Natural Sciences
Typically offered in Fall only
BIO 141 Animal Diversity Laboratory (1 credit hours)
Observation of living animals, dissections of preserved specimens, and microscopy; emphasis on classification of animals, patterns of diversification in body design, and relationship between body design and the environment. Students may not receive credit for both BIO 141 and BIO 350 or BIO 402 or BIO 403 or ZO 150.

Prerequisite: BIO 140
GEP Natural Sciences
Typically offered in Fall only

BIO 165 Introduction to Environmental Research (5 credit hours)
Introduction to environmental research is a hands-on learning experience for incoming freshmen interested in pursuing scientific research. The course introduces students to scientific methods and research through active participation in research on an environmental problem involving chemicals of environmental concern. Students will explore a topic in this field through guided readings, field samplings, and lab experimentation. Restricted to incoming freshmen who have been accepted into the HHMI RISE program. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

GEP Interdisciplinary Perspectives
Typically offered in Summer only

BIO 181 Introductory Biology: Ecology, Evolution, and Biodiversity (4 credit hours)
Introduction to ecology, evolution, and biodiversity within the context of structure and function including the adaptive strategies that organisms use to manage the everyday challenges of life. Emphasis on interactions of organisms with their environments, evolutionary change and role of natural selection in the evolution of life forms. Builds a foundation for understanding how science works, how to think critically and communicate scientifically.

X: Cannot receive credit for both BIO 181 and BIO 105 or BIO 106.
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

BIO 183 Introductory Biology: Cellular and Molecular Biology (4 credit hours)
Basic concepts and principles of molecular, cellular, and developmental biology. Emphasis is placed on the physical basis of life, on the molecular mechanisms that guide evolution, on the cell as the fundamental unit of life, and on the mechanisms involved in the development of multicellular organisms. The course promotes the development of crucial scientific skills including critical thinking, problem solving, design of experiments, and effective oral and written scientific communication. Students cannot receive credit for both BIO 183 and (BIO 105 or BIO 106).

Prerequisite: BIO 181 or CH 101
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

BIO 227 Understanding Structural Diversity through Biological Illustration (3 credit hours)
Biological concepts of diversity and anatomy taught through direct observation and illustrative techniques. Lecture topics include plant ID and structure, microscopic life forms, animal anatomy and identification. Laboratory work emphasizes close observation of structures and comparative anatomy as well as illustrative techniques to produce accurate drawings of specimens. Students will be required to provide their own transportation for one field trip.

GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Spring only

BIO 230 The Science of Studying Dinosaurs (3 credit hours)
This course introduces students to the scientific method as applied to the study of dinosaurs and the world in which they lived. Because we cannot directly observe dinosaurs, estimating biological features such as running speed, growth rates, and reproductive and other physiological strategies presents challenges. We will examine a range of biological concepts (including cellular biology and physiology, functional morphology and biomechanics, evolutionary relationships, and paleoecology), as well as geological concepts (such as sedimentology, radiometric dating, plate tectonics, and the geologic time scale) as they apply to dinosaurs as living organisms. An understanding of biology at the introductory college level will be assumed.

Prerequisite: C- or better in BIO 181 or BIO 183 or BIO 105
GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Fall only

BIO 240 Principles of Human Anatomy & Physiology (A): Nervous, Skeletal, Muscular, & Digestive Systems (4 credit hours)
BIO 240 provides an introduction to the anatomy and physiology of the nervous, skeletal, muscular, and digestive systems. Fundamental principles addressed throughout the course include (1) maintenance and regulation of homeostasis, (2) communication and control processes throughout the body, (3) integration and interdependence across organ systems, (4) structure-function relationships, and (5) anatomical and physiological adaptation. Together, BIO 240 and BIO 245 provide a strong foundation in human anatomy and physiology (through both lecture and lab) for students preparing for a variety of health-related professions.

Prerequisite: C- or better in BIO 183; Cannot receive credit for both this course and BIO 212 or BIO 421
Typically offered in Fall, Spring, and Summer

BIO 245 Principles of Human Anatomy & Physiology (B): Endocrine, Cardiovascular, Respiratory & Renal Systems (4 credit hours)
BIO 245 provides an introduction to the anatomy and physiology of the endocrine, cardiovascular, respiratory, and renal systems. Fundamental principles addressed throughout the course include (1) maintenance and regulation of homeostasis, (2) communication and control processes throughout the body, (3) integration and interdependence across organ systems, (4) structure-function relationships, and (5) anatomical and physiological adaptation. Together, BIO 240 and BIO 245 provide a strong foundation in human anatomy and physiology (through both lecture and lab) for students preparing for a variety of health-related professions.

Prerequisite: C- or better in BIO 183; Cannot receive credit for both this course and BIO 212 or BIO 421
Typically offered in Fall and Spring
BIO 267 Research in the Life Sciences I: Research Skills (3 credit hours)
This course is designed to help first year students learn basic skills associated with scientific research. Class structure is interactive and relies on group collaboration for most projects. Students will become confident in reading and analyzing scientific literature, communicating scientific principles, compiling a poster presentation, presenting at scientific conferences, and attending local scientific symposia as well as practicing some basic laboratory techniques. The 2-semester Research PackTrack Program (BIO 267 and 269) is designed to prepare undergraduates for an original research experience in a scientific laboratory. A B- or better in BIO 267 is required to take BIO 269. Students in BIO 267 are required to attending one research symposium outside of regular class time. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.
Prerequisite: C- or better in BIO 181 and Corequisite: BIO 183
Typically offered in Fall and Spring

BIO 269 Research in the Life Sciences II: Guided Research (3 credit hours)
This course is designed to provide students with a laboratory framework for conducting original research and (together with BIO 267) preparation to move on to conducting research in a scientific laboratory. Students will explore the binding characteristics of bacterially-expressed estrogen receptor genes by generating their own research goals, writing research proposals, conducting original independent research, and presenting their findings in at least one poster symposium. This course is the second part of the Research PackTrack program, and students in this course will have earned a B- or better in the first course (BIO 267). Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.
Prerequisite: C- or better in BIO 183 and B- or better in BIO 267
Typically offered in Fall and Spring

BIO 310 Quantitative Approaches to Biological Problems (3 credit hours)
This course serves as an introduction to the use of mathematical, statistical and computational models and tools for understanding biology at the molecular, population, ecological and evolutionary scales. We will use discrete and continuous mathematics to model disease spread, ecological competition and biochemical systems. We explore the effect of random events in biochemistry and learn how to model such randomness in a statistical framework. We will also use computation tools to analyze genetic data and write a short computer program that simulates the change in allele frequencies in a population in time due to random effects. All course topics will involve hands-on computational exercises, but no prior experience in these tools and methods is expected.
Prerequisite: BIO 181 and MA 131 or MA 141 (or equivalents).
Typically offered in Spring only

BIO 315 General Parasitology (3 credit hours)
General principles of parasitic symbiosis. Emphasis on life cycles, epidemiology, and pathology of major parasites of humans and domestic animals.
Prerequisite: C- or better in BIO 181 and BIO 183
Typically offered in Fall and Summer

BIO 325 Paleontological Field Methods (4 credit hours)
Understanding the history of life is not possible without first and foremost unearthing it. Discovering, collecting, and conserving fossil specimens for research is a time- and labor-intensive endeavor that requires hands-on training in the field. This course provides introductions to the evolution of life; Mesozoic biodiversity, biostratigraphy, and biogeography; vertebrate skeletal anatomy; stratigraphic and sedimentary concepts; and geomorphology. The course also covers paleontological research methods, including: specimen data collection, conservation, and preparation; topographic and geologic maps; GPS techniques; prospecting and excavation of fossil localities; and taphonomic indicators. Field work in Utah; additional costs involved.
Prerequisite: BIO 120 or BIO 181 or BIO 330
Typically offered in Summer only

BIO 330 Evolutionary Biology (3 credit hours)
Principles and patterns of organic evolution. Topics will include the origin of life, patterns of genetic variation, adaptations, natural selection, and the formation of species, the relationship between micro and macroevolution, and the importance of evolution to humans and medicine.
Prerequisite: C- or better in BIO 181 and BIO 183
Typically offered in Spring only

BIO 361 Developmental Biology (3 credit hours)
In this course students will discover the amazing journey that cells must take to get from an egg to an embryo, form a mature adult, and reproduce in order to continue the life cycle. Students will relate science to everyday life using developmental biology as a forum to integrate many aspects of biology from the molecules in single cells to the complete organism and how it is influenced by evolution and the environment. Cannot receive credit for both BIO 361 and GN 434.
Prerequisite: C- or better in BIO 183
Typically offered in Spring only

BIO 370 Developmental Anatomy of the Vertebrates (3 credit hours)
An integrated study of the functional anatomy, phylogeny, and embryonic development of organ systems in vertebrate animals.
Prerequisite: C- or better in BIO 181 or BIO 140
Typically offered in Spring only

BIO 375 Developmental Anatomy Laboratory (2 credit hours)
A hands-on study of embryonic development and organ systems in vertebrate animals, utilizing microscopic examination of living and preserved embryos, demonstrations of skeletons and mammalian organs, and dissections of preserved shark, salamander, and mink.
Prerequisite: C- or better in BIO 181 or BIO 140
Typically offered in Spring only

BIO 405 Functional Histology (3 credit hours)
Offered only as a distance education course via the internet. Functional Histology describes the cellular structure of tissues and organs. Human organs are emphasized, with brief consideration given to variation in other mammals. Tissue and organ structure is related to function, including examples of malfunction (histopathology). The course is especially appropriate for students planning a career in veterinary science, medicine, or allied health fields. Offered by distance education only.
Prerequisite: C- or better in BIO 183
Typically offered in Summer only
BIO 414  Cell Biology  (3 credit hours)
The chemical and physical bases of cellular structure and function with emphasis on methods and interpretations.

Prerequisite: C- or better in BIO 183 and (CH 221 or CH 225)
Typically offered in Spring only

BIO 416  Cancer Cell Biology  (3 credit hours)
Cancer cells are defective and yet they survive and often thrive despite having these defects. We will explore changes in tumor cells as they transition from normal cells - looking at disrupted growth signaling and cell death pathways, alterations in cell motility patterns and the induction of changes in other cells. Current research and treatments will be discussed. A focus will be on problem solving and critical thinking skills as we integrate case studies as well as primary and review literature into the course. This course will involve lecture, discussion, and group activities. Students will be expected to do assigned reading prior to coming to class, make presentations or lead discussions, analyze data, and design experiments.

P: C- or better in BIO 183 and GN 311. JR or SR standing; Students may not earn credit for both BIO/PB 414 and BIO 416.
Typically offered in Fall only

BIO 418  Cell Biology Research Lab  (2 credit hours)
BIO 418 is a laboratory course that emphasizes collaborative, inquiry-based learning through research. Students will design and implement experiments to explore mechanisms relating to cellular growth, metabolism, cell signaling pathways, environmental toxins, and/or intrinsic and extrinsic apoptotic processes in various cell lines. This course will include primary literature analysis, experimental design and implementation, maintenance of lab notebooks, data analysis, discussions, and presentations.

C: BIO/PB 414 or BIO 416. JR or SR standing
Typically offered in Fall and Spring

BIO 424  Endocrinology  (3 credit hours)
This course will explore the function of hormones and bioactive compounds in regulating animal physiology and homeostasis. Topics will include a study of hormones and their mechanism of actions in regulating various biological processes including development and growth; reproduction; feeding, digestion and metabolism; ion and water balance; stress and immunity; and sex determination. The methods used to study hormones and their physiological functions will also be addressed. 80% of enrollment is restricted to Biological Sciences and Zoology students with the remaining 20% open for all other majors.

Prerequisite: C- or better in BIO 250 or BIO 212 or BIO 240 or BIO 245
Typically offered in Fall, Spring, and Summer

BIO 432  Evolutionary Medicine  (3 credit hours)
This course introduces the rapidly emerging field of evolutionary medicine as one approach to appreciating evolution as a unifying principle of biology. The primary goal is for students to better understand the evolutionary nature of many issues connect

R: Junior or Senior standing; Prerequisite: C- or better in BIO 181 or BIO 183 or GN 311.
Typically offered in Spring only

BIO 434  Hormones and Behavior  (3 credit hours)
This course will focus on the field of behavioral neuroendocrinology, which explores mechanisms by which hormones affect and are affected by behavior. The course will use highly interactive lectures and discussions of material from the primary literature (seminal papers and recent exciting contributions). Student participation in class discussions and in-class assignments will be critical components of the learning process.

Prerequisite: C- or better in BIO 212 or BIO 250 or (ANS 205 & ANS 206) or BIO 240 or BIO 245
Typically offered in Spring only

BIO 440  The Human Animal: An Evolutionary Perspective  (3 credit hours)
An in-depth look at the evolution of a wide range of human behaviors, and some aspects of physiology as well. We will critically explore the perceptions we hold of ourselves and the research that has sought to lend new insights into the fundamental bases of human behavior. New uses of evolutionary theory, including the field of evolutionary psychology, will be examined using a comparative approach and careful readings from primary and secondary literature in evolutionary biology and psychology. Classes will be largely discussion based.

Prerequisite: C- or better in one of the following: BIO 317, BIO/PB 330, BIO 410, PSY 406, or PSY 416
GEP U.S. Diversity
Typically offered in Spring only

BIO 444  The Biology of Love and Sex  (3 credit hours)
The need to find and seduce a mate is one of the most powerful forces in biology. In this course, we will examine the biological factors that contribute to love and sex. We will adopt a broad evolutionarily-based perspective, examining a variety of strategies in both human and animal systems. Our readings and discussions will cover current hypotheses and experimental methodologies spanning genetics, neuroscience, and endocrinology.

P: C- or better in two of the following: BIO 330, BIO 410, BIO 424, BIO 488, GN 311; R: Junior or Senior Standing
Typically offered in Spring only

BIO 481  Senior Capstone Project  (1 credit hour)
This course provides students an opportunity to integrate and apply knowledge and skills gained from their major studies in addressing an important challenge or problem that they identify. Emphasis will be placed on (1) reflections on the value of experiences outside of the classroom, (2) using discipline-specific knowledge and approaches from both biology and from the second disciplinary area that they chose to study within the B.A. in Biological Sciences, and (3) peer- and self-critiques based on the intellectual standards of critical and creative thinking. Restricted to seniors who will graduate with a B.A. in Biological Sciences. 17BIOBA majors only.

Typically offered in Fall, Spring, and Summer
BIO 482 Capstone Course in Molecular, Cellular, and Developmental Biology (3 credit hours)
Topical problems in molecular, cellular, and developmental biology. BIO 482 provides a challenging opportunity for students to integrate and apply knowledge and skills gained from their major studies. Emphasis will be placed on collaborative learning and on effective, professional communication. Topics and instructors will vary from semester to semester. Priority will initially be given to seniors in the MCD curriculum; other students with the necessary prerequisites will be admitted on a space available basis.
Prerequisite: C- or better in BIO 361, BIO/PB 414, and one of the following: BCH 351 or BCH 451 or BIT 410 or GN 311.
Typically offered in Fall and Spring

BIO 483 Capstone Course in Integrative Physiology and Neurobiology (3 credit hours)
Topical problems in integrative physiology and neurobiology. BIO 483 provides a challenging opportunity for students to integrate and apply knowledge and skills gained from their major studies. Emphasis will be placed on collaborative learning and on effective, professional communication. Topics and instructors will vary from semester to semester. Priority will initially be given to seniors in the MCD curriculum; other students with the necessary prerequisites will be admitted on a space available basis.
Prerequisite: C- or better in BIO 424, BIO 488, and one of the following: BIO/PB 414 or BCH 351 or BCH 451 or GN 311 or ST 311.
Typically offered in Fall and Spring

BIO 484 Capstone Course in Human Biology (3 credit hours)
Topical problems in human biology. BIO 484 provides a challenging opportunity for students to integrate and apply knowledge and skills gained from their major studies. Emphasis will be placed on collaborative learning and on effective, professional communication. Topics and instructors will vary from semester to semester. Priority will initially be given to seniors in the HB curriculum; other students with the necessary prerequisites will be admitted on a space available basis.
Prerequisite: C- or better in BIO 421, MB 351 and one of the following: BCH 351 or BCH 451 or GN 311 or ST 311.
Typically offered in Fall and Spring

BIO 485 Capstone Course in Ecology, Evolution, and Conservation Biology (3 credit hours)
Topical problems in ecology, evolution, and conservation biology. BIO 485 provides a challenging opportunity for students to integrate and apply knowledge and skills gained from their major studies. Emphasis will be placed on collaborative learning and on effective, professional communication. Topics and instructors will vary from semester to semester. Priority will initially be given to seniors in the EEC curriculum; other students with the necessary prerequisites will be admitted on a space available basis.
Prerequisite: C- or better in BIO/PB 330, BIO/PB 360, and one of the following: BIO 460 or GN 311 or NR 406 or ST 311.
Typically offered in Fall and Spring

BIO 488/BIO 588 Neurobiology (3 credit hours)
Overview of the neurosciences, with a focus on fundamental principles in the function, structure, and development of the nervous system. Topics include neuroanatomy, electrical signaling, synaptic transmission, sensory and motor systems, neural development, neural plasticity, and complex brain functions. Multiple levels of analysis, from molecular to behavioral, with an emphasis on the mammalian nervous system. Motivated students who do not meet listed prerequisite can contact the instructor for permission to take the course.
Prerequisite: C- or better in BIO 250 or BIO 212 or BIO 240 or BIO 245 or permission of instructor
Typically offered in Fall only

BIO 498 Honors Project Part I (3 credit hours)
Together, BIO 498 and BIO 499 provide a two-semester sequence for honors projects conducted by students in good standing in an honors program within the Department of Biological Sciences. Before enrollment in BIO 498, students (1) identify a project in consultation with a faculty mentor, (2) work with that mentor to complete a contract describing the expectations for their work together in BIO 498, and (3) have the contract approved by the honors program coordinator. The approved contract will describe the specific requirements and expectations of the BIO 498 experience. Enrollment only by permission of the honors program director.
Typically offered in Fall, Spring, and Summer

BIO 499 Honors Project Part II (3 credit hours)
Together, BIO 498 and BIO 499 provide a two-semester sequence for honors projects by students in good standing in an honors program within the Department of Biological Sciences. Before beginning BIO 499, students will have successfully completed BIO 498 as well as a contract describing the expectations for their work with the mentor in BIO 499. The contract must be approved by the honors program director. The approved contract will describe the specific requirements and expectations of the BIO 499 experience. Enrollment only by permission of the honors program director.
Prerequisite: BIO 498
Typically offered in Fall, Spring, and Summer

BIO 518 Experience and the Brain (3 credit hours)
This seminar considers how an individual’s behavioral interactions with the world (i.e., experience) can alter the structure and/or function of the adult brain. Emphasis will be on reading and critically discussing the primary research literature.
Prerequisite: BIO 488 or ZO 588

BIO 520 Skeletal Biological Laboratory Methods in Human Identification & Cold Cases (3 credit hours)
This laboratory-based course covers skeletal biological methods such as those used in human identification applied to medicolegal issues or issues of the law. Forensic identification methods will be introduced via lecture and students will apply these methods in the laboratory. The investigation of cold cases will be addressed through laboratory methodologies that intersects with missing persons cases. This course covers a broad array of investigative skeletal methods. However, students will not be qualified to practice after taking this course.
P: Graduate Standing
Typically offered in Fall only
BIO 560/BMA 560 Population Ecology (3 credit hours)
Dynamics of natural populations. Current work, theories and problems dealing with population growth, fluctuation, limitation and patterns of dispersion, species interactions, community structure and ecological genetics. One semester of calculus and a junior/senior level ecology course are required.

Co-requisite: ST 511
Typically offered in Spring only

BIO 570 Evolutionary Ecology (3 credit hours)
This course provides a detailed overview of evolutionary ecology, the multidisciplinary interface of ecological and evolutionary processes. The course includes an historical perspective of the development of the field, major theoretical and empirical milestones, and the cutting edge of modern evolutionary ecology research and application. This is a discussion-oriented course, drawing heavily from peer-reviewed literature. Grading is centered on participation, leading discussions, critical literature reviews, and a research project. The course Moodle website will contain files for all assigned readings, the course syllabus, tips for leading discussions, and a schedule of class meetings and discussion leaders.

Pre requisite: Graduate Standing or C- or better in AEC/PB 360 and Corequisite: C- or better in BIO 330 or BIO 432
Typically offered in Fall only

BIO 572/CH 572/BIT 572 Proteomics (3 credit hours)
Introduction and history of the field of proteomics followed by the principles and applications of proteomics technology to understand protein expression and protein post-transitional modifications. Laboratory sessions include growing yeast with stable-isotope labeled amino acids, protein purification, Western blots, protein identification and quantification, and protein bioinformatic analysis. This is a half-semester course.

Prerequisite: BIT 410 or BIT 510 or BCH 454 (or approval from the instructor)
Typically offered in Spring only

BIO 588/BIO 488 Neurobiology (3 credit hours)
Overview of the neurosciences, with a focus on fundamental principles in the function, structure, and development of the nervous system. Topics include neuroanatomy, electrical signaling, synaptic transmission, sensory and motor systems, neural development, neural plasticity, and complex brain functions. Multiple levels of analysis, from molecular to behavioral, with an emphasis on the mammalian nervous system.

Motivated students who do not meet listed prerequisite can contact the instructor for permission to take the course.

Prerequisite: C- or better in BIO 250 or BIO 212 or BIO 240 or BIO 245 or permission of instructor
Typically offered in Fall only

BIO 592 Topical Problems (1-3 credit hours)
Organized, formal lectures and discussion of a special topic.
Typically offered in Fall, Spring, and Summer

BIO 624 Topical Problems (1-3 credit hours)
Organized, formal lectures and discussion of a special topic.
Typically offered in Fall and Spring

BIO 705/CBS 705 Fundamentals of Neuroscience (3 credit hours)
This is a fundamental course that will provide the student with an up-to-date coverage of molecular, cellular, physiological, and circuit-based aspects of Modern Neurosciences in the Comparative Biomedical Sciences Graduate Program. Being a graduate-level class, the instructors will assume that the students have acquired some background in basic biology and biochemistry. The most important goal of this course is to train PhD students in neuroscience function and disorders, preparing them for neuroscience research. Emphasis will be placed on the systems and skills needed to pursue experimental neuroscience activities.

Important components of the learning process will be presentations from neuroscience experts, class discussions, exams and in class activities.

P: BIO 488 or permission of instructor
Typically offered in Fall only

BIO 727/CH 727 Biological Mass Spectrometry (3 credit hours)
Fundamentals of mass spectrometry including source topics such as: mass, isotopic distributions, resolving power, mass accuracy. Ionization source topics: electron impact, chemical ionization, matrix-assisted laser desorption ionization, electrospray ionization and contemporary methods. Instrumentation and mass analyzers: quadrupole, time-of-flight, Fourier transform based mass analyzers; hybrid instruments such as a quadrupole orbitrap. Tandem mass spectrometry and dissociation. Applications: quantitation, small molecule analysis, and peptide sequencing.

Prerequisite: CH 223 or CH 227
Typically offered in Fall only

BIO 792 Topical Problems (1-6 credit hours)
Organized, formal lectures and discussion of a special topic.
Typically offered in Fall, Spring, and Summer

BIO 805/CBS 805 Special Topics in Neuroscience (1 credit hours)
Topics in neuroscience. This course will provide an opportunity for students to integrate and apply knowledge and skills gained from their graduate studies. Emphasis will be placed on primary literature, scientific practice, and on effective, professional communication and presentations. Topics and instructors will vary from semester to semester. Priority will initially be given to graduate students participating in the neuroscience concentration; other students with the necessary prerequisites will be admitted on a space available basis.

R: Grad Standing or Instructor Approval
Typically offered in Spring only

BIO 811 Forensic Sciences Seminar (1 credit hours)
This is a webinar series that includes professional development as well as practitioner presentations about the current state of the various forensic sciences disciplines. Topics covered will fill in the background and gaps needed for a career as a forensic

Typically offered in Fall only

BIO 824 Topical Problems (1-3 credit hours)
Organized, formal lectures and discussion of a special topic.
Typically offered in Fall and Spring
Biomanufacturing Training Education Center (BEC)

BEC 220 Introduction to Drug Development and Careers in Biomanufacturing (1 credit hours)
Introduction to discovery and development of biopharmaceuticals, industrial enzymes, food ingredients and biologics. Discussion of majors that prepare students for positions in the biotechnology industry. Lectures from staff and from professionals in the biotechnology industry focus on drug development, biopharmaceutical process development, design of biomanufacturing facilities, overview of methods used for manufacturing biopharmaceuticals, drug and enzyme purification, formulation, as well as careers in FDA compliance documentation related to manufacturing products using microbial biotechnology.

Typically offered in Fall and Spring

BEC 330 Principles and Applications of Bioseparations (2 credit hours)
Objectives, strategies, and approaches for recovery and purification of biomolecules, especially recombinant proteins. Description of common purification equipment, processes and materials used for cell lysis, precipitation, flocculation, membrane filtration, column chromatography, and centrifugation. Laboratories provide students with exposure to various techniques and the parameters that control protein isolation and purification of a recombinant protein. This is a half-semester course. Students who have completed BIT(CHE) 464 may not complete this course for credit.

Prerequisite: CH 223 or CH 227
Typically offered in Fall and Spring

BEC 363 Foundations of Recombinant Microorganisms for Biomanufacturing (2 credit hours)
Introduction to basic biomanufacturing techniques with particular focus on the most commonly used recombinant microbes in industry. Includes microbial identification, metabolism, and growth kinetics; recombinant production and analysis of low molecular weight molecules, alcohols, recombinant enzymes and others. The laboratory portion of this half-semester course provides students with practical experience on basic biomanufacturing techniques carried out in small scale

Prerequisite: BIO 183
Typically offered in Fall, Spring, and Summer

BEC 425/BEC 525 Molecular Biology for Biomanufacturing (2 credit hours)
This course is an introduction to fundamental molecular biology techniques, applied to generate bacterial cell lines for the production of recombinant proteins. Course material provides a comprehensive description of an expression system, with emphasis on the central dogma of molecular biology, detailed gene structure, vector components and bacterial host cell characteristics. Different genetic, physiologic and growth condition aspects are included to ensure the overproduction of a functional protein of interest. This comprises different molecular approaches for gene cloning, bacterial selection/screening and regulation of genetic expression. The course provides hands-on experience during laboratory sessions, where students isolate a gene of interest, clone the gene into an expression vector, transform bacteria, select for positive clones, grow recombinant cells, and induce the production of the protein of interest. Techniques such as SDS-PAGE, Western blot, and ELISA are used for the detection and quantification of the active recombinant protein.

Prerequisite: BIO 183 or equivalent
Typically offered in Fall, Spring, and Summer

BEC 426/BBS 526/FS 526/BEC 526/BBS 426/FS 426 Upstream Biomanufacturing Laboratory (2 credit hours)
This course is an introduction to current food manufacturing practice (CGMP) as applied to the growth of microbial cells in bioreactors. Hands-on experience is obtained in the operation and control of 30 liter bioreactors to study agitation, oxygen transfer, cleaning, sterilization, media preparation and the growth of recombinant E. coli for protein production. Credit will not be awarded in both BBS 426 and BBS/FS 526. This is an eight week course.

Prerequisite: (MB 351 and FS 231) CHE/BEC 463
Typically offered in Fall and Spring

BEC 436/BE 536 Introduction to Downstream Process Development (2 credit hours)
Objectives, strategies, and approaches for recovery and purification of biomolecules, especially recombinant proteins. Laboratories in the intermediate-scale pilot plant provide students with exposure to various unit operations and the parameters that control protein isolation and purification of a recombinant protein produced by an E. coli. This is a half-semester course. Students who have completed BEC 436 may not take BEC 536 for credit.

Prerequisite: BEC 330 or graduate standing
Typically offered in Fall and Spring

BEC 440/BEC 540 Expression Systems in Biomanufacturing 1 (3 credit hours)
Introduction to bacterial and yeast expression systems, their advantages and disadvantages. Basic techniques in molecular biology, cell transformation and optimization of protein expression. Selection, archiving and characterization of production line. Study of parameters affecting expression and yield. The lab portion of the course provides students with practical experience in DNA and protein expression techniques in bacterial and yeast expression systems. Credit not given for both.

Prerequisite: BEC 363 or (MB 351 and MB 352)
Typically offered in Fall only
**BEC 441/BEC 541 Expression Systems in Biomanufacturing II** (3 credit hours)
Introduction to insect and mammalian cell expression systems, their advantages and disadvantages. Advanced techniques in DNA cloning, cell transformation, and optimization of protein expression. Selection, archiving and characterization of production line. The lab portion of the course provides students with practical experience in DNA cloning and protein expression techniques in insect and mammalian cell expression systems. Credit not given for both.
Prerequisite: BEC 440/540 or BIT 410/510
Typically offered in Spring only

**BEC 445/BEC 545 Cell Line Development for Biomanufacturing** (2 credit hours)
This course provides the basic and advanced principles of genetic engineering in yeast and mammalian cells for the overproduction of a protein of interest. Students will use classical and novel strategies to establish a stable Chinese hamster ovary (CHO) cell line based on the industrially relevant strain, DG44 (DHFR system). Students will also generate a yeast expression system based on Pichia pastoris for the production of the same protein. The generation of two different cell lines for the overproduction of the same protein of interest should provide students with an appreciation of each system in terms of cost, speed, productivity and product quality.
Corequisite: BEC 425/525 or Prerequisite: BIT 410, BEC 440, MB 351, MB 352 or BEC 363
Typically offered in Fall and Spring

**BEC 448/BEC 548/CHE 548/CHE 448 Bioreactor Design** (2 credit hours)
This course will cover critical aspects of bioreactor design, including design of reactors for enzyme-catalyzed reactions, fermentation of microorganisms, and scale-up considerations for bioreactors. Hands-on experiments involving fermentation of microorganisms and scale-up of bioreactors will be included. Students cannot get credit for both CHE 448 and CHE 548.
Typically offered in Spring only

**BEC 462/BEC 562/CHE 462/CHE 562 Fundamentals of Bio-Nanotechnology** (3 credit hours)
Concepts of nanotechnology are applied in the synthesis, characterization, recognition and application of biomaterials on the nanoscale. Emphasis will be given to hands-on experience with nanostructured biomaterials; students will also be familiarized with the potential impact of these materials on different aspects of society and potential hazards associated with their preparation and application.
Prerequisite: MA 241 and PY 208 and (CH 223 or CH 227)
Typically offered in Spring only

**BEC 463/BIT 563/CHE 563/BEC 463/CHE 463 Fermentation of Recombinant Microorganisms** (2 credit hours)
Introduction to fermentation and protein chemistry. Theory behind laboratory techniques and overview of industrial scale expression systems. Laboratory sessions involve use of microbial expression vectors, fermentation systems, and large-scale purification of recombinant protein. Half semester course, first part.
Prerequisite: CH 223 or CH 227; Corequisite: (BIT 410 or BCH 452 or MB 352 or BEC 363)
Typically offered in Fall, Spring, and Summer

**BEC 475/BEC 575 Global Regulatory Affairs for Medical Products** (3 credit hours)
This lecture-based course introduces students to the quality systems used to meet the regulatory requirements for developing, testing, manufacturing, and selling medical products in the global marketplace. It provides a general background for those going into the medical products field, but is especially useful to students preparing for a career in the Regulatory Affairs or Quality Assurance Department within a pharmaceutical, biomanufacturing, or medical device company. BEC 575 students must have graduate standing.
Prerequisite: Senior standing
Typically offered in Fall and Spring

**BEC 480/BEC 580 cGMP Fermentation Operations** (2 credit hours)
Application of microbial fermentation techniques at production scale and evaluation of the inherent issues resulting from the integration of microbial fermentation unit operations, scale-up/production, and current Good Manufacturing (cGMP) compliance. Lectures prepare students for pilot-scale laboratory experiences in media preparation, bioreactor operation, process utilities, and manufacturing quality systems that simulate microbial cell growth and product expression in a commercial cGMP facility. This is a half-semester course. Students who have completed BEC 480 may not take BEC 580 for credit.
Corequisite: BBS/BEC/FS 426
Typically offered in Fall and Spring

**BEC 483/BME 583/BEC 583/BME 483 Tissue Engineering Technologies** (2 credit hours)
In this half-semester laboratory module, students will gain practical experience with two key elements of tissue engineering: tissue building and angiogenesis. Using advanced culture techniques, students will construct a complex living tissue that closely resembles its natural counterpart, then assess its ability to support ingrowth of capillaries (angiogenesis). The effects of different biomaterials and angiogenic factors will be evaluated. The engineered tissue will be embedded, sectioned and stained for histological analysis.
Prerequisite: BIT 466/566 or permission of instructor
Typically offered in Fall only

**BEC 485/BEC 585 cGMP Downstream Operations** (2 credit hours)
Application of downstream bioprocessing techniques at production scale and evaluation of the inherent issues resulting from the integration of recovery and purification unit operations, scale-up/production issues, and current Good Manufacturing Practice (cGMP) compliance. Lectures prepare students for pilot-scale laboratory experiences in cell removal, cell disruption, purification, and manufacturing quality systems that simulate downstream bioprocessing in a commercial cGMP facility. This is a half-semester course. Students who have completed BEC 485 may not take BEC 585 for credit.
Corequisite: BEC 436/536
Typically offered in Fall and Spring
BEC 488/CHE 488/BEC 588/CHE 588  Animal Cell Culture Engineering  (2 credit hours)
Design and operation of animal cell culture bioreactors for therapeutic protein production. Topics include: batch, fed-batch and perfusion bioreactors, agitation and aeration for mixing and oxygen mass transfer, bioreactor monitoring and control, optimizing bioreactor performance, single-use [disposal] bioreactors, and the production of gene therapy vectors. This is a half-semester course. Time outside of the regularly scheduled class time may be required.

Typically offered in Spring only

BEC 495  Special Topics in Biomanufacturing  (1-4 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis. Departmental approval required.

Typically offered in Fall, Spring, and Summer

BEC 497  Biomanufacturing Research Projects  (1-3 credit hours)
Introduction to biomanufacturing research through experimental, theoretical, and literature studies. Oral and written presentation of reports. Departmental approval required. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

BEC 515  Biopharmaceutical Product Characterization Techniques  (2 credit hours)
This 8 week graduate course introduces engineering students to biomanufacturing techniques, applied to generate bacterial cell lines for the production of recombinant proteins. Course material provides a comprehensive description of an expression system, with emphasis on the central dogma of molecular biology, detailed gene structure, vector components and bacterial host cell characteristics. Different genetic, physiologic and growth condition aspects are included to ensure the overproduction of a functional protein of interest. This comprises different molecular approaches for gene cloning, bacterial selection/screening and regulation of genetic expression. The course provides hands-on experience during laboratory sessions, where students isolate a gene of interest, clone the gene into an expression vector, transform bacteria, select for positive clones, grow recombinant cells, and induce the production of the protein of interest. Techniques such as SDS-PAGE, Western blot, and ELISA are used for the detection and quantification of the active recombinant protein.

Prerequisite: BIO 183 or equivalent
Typically offered in Fall, Spring, and Summer

BEC 525/BEC 425  Molecular Biology for Biomanufacturing  (2 credit hours)
This course is an introduction to fundamental molecular biology techniques, applied to generate bacterial cell lines for the production of recombinant proteins. Course material provides a comprehensive description of an expression system, with emphasis on the central dogma of molecular biology, detailed gene structure, vector components and bacterial host cell characteristics. Different genetic, physiologic and growth condition aspects are included to ensure the overproduction of a functional protein of interest. This comprises different molecular approaches for gene cloning, bacterial selection/screening and regulation of genetic expression. The course provides hands-on experience during laboratory sessions, where students isolate a gene of interest, clone the gene into an expression vector, transform bacteria, select for positive clones, grow recombinant cells, and induce the production of the protein of interest. Techniques such as SDS-PAGE, Western blot, and ELISA are used for the detection and quantification of the active recombinant protein.

Prerequisite: BIO 183 or equivalent
Typically offered in Fall, Spring, and Summer

BEC 526/BBS 426/FS 426/BEC 426/BBS/FS 526  Upstream Biomanufacturing Laboratory  (2 credit hours)
This course is an introduction to current food manufacturing practice (CGMP) as applied to the growth of microbial cells in bioreactors. Hands-on experience is obtained in the operation and control of 30 liter bioreactors to study agitation, oxygen transfer, cleaning, sterilization, media preparation and the growth of recombinant E. coli for protein production. Credit will not be awarded in both BBS 426 and BBS/FS 526. This is an eight week course.

Prerequisite: (MB 351 and FS 231) CHE/BEC 463
Typically offered in Fall and Spring

BEC 532  Biological Processing Science  (2 credit hours)
Fundamental scientific principles underlying the recovery, purification and formulation of biologics (biotherapeutics), especially proteins, are examined. Emphasis is placed on delineating the key chemical and physical properties of biomolecules that impact processing and formulation development. Laboratories in the analytical and small-scale purification facility provide students with ‘hands-on’ exposure to key scientific principles and small scale unit operations. This is a half-semester course.

Prerequisite: BCH 451 or graduate standing
Typically offered in Fall and Spring

BEC 536/BEC 436  Introduction to Downstream Process Development  (2 credit hours)
Objectives, strategies, and approaches for recovery and purification of biomolecules, especially recombinant proteins. Laboratories in the intermediate-scale pilot plant provide students with exposure to various unit operations and the parameters that control protein isolation and purification of a recombinant protein produced by an E. coli. This is a half-semester course. Students who have completed BEC 436 may not take BEC 536 for credit.

Prerequisite: BEC 330 or graduate standing
Typically offered in Fall and Spring
**BEC 540/BEC 440 Expression Systems in Biomanufacturing I** (3 credit hours)
Introduction to bacterial and yeast expression systems, their advantages and disadvantages. Basic techniques in molecular biology, cell transformation and optimization of protein expression. Selection, archiving and characterization of production line. Study of parameters affecting expression and yield. The lab portion of the course provides students with practical experience in DNA and protein expression techniques in bacterial and yeast expression systems. Credit not given for both.

Prerequisite: BEC 363 or (MB 351 and MB 352)
Typically offered in Fall only

**BEC 541/BEC 441 Expression Systems in Biomanufacturing II** (3 credit hours)
Introduction to insect and mammalian cell expression systems, their advantages and disadvantages. Advanced techniques in DNA cloning, cell transformation, and optimization of protein expression. Selection, archiving and characterization of production line. The lab portion of the course provides students with practical experience in DNA cloning and protein expression techniques in insect and mammalian cell expression systems. Credit not given for both.

Prerequisite: BEC 440/540 or BIT 410/510
Typically offered in Spring only

**BEC 545/BEC 445 Cell Line Development for Biomanufacturing** (2 credit hours)
This course provides the basic and advanced principles of genetic engineering in yeast and mammalian cells for the overproduction of a protein of interest. Students will use classical and novel strategies to establish a stable Chinese hamster ovary (CHO) cell line based on the industrially relevant strain, DG44 (DHFR system). Students will also generate a yeast expression system based on Pichia pastoris for the production of the same protein. The generation of two different cell lines for the overproduction of the same protein of interest should provide students with an appreciation of each system in terms of cost, speed, productivity and product quality.

Corequisite: BEC 425/525 or Prerequisite: BIT 410, BEC 440, MB 351, MBA 352/354
Typically offered in Fall and Spring

**BEC 548/CHE 448/BEC 448 Bioreactor Design** (2 credit hours)
This course will cover critical aspects of bioreactor design, including design of reactors for enzyme-catalyzed reactions, fermentation of microorganisms, and scale-up considerations for bioreactors. Hands-on experiments involving fermentation of microorganisms and scale-up of bioreactors will be included. Students cannot get credit for both CHE 448 and CHE 548.

Typically offered in Spring only

**BEC 562/CHE 462/CHE 562/BEC 462 Fundamentals of Bio-Nanotechnology** (3 credit hours)
Concepts of nanotechnology are applied in the synthesis, characterization, recognition and application of biomaterials on the nanoscale. Emphasis will be given to hands-on experience with nanostructured biomaterials; students will also be familiarized with the potential impact of these materials on different aspects of society and potential hazards associated with their preparation and application.

Prerequisite: MA 241 and PY 208 and (CH 223 or CH 227)
Typically offered in Spring only

**BEC 563/BIT 463/CHE 463/BEC 463/BIT 563/CHE 563 Fermentation of Recombinant Microorganisms** (2 credit hours)
Introduction to fermentation and protein chemistry. Theory behind laboratory techniques and overview of industrial scale expression systems. Laboratory sessions involve use of microbial expression vectors, fermentation systems, and large-scale purification of recombinant protein. Half semester course, first part.

Prerequisite: CH 223 or CH 227; Corequisite: (BIT 410 or BCH 452 or MB 352 or BEC 363)
Typically offered in Fall and Spring

**BEC 575/BEC 475 Global Regulatory Affairs for Medical Products** (3 credit hours)
This lecture-based course introduces students to the quality systems used to meet the regulatory requirements for developing, testing, manufacturing, and selling medical products in the global marketplace. It provides a general background for those going into the medical products field, but is especially useful to students preparing for a career in the Regulatory Affairs or Quality Assurance Department within a pharmaceutical, biomanufacturing, or medical device company. BEC 575 students must have graduate standing.

Prerequisite: Senior standing
Typically offered in Fall and Spring

**BEC 577/CHE 577 Advanced Biomanufacturing and Biocatalysis** (3 credit hours)
Overview of biomanufacturing using microorganisms (bacteria, yeast, fungi), eukaryotic cells (hybridomas, insect, plant, CHO) and recombinant enzymes focusing on methods used in industry. Course will emphasize process design for optimization of heterologous protein expression, metabolic/cell line engineering, metabolomics, protein engineering to alter enzymes and antibodies. Pathway engineering strategies include developing microbes to produce new therapeutic compounds or overproduce primary metabolites, antibiotics, biotherapeutics, therapeutic enzymes, diagnostics, recombinant vaccines, and biopharmaceuticals. Utilization of immobilized biocatalysts, and microbial kinetics are covered.

Graduate standing in engineering or life-science graduate program
Typically offered in Spring only
BEC 580/BEC 480 cGMP Fermentation Operations (2 credit hours)
Application of microbial fermentation techniques at production scale and evaluation of the inherent issues resulting from the integration of microbial fermentation unit operations, scale-up-production, and current Good Manufacturing (cGMP) compliance. Lectures prepare students for pilot-scale laboratory experiences in media preparation, bioreactor operation, process utilities, and manufacturing quality systems that simulate microbial cell growth and product expression in a commercial cGMP facility. This is a half-semester course. Students who have completed BEC 480 may not take BEC 580 for credit.
Corequisite: BBS/BEC/FS 426
Typically offered in Fall and Spring

BEC 583/BME 483/BEC 483/BME 583 Tissue Engineering Technologies (2 credit hours)
In this half-semester laboratory module, students will gain practical experience with two key elements of tissue engineering: tissue building and angiogenesis. Using advanced culture techniques, students will construct a complex living tissue that closely resembles its natural counterpart, then assess its ability to support ingrowth of capillaries (angiogenesis). The effects of different biomaterials and angiogenic factors will be evaluated. The engineered tissue will be embedded, sectioned and stained for histological analysis.
Prerequisite: BIT 466/566 or permission of instructor
Typically offered in Fall only

BEC 585/BEC 485 cGMP Downstream Operations (2 credit hours)
Application of downstream bioprocessing techniques at production scale and evaluation of the inherent issues resulting from the integration of recovery and purification unit operations, scale-up-production issues, and current Good Manufacturing Practice (cGMP) compliance. Lectures prepare students for pilot-scale laboratory experiences in cell removal, cell disruption, purification, and manufacturing quality systems that simulate downstream bioprocessing in a commercial cGMP facility. This is a half-semester course. Students who have completed BEC 485 may not take BEC 585 for credit.
Corequisite: BEC 436/536
Typically offered in Fall and Spring

BEC 588/CHE 588/BEC 488/CHE 488 Animal Cell Culture Engineering (2 credit hours)
Design and operation of animal cell culture bioreactors for therapeutic protein production. Topics include: batch, fed-batch and perfusion bioreactors, agitation and aeration for mixing and oxygen mass transfer, bioreactor monitoring and control, optimizing bioreactor performance, single-use [disposal] bioreactors, and the production of gene therapy vectors. This is a half-semester course. Time outside of the regularly scheduled class time may be required.
Typically offered in Spring only

BEC 590 Industry Practicum in Biomanufacturing (3 credit hours)
This is an industry case study course emphasizing scientific, engineering, analytical, and professional skills related to biomanufacturing of human therapeutics; the course will provide students with the opportunity to design a complete cGMP process and facility capable of licensure.
Typically offered in Fall only

BEC 595 Special Topics in Biomanufacturing (1-6 credit hours)
Offered to present graduate course content not available in existing courses or for offering of new graduate courses on a trial basis. Departmental approval required.

BEC 601 Biomanufacturing Seminar (1 credit hours)
Weekly seminars on topics of current interest in biomanufacturing and affiliated subjects. Seminars will be presented by resident faculty members, graduate students and visiting lecturers from industry, government regulatory agencies such as the FDA or from academic programs related to biomanufacturing.
Typically offered in Fall and Spring

BEC 620 Leadership and Preparation for Industry Internship in Biomanufacturing (2 credit hours)
Advanced communication skills specific to the regulatory requirements of the biomanufacturing and biopharmaceutical industries regulated by the U.S. FDA. Instructors teach writing professional and technical resumes, advanced interview skills, team or project leadership, teamwork and communication skills required by industry to prepare and present discipline-specific documents to the FDA. Students learn change management in a biopharmaceutical company and how to develop emotional intelligence. Interviews by industry professionals give each student experience and feedback. Restricted to students with graduate standing.
Typically offered in Spring only

BEC 621 Communicating and Industry Internship in Biomanufacturing (1 credit hours)
Organize information learned in a biomanufacturing internship and demonstrate effective oral presentation of proprietary information. Create a professional presentation about their industry internship experience and write a paper describing their experience.
Prerequisite: BEC 620
Typically offered in Fall only

BEC 669 Biomanufacturing Research Projects (1-4 credit hours)
Introduction to biomanufacturing research through experimental, theoretical and literature studies under the mentorship of a member of the graduate faculty. Oral and written presentation of reports. Departmental approval required.
Prerequisite: Graduate standing in engineering, biological science or physical science
Typically offered in Fall, Spring, and Summer

Biomathematics (BMA)

BMA 560/BIO 560 Population Ecology (3 credit hours)
Dynamics of natural populations. Current work, theories and problems dealing with population growth, fluctuation, limitation and patterns of dispersion, species interactions, community structure and ecological genetics. One semester of calculus and a junior/senior level ecology course are required.
Co-requisite: ST 511
Typically offered in Spring only

BMA 567 Modeling of Biological Systems (4 credit hours)
An introduction to quantitative modeling in biology. Use of Forrester diagrams, probabilistic and deterministic description of dynamic processes, development of model equations, simulation methods and criteria for model evaluation. Examination of current literature dealing with application of models and simulation in biology. Individual and class modeling projects.
Prerequisite: MA 131
BMA 573/MA 573 Mathematical Modeling of Physical and Biological Processes I (3 credit hours)
Introduction to model development for physical and biological applications. Mathematical and statistical aspects of parameter estimation. Compartmental analysis and conservation laws, heat transfer, and population and disease models. Analytic and numerical solution techniques and experimental validation of models. Knowledge of high-level programming languages required.
Prerequisite: MA 341 and knowledge of high-level programming language.
Typically offered in Fall only

BMA 574/MA 574 Mathematical Modeling of Physical and Biological Processes II (3 credit hours)
Model development, using Newtonian and Hamiltonian principles, for acoustic and fluid applications, and structural systems including membranes, rods, beams, and shells. Fundamental aspects of electromagnetic theory. Analytic and numerical solution techniques and experimental validation of models.
Prerequisite: MA/BMA 573
Typically offered in Spring only

BMA 590 Special Topics (1-6 credit hours)
Special topics in BMA.
Typically offered in Fall, Spring, and Summer

BMA 591 Special Topics (1-6 credit hours)
Directed readings, problem sets, written and oral reports as dictated by need and interest of student, e.g., cellular, molecular and physiological modeling; new 500-level courses during the developmental phase.
Typically offered in Fall, Spring, and Summer

BMA 610 Special Topics (1-6 credit hours)
Directed readings, problem sets, written and oral reports as dictated by need and interest of student, e.g., cellular, molecular and physiological modeling; new 500-level courses during the developmental phase.
Typically offered in Fall, Spring, and Summer

BMA 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BMA 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.
Prerequisite: Master's student
Typically offered in Fall and Spring

BMA 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BMA 695 Master's Thesis Research (1-9 credit hours)
Thesis research.
Prerequisite: Master's student
Typically offered in Fall and Spring

BMA 696 Summer Thesis Research (1 credit hour)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master's student
Typically offered in Summer only

BMA 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BMA 771/MA 771/ST 771 Biomathematics I (3 credit hours)
Role of theory construction and model building in development of experimental science. Historical development of mathematical theories and models for growth of one-species populations, including age distributions (matrix models, Leslie and Lopez; continuous theory, renewal equation). Some of the more elementary theories on the growth of organisms (von Bertalanffy and others; allometric theories; cultures grown in a chemostat). Mathematical theories oftwo and more species systems (predator-prey, competition, symbiosis; leading up to present-day research and discussion of some similar models for chemical kinetics. Much emphasis on scrutiny of biological concepts as well as of mathematical structure of models in order to uncover both weak and strong points of models discussed. Mathematical treatment of differential equations in models stressing qualitative and graphical aspects, as well as certain aspects of discretization. Difference equation models.
Prerequisite: Advanced calculus, reasonable background in biology
Typically offered in Fall only

BMA 772/MA 772/ST 772 Biomathematics II (3 credit hours)
Continuation of topics of BMA 771. Some more advanced mathematical techniques concerning nonlinear differential equations of types encountered in BMA 771: several concepts of stability, asymptotic directions, Liapunov functions; different time-scales. Comparison of deterministic and stochastic models for several biological problems including birth and death processes. Discussion of various other applications of mathematics to biology, some recent research.
Prerequisite: BMA 771, elementary probability theory
Typically offered in Spring only

BMA 773/MA 773/OR 773/ST 773 Stochastic Modeling (3 credit hours)
Prerequisite: BMA 772 or ST (MA) 746
Typically offered in Spring only
BMA 774/OR 774/MA 774  Partial Differential Equation Modeling in Biology  (3 credit hours)
Prerequisite: BMA 771 or MA/OR 731; BMA 772 or MA 401 or MA 501
Typically offered in Spring only

BMA 790  Special Topics  (1-6 credit hours)
Typically offered in Fall and Spring

BMA 801  Seminar  (1 credit hours)
Graduate students in biomathematics are expected to attend through most of their residence period.
Prerequisite: Graduate standing

BMA 815  Advanced Special Topics  (1-6 credit hours)
Directed readings, problem sets, written and oral reports as dictated by need and interest of student; new 600-level courses during the development phase (currently includes courses in stochastic modeling and biophysical theory).
Typically offered in Fall, Spring, and Summer

BMA 885  Doctoral Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

BMA 890  Doctoral Preliminary Exam  (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

BMA 893  Doctoral Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

BMA 895  Doctoral Dissertation Research  (1-9 credit hours)
Dissertation research
Prerequisite: Doctoral student
Typically offered in Fall and Spring

BMA 896  Summer Dissertation Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Summer only

BMA 899  Doctoral Dissertation Preparation  (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Biomedical Engineering (BME)

BME 201  Computer Methods in Biomedical Engineering  (3 credit hours)
Students develop computer-based problem solving techniques using Excel and MATLAB to solve introductory problems in Biomedical Engineering. Emphasis is on developing solution algorithms, implementing these with spreadsheets and computer programming, and presenting results in a clear and concise manner. Students registered for BME 201 who fail to matriculate into BME will be dropped from the course.
Prerequisite: BME matriculated students
Typically offered in Fall only

BME 203/MSE 203  Introduction to the Materials Science of Biomaterials  (3 credit hours)
This course introduces fundamental physical principles governing the structure, processing, properties and performance of metallic, ceramic and polymer materials. Relationships are developed defining how mechanical, physical and chemical properties are controlled by microstructure and chemistry. Material failure modes are developed with an emphasis on biocompatibility and the applications/performance of materials in the human body. Basic aspects of material biocompatibility are presented, leading into studies of the current and future applications of biomaterials.
Prerequisite: C- or better in CH 101, CH 102 and PY 205
Typically offered in Fall and Spring

BME 204  Biomedical Measurements  (3 credit hours)
This course will introduce students to modern topics in biomedical engineering and areas of emphasis in the biomedical engineering curriculum through the study and use of biomedical measurement tools. The course will include a lecture and a laboratory component.
Prerequisite: BME Majors
Typically offered in Fall and Spring

BME 205  Introduction to Biomedical Mechanics  (4 credit hours)
Study of the state of rest or motion of bodies subjected to the action of forces. Properties of force systems, free body diagrams, concepts of equilibrium, kinematics of particles, newton's laws, conservational principles of energy of momentum in mechanics, mechanical vibrations and their applications in biomedical systems. Restricted to student in the Biomedical Engineering Department.
Credit cannot be received for both BME 205 and (CE 214 or MAE 206)
Typically offered in Spring only
BME 207 Biomedical Electronics (4 credit hours)
Fundamentals of analog and digital circuit analysis and design as applied to biomedical instrumentation and measurement of biological potentials. Passive circuit components, node and mesh analysis, transient behavior, operational amplifiers, frequency response, analog filter design, diode, transistors, biological signal acquisition, binary math and logical operators, digital circuit design, circuit simulation tools and techniques. Laboratory exercises supplement the topics presented in class lectures.

Prerequisites: PY 208/209, BME Majors Only
Typically offered in Spring only

BME 209 Introduction to the Materials Science of Biomaterials (4 credit hours)
This course covers the chemistry, physics, and engineering theory underlying materials science and also discusses the diagnostic and analytical techniques necessary to assess these properties experimentally. This strong foundation prepares students to conceive and build better materials for a wide assortment of biomedical applications.

Co-req: PY 208/209. Pre-req: BME Students Only. Credit cannot be received for BME 209 and (MSE 200, MSE 201, MSE 203 or BME 203)
Typically offered in Fall only

BME 215 Biomedical Mechanics Laboratory (1 credit hours)
This laboratory is part of BME 205 - Biomedical Mechanics and complements it with relevant labs and examples. Statics and dynamics subjects will be studied with experimental techniques, including strain gauges and accelerometers, and computational methods, including finite-element analysis and motion capture. Finally, the human arm will be studied to derive forces, moments, and kinematic properties during various exercises. BME student only.

Co-requisites: MAE 208
Typically offered in Spring only

BME 217 Biomedical Electronics Laboratory (1 credit hours)
Laboratory in analog and digital circuit analysis. Electrical safety; Exercises in resistor networks, capacitors and inductors, steady-state and dynamic circuit behavior, active circuits, amplifiers, logic gates, combinatorial and sequential circuits, elementary digital system design, A/D conversion, biomedical applications.

Prerequisite: ECE 331, BME Majors
Typically offered in Spring only

BME 219 Materials Science of Biomaterials Lab (1 credit hours)
Introductory laboratory experience focused on integrating biological engineering and materials engineering principles by exploring key topics in materials science. Topics include biomaterial fabrication, evaluation of their physical properties and interpretation of results.

Pre-requisite: MSE 200 or MSE 201 or MSE/BME 203. Credit cannot be received for both BME 219 and BME 209
Typically offered in Fall only

BME 295 Research in Biomedical Engineering for Undergraduates (1-3 credit hours)
Opportunity for faculty mentored research in biomedical engineering. Approved plan of work required with significant independent research culminating in a final paper. Students must identify an advisor or co-advisor from within the BME faculty with whom

R: BME Majors, Departmental Approval Required
Typically offered in Fall and Spring

BME 298 Biomedical Engineering Design and Manufacturing I (2 credit hours)
This is the first in a series of four courses in Biomedical Design. The course introduces the tools and problem-solving skills required in the field of Biomedical Engineering.

Co-requisites: PY 208/209, BME Majors only
Typically offered in Fall only

BME 299 Biomedical Engineering Design and Manufacturing I Lab (1 credit hours)
BME 299 together with BME 252 or another course in CAD design fulfills the requirements of BME 298 Biomedical Engineering Design and Manufacturing I. In this course students learn some of the practical fundamentals of electronics manufacturing. Activities include use of bench equipment, soldering techniques, circuit board types, how to identify common electronic components and how they work in a circuit and simple C programming for microcontrollers.

Prerequisite: BME 252. Credit cannot be received for both BME 298 and BME 299
Typically offered in Fall only

BME 301 Human Physiology: Electrical Analysis (4 credit hours)
This course includes a quantitative approach to human physiology from the biomedical engineering perspective with an emphasis on neural, sensory, muscle, and cardiac physiology. Autonomic and somatic motor control will be discussed. Engineering applications, including neural stimulators, functional imaging, cochlear implants, artificial noses, vestibular implants, visual implants, artificial larynges, pacemakers and defibrillators will be discussed. Assignments include computer-based exercises using MATLAB.

Prerequisites: BIO 183, BM(M)E 201, [BME 210 or BM(M)E 207]
Typically offered in Fall only

BME 302 Human Physiology: Mechanical Analysis (4 credit hours)
This course explores a quantitative approach to human physiology from the biomedical engineering perspective with an emphasis on systems physiology described using mechanical properties. Topics include the physiological and mechanical behavior of the blood vessels, lungs, kidney muscles and larynx. In the course lab exercises, students investigate mechanical properties of fluids, electrolyte exchange in dialysis, spirometry and blood pressure measurement among other topics. The course culminates with the design of a novel laboratory experiment.

Prerequisite: BIO 183, [BM(M)E 205 or MAE 208], [BM(M)E 209 or BMME 150]
Typically offered in Spring only

BME 315 Biotransport (3 credit hours)
Quantification and modeling of heat and mass transfer in biomedical systems. Topics include heat transfer rate equations, conservation of energy, steady-state and transient heat transfer, Brownian motion, Fick’s laws, conservation of mass equations, molecular transport through membranes, porous media, Stoke-Einstein relations, boundary layer theory, mass transfer coefficients and hemodialysis.

Prerequisite: BIO 183 and BME/BMEE 201 and BME/BMME 205 or MAE 208 and MA 341 or MA 331
Typically offered in Spring only
BME 325 Biochemistry for Biomedical Engineers (3 credit hours)
An overview of how alterations in bioenergetics, enzyme catalysis, protein and membrane structure, carbohydrate, lipid and nucleic acid metabolism affect human health and how biomedical engineering tools are used to detect and monitor the problems by understanding these biochemical processes. Topics include: Biological Thermodynamics, Energy of macromolecular structure and binding, Structure/function of proteins, enzymes and nucleic acids, Kinetics, enzyme catalysis and biochemical network analysis, Generation of chemical and electrical potential in membranes, Carbohydrate/lipid/protein metabolism and energy production, DNA synthesis, transcription, Technologies used to monitor/detect biochemical processes including clinical imaging modalities.
Prerequisite: CH 221, (BME 209 or BME 203)
Typically offered in Fall only

BME 335 Biomaterials (3 credit hours)
Fundamental sciences behind the design and selection of biomaterials, including crystallography, polymer science, characterization, mechanical testing, and surface preparation. Integration of biomaterials into the body and its response, including inflammation and rejection. Semester-long research project.
Pre-req: BIO 183, (BME 209 or BME 203)
Typically offered in Spring only

BME 342 Analytical and Experimental Methods for Biomedical Engineers (3 credit hours)
Experimental and analytic tools are developed and used to solve problems in biomedical engineering. Techniques include kinematic analysis, closed form and finite element analysis of stresses and strains in a body, and failure analysis. Transducers necessary for experimental analysis and testing are introduced. Students learn advanced software packages such as the finite element program ANSYS and the dynamic analysis program ADAMS to assist in their analyses.
Prerequisite: BME 201; MAE 208 or CE 215; MAE 214 or CE 313; MA 341
Typically offered in Spring only

BME 345 Biomedical Solid Mechanics (3 credit hours)
This course covers topics ranging from multi-body systems to stress superposition to failure criteria to prepare students for the more advanced subjects of biomechanics and rehabilitation engineering. Topics include the following: Free-body diagrams, Multibody statics and dynamics, Linkage kinematics and kinetics, Anthropometric kinematics, Stress/strain/torsion, Beam bending, Stress superposition, Constitutive relationship, Strain gauges, Finite-element analysis, Failure analysis, Failure mechanisms.
P: BME 201 and (BME 205 or MAE 208) and (BME 209 or BME 203)
Typically offered in Spring only

BME 355 Biocontrols (3 credit hours)
Quantitative analysis of dynamic and feedback control systems, including modeling of physiological systems and physiological control systems, system time and frequency responses, control characteristics, and stability analysis. Design techniques for feedback systems in biomedical applications.
Prerequisite: MA 341; Corequisite: BME 311
Typically offered in Spring only

BME 365 Linear Systems in Biomedical Engineering (3 credit hours)
Fundamentals of linear systems analysis as applied to problems in biomedical modeling and instrumentation. Properties of biomedical systems and signals. Representation of continuous- and discrete-time signals and system response. Convolution.
Pre-reqs: [BM(M)E 207 or BME 210], BM(M)E 201. Co-reqs: MA 341 or MA 331
Typically offered in Fall only

BME 375 Biomedical Microcontroller Applications (3 credit hours)
Overview of microcontroller-based systems, including applications, architecture, number systems, and languages. Students gain experience using a PIC-based microcontroller to input information from a user and output information using LEDs and LCD displays. Students will learn capabilities of the PIC through in class exercises and weekly programming assignments. Both assembly language and PIC-based C are used. Students develop a PIC-based heart rate monitor and work in pairs on a BME-related project of their choice.
Pre-reqs: [BM(M)E 207 or BME 210], BM(M)E 201. Co-reqs: BM(M)E 385 or BME 422
Typically offered in Fall only

BME 385 Bioinstrumentation (3 credit hours)
Fundamentals of biomedical instrument design and implementation. Sensing mechanisms, sensor microfabrication methods, sensor interfacing circuits, analog-to-digital conversion, biosignal capture and storage, embedded microprocessors, data compression methods, system integration and prototyping. Laboratory exercises using LabVIEW and MATLAB, supplement the topics presented in class lectures. Students build a sensor using cleanroom facilities in the BME department as part of a semester-long design project.
Pre-reqs: [BM(M)E 207 or BME 219], BM(M)E 201
Typically offered in Fall only

BME 398 Biomedical Engineering Design and Manufacturing II (2 credit hours)
Students will be required to continue their use of the tools learned in Biomedical Design and Manufacturing I in the context of modern design practices and manufacturing processes. The organizational and project management tools of modern design will be introduced, and a technical discussion of a modern manufacturing technology will be introduced each week.
Pre-reqs: BM(M)E 298, [BM(M)E 207 or BME 210], BM(M)E 201
Typically offered in Spring only

BME 412 Biomedical Signal Processing (3 credit hours)
Fundamentals of continuous- and discrete-time signal processing as applied to problems in biomedical instrumentation. Properties of biomedical signals and instruments. Descriptions of random noise and signal processes. Interactions between randombiom
Pre-reqs: BM(M)E 365 or BME 311
Typically offered in Spring only
BME 418/BME 518/ECE 518/ECE 418 Wearable Biosensors and Microsystems (3 credit hours)
This course surveys the methods and application of wearable electronics and microsystems to monitor human biometrics, physiology, and environmental conditions. Topics covered include wearable electrocardiograms, blood-glucose monitors, electronic tattoos, wearable energy harvesting, "smart" clothing, body area networks, and distributed population networks. Critical comparison of different sensor modalities, quantitative metrics, and how their limitations in realistic applications define the selection, design, and operation criteria of one type of sensor over another will be considered.

Prerequisite: Senior standing
Typically offered in Fall only

BME 425/BME 525 Bioelectricity (3 credit hours)
Quantitative analysis of excitable membranes and their signals, including plasma membrane characteristics, origin of electrical membrane potentials, action potentials, voltage clamp experiments, the Hodgkin-Huxley equations, propagation, subthreshold stimuli, extracellular fields, membrane biophysics, and electrophysiology of the heart. Design and development of an electrocardiogram analysis system.

Prerequisite: BME 302 or (ZO 421 and a course in electrical circuits)
Typically offered in Spring only

BME 444/BME 544 Orthopaedic Biomechanics (3 credit hours)
Students study human body kinematics, force analysis of joints, and the structure and composition of biological materials. Emphasis is placed on the measurement of mechanical properties and the development and understanding of models of biological material mechanical behavior.

P: BM(M)E 301, BM(M)E 302, [BM(M)E 345 or MAE 214 or CE 313]
Typically offered in Fall only

BME 451 Biomedical Engineering Senior Design I (3 credit hours)
This course encompasses the project proposal and design concepts, including: individual pre-proposals, team proposals, project planning, scheduling, needs assessment, product requirements, competitive landscape and patent review, business risks, design concepts, and phase reviews. BME majors only.

Prerequisites: BME 302, BME 352, and completion of two of the suggested BME electives for their area of emphasis; BME majors;
Corequisites: ENG 331 or ENG 333
Typically offered in Fall only

BME 452 Biomedical Engineering Senior Design II (3 credit hours)
This course is a continuation of BME 451 moving from proposal and concepts into manufacturing, prototyping, and testing. The deliverables in this course include: detailed manufacturing specifications, biomaterials review, supplier identification, product feasibility, issues tracking, manufacturing planning, bill of materials, product risks, qualification protocol, IP disclosure, process validation planning, regulatory review, design history file audit, lessons learned, and phase reviews.

Prerequisite: BME 451, BME Majors
Typically offered in Spring only

BME 462 Biomaterials Characterization (3 credit hours)
Introductory laboratory experience focused on integrating engineering and biological principles by exploring key topics in biomaterials. Topics include evaluation and interpretation of experimental results, modeling and testing of tissues and cells, and biomaterial/tissue, cell interactions. BME and MSE Majors only; Juniors and Seniors.

Pre-reqs: [BM(M)E 325 or BCH351 or BCH 451], [BM(M)E 335 or MSE 485] and BME Majors.
Typically offered in Spring only

BME 466/TE 566/BME 566/TE 466 Polymeric Biomaterials Engineering (3 credit hours)
In-depth study of the engineering design of biomedical polymers and implants. Polymeric biomaterials, including polymer synthesis and structure, polymer properties as related to designing orthopedic and vascular grafts. Designing textile products as biomaterials including surface modification and characterization techniques. Bioreabsorbable polymers.

Prerequisite: PY 208 and (TE 200 or CH 220 or CH 221 or CH 225) and (MAE 206 or CE 214)
Typically offered in Fall only

BME 467/TE 467 Mechanics of Tissues & Implants Requirements (3 credit hours)
Application of engineering and biological principles to understand the structure and performance of tendons, ligaments, skin, and bone; bone mechanics; viscoelasticity of soft biological tissues; models of soft biological tissues; mechanics of skeletal muscle; and tissue-derived devices as well as interfaces between native tissues and synthetic devices.

Prerequisite: (ZO 160 or BIO 183) and (MAE 214 or CE 225)
Typically offered in Spring only

BME 481 Quality Management Systems for Engineers (3 credit hours)
This course is designed for biomedical engineering students who plan to work in industry. The course covers industry related topics including team work, conflict resolution, manufacturing and specifications, gap analysis, and root cause of analysis. Design topics including design of experiments, and standards and regulations relevant to the biomedical engineering profession are also covered. Lean and six sigma are taught with an option to test for a six sigma green belt if a six sigma project is completed in the following semester.

Co-reqs: BMME 697 or BME 451
Typically offered in Fall only

BME 483/BE 483/BME 583/BE 583 Tissue Engineering Technologies (2 credit hours)
In this half-semester laboratory module, students will gain practical experience with two key elements of tissue engineering: tissue building and angiogenesis. Using advanced culture techniques, students will construct a complex living tissue that closely resembles its natural counterpart, then assess its ability to support ingrowth of capillaries (angiogenesis). The effects of different biomaterials and angiogenic factors will be evaluated. The engineered tissue will be embedded, sectioned and stained for histological analysis.

Prerequisite: BIT 466/566 or permission of instructor
Typically offered in Fall only
BME 484/BME 584 Fundamentals of Tissue Engineering (3 credit hours)
This course covers essential concepts of organ and tissue design and engineering using living components, including cell-based systems and cells/tissues in combination with biomaterials, synthetic materials and/or devices. Topics include: In vivo tissue structure and function; Isolation and culture of primary cells and stem cells; Principles of cellular differentiation; Mass transport processes in cell culture systems; Design, production and seeding of scaffolds for 3D culture; Design of bioreactors to support high-density cell growth; State-of-the-art engineered tissue systems; Clinical translation; and Ethics.
Prerequisite: BIO 183, CH 221, and (MAE 201 or MSE 301 or CHE 315 or TE 303 or BME 315 or BME 325)
Typically offered in Spring only

BME 490 Special Topics in Biomedical Engineering (1-4 credit hours)
Offered as needed for presenting material not normally available in regular BME Department courses or for new BME courses on a trial basis.

Typically offered in Fall, Spring, and Summer

BME 498 Undergraduate Research in Biomedical Engineering (3 credit hours)
Opportunity for hands-on faculty mentored research project in biomedical engineering. Course may be a stand-alone project completed in one semester/summer or serve as part of a two-semester project. Approved plan of work required with significant indepe

Typically offered in Fall and Spring

BME 501 Biomedical Innovation and Entrepreneurship I - Needs Discovery (4 credit hours)
This course utilizes clinical immersion to identify medical device and other healthcare opportunities. Students will be exposed to diverse healthcare environments and learn to triage opportunities based on financial, regulatory and intellectual property landscapes. Guest lectures will feature experts in the medical device, pharmaceutical and healthcare industries as well as local entrepreneurs.
Prerequisite: Graduate Standing; R: Restricted to students enrolled in the M.S. Biomedical Engineering Program
Typically offered in Summer only

BME 502 Biomedical Innovation and Entrepreneurship II - Design and Regulation (4 credit hours)
This course teaches path-to-market concepts including regulatory aspects unique to medical devices and pharmaceuticals. Topics include detailed analyses of Phase I-IV clinical trials; 510(k) and PMA approvals, Investigational Device Exemption (IDE) Investigational New Drug (IND) application, Good Laboratory Practices (GLP) and clinical research organizations (CROs). Students will participate in frequent visits to local biotech companies. Guest lectures will feature experts in FDA processes, clinical research and early stage biotech ventures.
Prerequisite: Graduate Standing; R: Restricted to students enrolled in the M.S. Biomedical Engineering Program
Typically offered in Fall only

BME 503 Biomedical Innovation and Entrepreneurship III - Product Development (4 credit hours)
This course covers product development and project management for new biomedical-related products from accessing various streams of funding to allocation of resources for rapid prototyping and scale-up manufacturing. Students will visit local biotech co
Prerequisite: Graduate Standing; R: Restricted to students enrolled in the M.S. Biomedical Engineering Program
Typically offered in Spring only

BME 518/ECE 518/ECE 418/BME 418 Wearable Biosensors and Microsystems (3 credit hours)
This course surveys the methods and application of wearable electronics and microsystems to monitor human biometrics, physiology, and environmental conditions. Topics covered include wearable electrocardiograms, blood-glucose monitors, electronic tattoos, wearable energy harvesting, "smart" clothing, body area networks, and distributed population networks. Critical comparison of different sensor modalities, quantitative metrics, and how their limitations in realistic applications define the selection, design, and operation criteria of one type of sensor over another will be considered.
Prerequisite: Senior standing
Typically offered in Fall only

BME 522/ECE 522 Medical Instrumentation (3 credit hours)
Fundamentals of medical instrumentation systems, sensors, and biomedical signal processing. Example instruments for cardiovascular and respiratory assessment. Clinical laboratory measurements, therapeutic and prosthetic devices, and electrical safety requirements. Students should have background in electronics design using operational amplifiers.
Typically offered in Spring only

BME 525/BME 425 Bioelectricity (3 credit hours)
Quantitative analysis of excitable membranes and their signals, including plasma membrane characteristics, origin of electrical membrane potentials, action potentials, voltage clamp experiments, the Hodgkin-Huxley equations, propagation, subthreshold stimuli, extracellular fields, membrane biophysics, and electrophysiology of the heart. Design and development of an electrocardiogram analysis system.
Prerequisite: BME 302 or (ZO 421 and a course in electrical circuits)
Typically offered in Spring only

BME 540 Biomechatronics (3 credit hours)
Combines biologic systems and mechanical, electronic and control engineering systems to support high-density cell growth; State-of-the-art engineered tissue systems; Clinical translation; and Ethics.

Typically offered in Fall only

BME 543 Cardiovascular Biomechanics (3 credit hours)
Engineering principles are applied to the cardiovascular system. Anatomy of cardiovascular system; form and function of blood and blood vessels. Electric analogs; continuum mechanics with derivation of equations of motion; and constitutive models of soft tissue mechanics, with attention to normal, diseased, and adaptive processes. Programming project required.
BME 544/BME 444 Orthopaedic Biomechanics (3 credit hours)
Students study human body kinematics, force analysis of joints, and the structure and composition of biological materials. Emphasis is placed on the measurement of mechanical properties and the development and understanding of models of biological material mechanical behavior.
Prerequisite: BM(E)E 301, BM(E)E 302, [BM(E)E 345 or MAE 214 or CE 313]
Typically offered in Fall only

BME 550 Medical Imaging: Ultrasonic, Optical, and Magnetic Resonance Systems (3 credit hours)
Physical and mathematical foundations of ultrasonic, optical, and magnetic resonance imaging systems in application to medical diagnostics. Each imaging modality is examined on a case-by-case basis, highlighting the following critical system characteristics: (1) underlying physics of the imaging system, including the physical mechanisms of data generation and acquisition; (2) image creation, and (3) basic processing methods of high relevance, such as noise reduction.
Prerequisite: BME 412, ST 370 or ST 371, and PY 208
Typically offered in Fall only

BME 551 Medical Device Design (3 credit hours)
Student multidisciplinary teams work with local medical professionals to define specific medical device concepts for implementation. Medical specialty immersion with clinical departments at local medical centers; design input based on stakeholder-needs
Typically offered in Fall only

BME 552 Medical Device Design II (3 credit hours)
Student groups build and test prototypes of devices designed in the first course of this series. Good manufacturing practices; process validation; FDA quality system regulations; design verification and validation; regulatory approval planning; and inte

BME 560 Medical Imaging: X-ray, CT, and Nuclear Medicine Systems (3 credit hours)
Prerequisite: BME 311, ST 370 or ST 371, and PY 208

BME 566/TE 466/BME 466/TE 566 Polymeric Biomaterials Engineering (3 credit hours)
In-depth study of the engineering design of biomedical polymers and implants. Polymeric biomaterials, including polymer synthesis and structure, polymer properties as related to designing orthopedic and vascular grafts. Designing textile products as biomaterials including surface modification and characterization techniques. Biodegradable polymers.
Prerequisite: PY 208 and (TE 200 or CH 220 or CH 221 or CH 225) and
(MAE 206 or CE 214)
Typically offered in Fall only

BME 583/BEC 583/BME 483/BEC 483 Tissue Engineering Technologies (2 credit hours)
In this half-semester laboratory module, students will gain practical experience with two key elements of tissue engineering: tissue building and angiogenesis. Using advanced culture techniques, students will construct a complex living tissue that closely resembles its natural counterpart, then assess its ability to support ingrowth of capillaries (angiogenesis). The effects of different biomaterials and angiogenic factors will be evaluated. The engineered tissue will be embedded, sectioned and stained for histological analysis.
Prerequisite: BIT 466/566 or permission of instructor
Typically offered in Fall only

BME 584/BME 484 Fundamentals of Tissue Engineering (3 credit hours)
This course covers essential concepts of organ and tissue design and engineering using living components, including cell-based systems and cells/tissues in combination with biomaterials, synthetic materials and/or devices. Topics include: In vivo tissue structure and function; Isolation and culture of primary cells and stem cells; Principles of cellular differentiation; Mass transport processes in cell culture systems; Design, production and seeding of scaffolds for 3D culture; Design of bioreactors to support high-density cell growth; State-of-the-art engineered tissue systems; Clinical translation; and Ethics.
Prerequisite: BIO 183, CH 221, and (MAE 201 or MSE 301 or CHE 315 or TE 303 or BME 315 or BME 325)
Typically offered in Spring only

BME 590 Special Topics in Biomedical Engineering (1-6 credit hours)
A study of topics in the special fields under the direction of the graduate faculty.
Prerequisite: Senior or Graduate standing in Engineering or physical or biological sciences or textiles
Typically offered in Fall, Spring, and Summer

BME 620 Special Problems in Biomedical Engineering (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. Subject may pertain to the student's particular interest in any area of study in biomedical engineering.
Prerequisite: Graduate standing in BME
Typically offered in Fall, Spring, and Summer

BME 650 Internship in Biomedical Engineering (1 credit hours)
Students obtain professional experience through advanced engineering work in industrial and commercial settings under joint supervision of a member of the graduate faculty and an outside professional.
Prerequisite: Graduate standing in BME
Typically offered in Summer only

BME 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer
BME 693 Master’s Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master’s student
Typically offered in Fall and Spring

BME 695 Master’s Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

BME 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master’s student
Typically offered in Summer only

BME 699 Master’s Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master’s degree and are writing and defending their thesis.

Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

BME 790 Advanced Special Topics in Biomedical Engineering (1-6 credit hours)
A study of topics in advanced or emerging special areas under the direction of the graduate faculty. Experimental doctoral level courses.

Prerequisite: Graduate standing in engineering, physical, or biological sciences or textiles
Typically offered in Fall, Spring, and Summer

BME 802 Advanced Seminar in Biomedical Engineering (1 credit hours)
Elaboration of advanced subject areas, techniques and methods related to professional interest through presentations of personal and published works; opportunity for students to present and critically defend ideas, concepts, and inferences; opportunity for distinguished scholars to present results of their work. Discussions to uncover analytical solutions and analogies between problems in biomedical engineering and other technologies, and to present relationship of biomedical engineering to society.

Prerequisite: Doctoral student in BME or other engineering, physical science, or biological science majors, or textiles
Typically offered in Fall and Spring

BME 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning but the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

BME 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Summer only

BME 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

BME 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

BME 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

BME 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Bioprocessing (BBS)

BBS 201 Introduction to Biopharmaceutical Science (3 credit hours)
Through this course, students will experience laboratory and manufacturing terminology relevant to the biomanufacturing industries. Students will also gain exposure to regulatory and compliance procedures and issues facing this industry. This course will provide an introduction to prepare students to meet the demands and expectations of this industry and the bioprocessing science program.

Typically offered in Spring only

BBS 301 Process Validation Science (3 credit hours)
Process validation is a tested and documented subset of the panel of activities that are performed during the production of a biopharmaceutical. This course will introduce the concept of process validation as it applies to the biotechnology industry, and more specifically, to the manufacture of protein molecules as therapeutic agents.

Prerequisite: (FS 231 and BBS 201) or BBS 426.
Typically offered in Fall only
Biotechnology (BIT)

BIT 100 Current Topics in Biotechnology (4 credit hours)
This course provides both science and non-science students an opportunity to learn about current issues in biotechnology that play a role in our society. Topic areas will include contemporary and historical applications of biotechnology. From alternative fuel sources to the ramifications of the elucidation of the human genome on health care issues, advances in biotechnology are constantly reshaping the world we live in. Students will give presentations and participate in discussions in the classroom, as well as be engaged in the laboratory on a variety of different topics in biotechnology that affects all our lives.

Prerequisite: High School Biology
GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Fall only

BIT 200 Early Research in Biotechnology (4 credit hours)
This course offers first-and second-year students an opportunity for a mentored research experience in a small class environment. Students will learn how to apply the scientific method to make new discoveries and contribute to scientific knowledge. Stud

Prerequisite: High School Biology
GEP Natural Sciences
Typically offered in Fall and Spring

BIT 210/MB 210 Phage Hunters (3 credit hours)
This course offers first-year students an opportunity for mentored research. Students will apply the scientific method to make novel discoveries. Students will isolate and characterize naturally-occurring bacteriophage (viruses that infect bacteria, but not humans) from the environment. They will present their data to each other, and the genome of one phage will be sequenced. Students have the option to continue in a second semester to annotate that genome, culminating in a submission to Genbank and a poster presentation. Students in the course are part of the National Genome Research Initiative funded by The Howard Hughes Medical Institute. Student should have had a high school biology course before taking this course.

GEP Natural Sciences
Typically offered in Fall only

BIT 211/MB 211 Phage Genomics (2 credit hours)
This course offers first-year students an opportunity for mentored research. Students will apply the scientific method to make novel discoveries. Students will build on the work they began in BIT/MB 210; The novel phage isolated in the previous semester will undergo genome sequencing over winter break, and in this course students will learn to analyze and annotate the genome sequence. This semester will culminate in a submission to Genbank and a poster presentation. Students in the course are part of the national genome research initiative funded by the Howard Hughes Medical Institute.

Prerequisite: BIT(MB) 210
GEP Natural Sciences
Typically offered in Fall only

BIT 295 Special Topics in Biotechnology (1-3 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer
BIT 402/BIT 502 Biotechnology Networking and Professional Development (1 credit hours)
This course provides students interested in the biotechnology field an opportunity to gain valuable network, job application and interviewing skills. Over the course of the semester students will meet with ~30 biotechnology professionals in our area. In addition, students will learn from individuals in biotechnology jobs about the diverse careers options available and strategies for navigating the job market successfully.

Typically offered in Spring only

BIT 410 Manipulation of Recombinant DNA (4 credit hours)
Introduction to molecular biology and protein chemistry. Theory behind laboratory techniques and overview of cloning strategies starting from nucleic acid or protein sequence data. Laboratory sessions involve subcloning, preparation of competent cells, transformation, screening recombinant DNA by colony hybridization and PCR, SDS-PAGE of recombinant protein, affinity purification, and western blots.

Prerequisite: BIO 183 or ZO/BIO 160 and CH 223 or CH 227 with a C- or better
Typically offered in Fall, Spring, and Summer

BIT 462/BIT 562 Gene Expression Analysis: Microarrays (2 credit hours)
Microarray analysis is an evolving technique with its basis in the dynamic properties of the nucleic acid hybridization. We will review current theory, techniques, instrumentation, troubleshooting, analysis tools, and advanced protocols for microarray analysis. Students will have the opportunity to utilize skills learned during lecture in a laboratory environment and have access to exceptional instrumentation. At the conclusion of this course, students should feel comfortable with microarray experimental design, its tools, an analysis of generated data. This is a half-semester course. Student must register for both lecture and lab sections

Prerequisite: BIT 410 or 510
Typically offered in Fall only

BIT 463/CHE 463/BEC 463/BIT 563/CHE 563/BEC 563 Fermentation of Recombinant Microorganisms (2 credit hours)
Introduction to fermentation and protein chemistry. Theory behind laboratory techniques and overview of industrial scale expression systems. Laboratory sessions involve use of microbial expression vectors, fermentation systems, and large-scale purification of recombinant protein. Half semester course, first part.

Prerequisite: CH 223 or CH 227; Corequisite: (BIT 410 or BHC 452 or MB 352 or BEC 363)
Typically offered in Fall and Spring

BIT 464/BIT 564 Protein Purification (2 credit hours)

Prerequisite: BIT 410 or BIT 510 or BCH 454
Typically offered in Spring only

BIT 465/BIT 565 Real-time PCR Techniques (2 credit hours)
Real time PCR is an evolving technique with its basis in the dynamic properties of the polymerase chain reaction and fluorescent detection. We will review current real-time theory, techniques, machinery, troubleshooting, tools, and advanced protocols for sequence detection including SYBR green, TaqMan, Beacons, multiplexing, and single nucleotide polymorphism analysis. Students will have the opportunity to utilize skills learned during lecture in a laboratory environment. At the conclusion of this course, students should feel comfortable with real-time experimental design, its tools, and analysis of generated data. This is a half-semester course. Student must register for both lecture and lab sections.

Prerequisite: BIT 410 or 510
Typically offered in Spring only

BIT 466/BIT 566/PO 566/PO 466 Animal Cell Culture Techniques (2 credit hours)
Introduction to animal cell culture techniques. Aseptic technique for vertebrate cell culture, media formulation, primary cell culture, long-term maintenance of cell lines, application of molecular techniques to in vitro situations. Half semester course, first part.

Prerequisite: BIT 410 or BIT 510 or BCH 454
Typically offered in Fall, Spring, and Summer

BIT 467/BIT 567 PCR and DNA Fingerprinting (2 credit hours)
Introduction to polymerase chain reaction. Optimization of PCR reactions and primer design for DNA sequencing using DNA databases available on the web. Laboratory sections include using rapid techniques for isolating and sequencing DNA from small amount

Prerequisite: BIT 410/510
Typically offered in Spring only

BIT 468/BIT 568 Genome Mapping (2 credit hours)
Students will be introduced to basic techniques in genetic and physical mapping. The principles of DNA marker development, marker detection, genetic and physical mapping and DNA sequencing will be addressed from a practical view with an emphasis on agricultural applications. This is a half semester course. Student must register for both lecture and lab sections.

Prerequisite: BIT 410 or BIT 510 or BCH 454
Typically offered in Spring only

BIT 471/BIT 571 RNA Interference and Model Organisms (2 credit hours)
Introduction and history of RNA interference technology. Principles, mechanism, and applications of RNA interference in model organisms. Laboratory sessions include RNA interference-mediated silencing of genes in plants, C. elegans, and mammalian cell culture. This is a half-semester course (8 weeks). Student may not earn credit for both BIT 471 and BIT 571.

Prerequisite: BIT 410 or BIT 510 or BCH 454
Typically offered in Spring only
BIT 473/BIT 573 Protein Interactions (2 credit hours)
The interactions of proteins mediate numerous biological processes of cells. This course focuses on ways to identify and study protein-protein interactions, focusing on the advantages and limitations of each technique and how to apply the methods in a laboratory setting. In lab, students will perform a yeast two-hybrid experiment and a co-immunoprecipitation from proteins expressed in mammalian cell culture to confirm detected interactions. This is a half-semester course.

Prerequisite: BIT 410 or BCH 454
Typically offered in Fall and Spring

BIT 474/BIT 574 Plant Genetic Engineering (2 credit hours)
This course covers fundamental hands-on techniques and strategies in plant genetic engineering. Plants are major sources of food, fiber and fuel and provide model systems for both fundamental and applied research. Students will learn techniques for stable and transient transformation of plants and plant cell cultures and selection and detection of transgene expression. Additional topics covered will include methods to generate and screen for mutants, synthetic biology and applications of plant genetic engineering. This is a half-semester course. Credit is not allowed for both BIT 474 and BIT 574.

Prerequisite: BIT 410 or BIT 510 or BCH 454 or PB 421
Typically offered in Fall only

BIT 476 Applied Bioinformatics (2 credit hours)
The haploid human genome occupies a total of just over 3 billion DNA base pairs. This information is not contained in books, but stored in electronic databases. Computational biology utilizes infer function by comparative analysis. This course is designed for life scientists from all fields to introduce them to the power of bioinformatics and enable them to access and utilize biological information in databases for their own research.

Prerequisite: BIT 410 or BIT 510 or BCH 454 or GN 311
Typically offered in Fall only

BIT 477/BIT 577 Metagenomics (2 credit hours)
Participants will be introduced to a variety of methods for studying the complex microbial populations that surround us, including theory, applications, limitations, and health and legal implications. Students will apply deep sequencing techniques to mine the genetic diversity of complex microbial populations such as the rhizosphere, a swine lagoon sample, or even the communities of microbes growing happily inside your kitchen sink drain. This course will provide hands-on experience with molecular and computational tools that can be used to study the relationships between microbial communities and ecosystems or hosts.

Prerequisite: BIT 410 or BIT 510
Typically offered in Fall only

BIT 478/BIT 578 Mapping the Brain (2 credit hours)
Mapping the Brain is designed to provide students with a neuroscience research experience. In lecture, students will gain an appreciation for the fundamental challenges inherent in studying the brain and explore the theory, applications, and limitations of new and traditional technologies employed in modern neuroscience. In the lab, students will use a novel transgenic mouse model to analyze the connections of a single population of neurons and the effects of stimulating their activity in vivo. This hands-on laboratory research experience will expose students to common laboratory approaches (histology, microscopy, etc.) as well as to cutting edge genetic approaches.

Prerequisite: BIT 410 or 510
Typically offered in Fall only

BIT 479/BIT 579 High-Throughput Discovery (2 credit hours)
In this eight-week lab module, participants will be introduced to high-throughput (HT) discovery science and the underlying quantitative biology skills necessary for robust assay design. Participants will learn modern high-throughput screening approaches that will prepare them to design, validate, and perform cutting-edge screens. Different HT approaches will be discussed using authentic case studies and critical thinking scenarios based on published studies. Essential quantitative biology skills for the design and analysis of HT discovery science will be emphasized and tested regularly using "biomath" quizzes. The power of automation and robotics will be highlighted and hands-on experience with a liquid handler and the software used to operate it will be routine in the lab sessions. Participants will also be exposed to novel high-throughput approaches through discussions of new technologies and guest speakers who are experts in the field. Students will not receive credit for both BIT 479 and BIT 579.

Prerequisite: BIT 410 or 510
Typically offered in Spring only

BIT 480/BIT 580 Yeast Metabolic Engineering (2 credit hours)
Participants will be introduced to a variety of methods for using yeast to produce commercially relevant products. Topics will include cultivation, genetic manipulation to delete or replace genes, transformation, heterologous gene expression and codon optimization/gene synthesis. Various modern molecular cloning approaches and computational resources will be discussed. Students will apply gene manipulation approaches to engineer Saccharomyces cerevisiae to produce beta-carotene and/or other relevant biotechnology products. This will be accomplished by assembling a series of optimized genes in the biosynthetic pathway using the versatile genetic assembly system (VEGAS) that exploits the capacity of Saccharomyces cerevisiae to join sequences with terminal homology by homologous recombination. Expression will be compared by assembling libraries of transcriptional units with different promoters and using different genetic knock-outs as hosts. Additionally, computational modeling of metabolic processes will be used to assess perturbations to metabolic fluxes.

Prerequisite: BIT 410 or 510
Typically offered in Spring only
BIT 481/PB 481 Plant Tissue Culture and Transformation (2 credit hours)
Basic techniques in plant tissue culture and transformation. Empirical approaches to techniques in plant tissue culture, designing transgenes for expression in specific plant cell organelles and tissues, use of reporter genes to optimize transformation, and troubleshooting transformation. Laboratory sessions provide hands-on experience with plant tissue culture and transformation. Use of reporter genes, fluorescence microscopy and digital imaging. Half semester course, first part.

Typically offered in Spring only

BIT 492 External Learning Experience (1-6 credit hours)
A learning experience in the area of biotechnology within an academic framework that utilizes campus facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, and the departmental teaching coordinator prior to the experience. Project must be approved by the Academic Coordinator or Program Director of the Biotechnology Program.

Typically offered in Fall and Summer

BIT 493 Special Problems in Biotechnology (1-6 credit hours)
A learning experience within an academic framework that utilizes campus facilities and resources. Contact and arrangements with prospective mentor(s) must be initiated by student and approved by a faculty adviser, the prospective mentor, and the departmental teaching coordinator prior to the experience. Project must be approved by the Academic Coordinator or Program Director of the Biotechnology Program.

Typically offered in Fall, Spring, and Summer

BIT 495 Special Topics in Biotechnology (1-3 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

BIT 501 Ethical Issues in Biotechnology (1 credit hour)
Students investigate and discuss current controversial issues in biotechnology. This course emphasizes thinking about new technologies in a rational and thoughtful way.

Typically offered in Fall and Spring

BIT 502/BIT 402 Biotechnology Networking and Professional Development (1 credit hour)
This course provides students interested in the biotechnology field an opportunity to gain valuable network, job application and interviewing skills. Over the course of the semester students will meet with ~30 biotechnology professionals in our area. In addition, students will learn from individuals in biotechnology jobs about the diverse careers options available and strategies for navigating the job market successfully.

Typically offered in Spring only

BIT 510 Core Technologies in Molecular and Cellular Biology (4 credit hours)
Basic technologies of recombinant DNA procedures, gene expression, isolation and identification of nucleic acids and proteins.

Prerequisite: Equivalent of CH 223 and (MB 351 or GN 311)
Typically offered in Fall, Spring, and Summer

BIT 520/BIT 420 Microarray Analysis: Techniques and Applications (2 credit hours)
Microarray analysis is an evolving technique with its basis in the dynamic properties of the nucleic acid hybridization. We will review current theory, techniques, instrumentation, troubleshooting, analysis tools, and advanced protocols for microarray analysis. Students will have the opportunity to utilize skills learned during lecture in a laboratory environment and have access to exceptional instrumentation. At the conclusion of this course, students should feel comfortable with microarray experimental design, its tools, an analysis of generated data. This is a half-semester course. Student must register for both lecture and lab sections.

Prerequisite: BIT 410 or 510
Typically offered in Fall only

BIT 530/CHE 530/BEC 530/BIT 463/CHE 463/BEC 463 Fermentation of Recombinant Microorganisms (2 credit hours)
Introduction to fermentation and protein chemistry. Theory behind laboratory techniques and overview of industrial scale expression systems. Laboratory sessions involve use of microbial expression vectors, fermentation systems, and large-scale purification of recombinant protein. Half semester course, first part.

Prerequisite: CH 223 or CH 227; Corequisite: (BIT 410 or BCH 452 or MB 352 or BEC 363)
Typically offered in Fall and Spring

BIT 544/BIT 444 Protein Purification (2 credit hours)

Prerequisite: BIT 410 or BIT 510 or BCH 454
Typically offered in Spring only

BIT 550/BIT 455 Real-time PCR Techniques (2 credit hours)
Real time PCR is an evolving technique with its basis in the dynamic properties of the polymerase chain reaction and fluorescent detection. We will review current real-time theory, techniques, machinery, troubleshooting, tools, and advanced protocols for sequence detection including SYBR green, TaqMan, Beacons, multiplexing, and single nucleotide polymorphism analysis. Students will have the opportunity to utilize skills learned during lecture in a laboratory environment. At the conclusion of this course, students should feel comfortable with real-time experimental design, its tools, and analysis of generated data. This is a half-semester course. Student must register for both lecture and lab sections.

Prerequisite: BIT 410 or 510
Typically offered in Spring only

BIT 566/PO 466/PO 566/BIT 466 Animal Cell Culture Techniques (2 credit hours)
Introduction to animal cell culture techniques. Aseptic technique for vertebrate cell culture, media formulation, primary cell culture, long-term maintenance of cell lines, application of molecular techniques to in vitro situations. Half semester course, first part.

Prerequisite: BIT 410 or BIT 510 or BCH 454
Typically offered in Fall, Spring, and Summer
BIT 567/BIT 467 PCR and DNA Fingerprinting (2 credit hours)
Introduction to polymerase chain reaction. Optimization of PCR reactions and primer design for DNA sequences using DNA databases available on the web. Laboratory sections include using rapid techniques for isolating and sequencing DNA from small amounts.
Prerequisite: BIT 410/510
Typically offered in Spring only

BIT 568/BIT 468 Genome Mapping (2 credit hours)
Students will be introduced to basic techniques in genetic and physical mapping. The principles of DNA marker development, marker detection, genetic and physical mapping and DNA sequencing will be addressed from a practical view with an emphasis on agricultural applications. This is a half-semester course. Student must register for both lecture and lab sections.
Prerequisite: BIT 410 or BIT 510 or BCH 454
Typically offered in Spring only

BIT 569 RNA Purification and Analysis (2 credit hours)
Laboratory-intensive course covering techniques in RNA purification and analysis including: isolation of quality RNA; quantification by gel and spectrophotometer; separation by gel electrophoresis; reverse transcription PCR; and Northern blotting using
Prerequisite: BIT 410 or 510
Typically offered in Fall only

BIT 571/BIT 471 RNA Interference and Model Organisms (2 credit hours)
Introduction and history of RNA interference technology. Principles, mechanism, and applications of RNA interference in model organisms. Laboratory sessions include RNA interference-mediated silencing of genes in plants, C. elengeans, and mammalian cell culture. This is a half-semester course (8 weeks). Student may not earn credit for both BIT 471 and BIT 571.
Prerequisite: BIT 410 or BIT 510 or BCH 454
Typically offered in Fall only

BIT 572/BIO 572/CH 572 Proteomics (3 credit hours)
Introduction and history of the field of proteomics followed by the principles and applications of proteomics technology to understand protein expression and protein post-transitional modifications. Laboratory sessions include growing yeast with stable-isotope labeled amino acids, protein purification, Western blots, protein identification and quantification, and protein bioinformatic analysis. This is a half-semester course.
Prerequisite: BIT 410 or BIT 510 or BCH 454 (or approval from the instructor)
Typically offered in Spring only

BIT 573/BIT 473 Protein Interactions (2 credit hours)
The interactions of proteins mediate numerous biological processes of cells. This course focuses on ways to identify and study protein-protein interactions, focusing on the advantages and limitations of each technique and how to apply the methods in a laboratory setting. In lab, students will perform a yeast two-hybrid experiment and a co-immunoprecipitation from proteins expressed in mammalian cell culture to confirm detected interactions. This a half-semester course.
Prerequisite: BIT 410 or BCH 454
Typically offered in Spring only

BIT 574/BIT 474 Plant Genetic Engineering (2 credit hours)
This course covers fundamental hands-on techniques and strategies in plant genetic engineering. Plants are major sources of food, fiber and fuel and provide model systems for both fundamental and applied research. Students will learn techniques for stable and transient transformation of plants and plant cell cultures and selection and detection of transgene expression. Additional topics covered will include methods to generate and screen for mutants, synthetic biology and applications of plant genetic engineering. This is a half-semester course. Credit is not allowed for both BIT 474 and BIT 574.
Prerequisite: BIT 410 or BIT 510 or BCH 454 or PB 421
Typically offered in Fall only

BIT 577/BIT 477 Metagenomics (2 credit hours)
Participants will be introduced to a variety of methods for studying the complex microbial populations that surround us, including theory, applications, limitations, and health and legal implications. Students will apply deep sequencing techniques to mine the genetic diversity of complex microbial populations such as the rhizosphere, a swine lagoon sample, or even the communities of microbes growing happily inside your kitchen sink drain. This course will provide hands-on experience with molecular and computational tools that can be used to study the relationships between microbial communities and ecosystems or hosts.
Prerequisite: BIT 410 or 510
Typically offered in Fall only

BIT 578/BIT 478 Mapping the Brain (2 credit hours)
Mapping the Brain is designed to provide students with a neuroscience research experience. In lecture, students will gain an appreciation for the fundamental challenges inherent in studying the brain and explore the theory, applications, and limitations of new and traditional technologies employed in modern neuroscience. In the lab, students will use a novel transgenic mouse model to analyze the connections of a single population of neurons and the effects of stimulating their activity in vivo. This hands-on laboratory research experience will expose students to common laboratory approaches (histology, microscopy, etc.) as well as to cutting edge genetic approaches.
Prerequisite: BIT 410 or 510
Typically offered in Fall only

BIT 579/BIT 479 High-Throughput Discovery (2 credit hours)
In this eight-week lab module, participants will be introduced to high-throughput (HT) discovery science and the underlying quantitative biology skills necessary for robust assay design. Participants will learn modern high-throughput screening approaches that will prepare them to design, validate, and perform cutting-edge screens. Different HT approaches will be discussed using authentic case studies and critical thinking scenarios based on published studies. Essential quantitative biology skills for the design and analysis of HT discovery science will be emphasized and tested regularly using "biomath" quizzes. The power of automation and robotics will be highlighted and hands-on experience with a liquid handler and the software used to operate it will be routine in the lab sessions. Participants will also be exposed to novel high-throughput approaches through discussions of new technologies and guest speakers who are experts in the field. Students will not receive credit for both BIT 479 and BIT 579.
Prerequisite: BIT 410 or 510
Typically offered in Spring only
BIT 580/BIT 480 Yeast Metabolic Engineering (2 credit hours)
Participants will be introduced to a variety of methods for using yeast to produce commercially relevant products. Topics will include cultivation, genetic manipulation to delete or replace genes, transformation, heterologous gene expression and codon optimization/gene synthesis. Various modern molecular cloning approaches and computational resources will be discussed. Students will apply gene manipulation approaches to engineer Saccharomyces cerevisiae to produce beta-carotene and/or other relevant biotechnology products. This will be accomplished by assembling a series of optimized genes in the biosynthetic pathway using the versatile genetic assembly system (VEGAS) that exploits the capacity of Saccharomyces cerevisiae to join sequences with terminal homology by homologous recombination. Expression will be compared by assembling libraries of transcriptional units with different promoters and using different genetic knock-outs as hosts. Additionally, computational modeling of metabolic processes will be used to assess perturbations to metabolic fluxes.

Prerequisite: BIT 410 or 510
Typically offered in Fall, Spring, and Summer

BIT 581 Plant Transformation (2 credit hours)

BIT 590 Independent Study in Biotechnology (1-3 credit hours)
Independent study in Biotechnology under the supervision of a Biotechnology faculty member. Restricted to graduate students in the Biotechnology Program with consent of the supervising faculty. May not be taken in the first semester of graduate study.

Typically offered in Fall, Spring, and Summer

BIT 595 Special Topics (1-6 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

BIT 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Master's students only
Typically offered in Fall and Spring

BIT 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BIT 696 Summer Thesis Res (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Typically offered in Summer only

BIT 790 Independent Study in Biotechnology (1-3 credit hours)
Independent study in Biotechnology under the supervision of a Biotechnology faculty member. Restricted to graduate students in the Biotechnology Program with consent of the supervising faculty. May not be taken in the first semester of graduate study.

Typically offered in Fall, Spring, and Summer

BIT 815 Advanced Special Topics (1-6 credit hours)
Intensive three-week or six-week courses in advanced technologies such as DNA sequencing, downstream processing, immunological techniques, construction of c-DNA libraries, mammalian embryo manipulation, plant transformation, bioreactor design, cloning in gram positive bacteria, electron microscopy or techniques in yeast molecular biology.

Prerequisite: BIT 510
Typically offered in Summer only

BIT 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Doctoral students only (DR)
Typically offered in Fall and Spring

BIT 896 Summer Dissertation Res (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Typically offered in Summer only

Business Administration (MBA)

MBA 500 Managerial and Career Effectiveness (0.5-3 credit hours)
Frameworks, concepts and tools for management and career effectiveness. Assessment of managerial strengths, weaknesses, and potential. Team building, public speaking, networking, decision making, creativity and problem solving. Career development techniques including data mining, job search, behavior based interviewing, and negotiation skills with practical application of those concepts. Restricted to MBA Students.

Typically offered in Fall only

MBA 501 Financial Accounting for Decision Makers (1 credit hours)
Methods used by accountants record to economic events such as operating, investing, and financing activities, in the income statement, balance sheet, and statement of cash flows. Analysis of financial statements and disclosures. Impact of accounting standards and managerial incentives on the financial reporting process. Restricted to MBA students.

Typically offered in Fall, Spring, and Summer

MBA 502 Managerial Accounting for Decision Makers (1 credit hours)
Foundational knowledge in managerial accounting for decision making. Internal uses of accounting information for decision making within the organization. Identification of revenue and cost information to conduct break-even analyses, assign product costs, complete operational budgets, assess performance, and complete other management decision-making processes. Restricted to MBA students.

Typically offered in Fall, Spring, and Summer

MBA 503 Managerial and Decision-making (0.5-3 credit hours)
Foundational knowledge in managerial accounting for decision making. Internal uses of accounting information for decision making within the organization. Identification of revenue and cost information to conduct break-even analyses, assign product costs, complete operational budgets, assess performance, and complete other management decision-making processes. Restricted to MBA students.

Typically offered in Fall, Spring, and Summer

MBA 504 Managerial Finance (0.5-3 credit hours)
Foundational knowledge in managerial accounting for decision making. Internal uses of accounting information for decision making within the organization. Identification of revenue and cost information to conduct break-even analyses, assign product costs, complete operational budgets, assess performance, and complete other management decision-making processes. Restricted to MBA students.

Typically offered in Fall, Spring, and Summer
MBA 505  **Essential Economics for Managers** (2 credit hours)

Typically offered in Fall and Spring

MBA 506  **Data-Driven Managerial Decisions 1** (1 credit hours)
Business cases and problems where data analysis is part of the decision-making process. Applications to finance, management, marketing, and operations. Proficiency in Excel methods commonly used in management. Completion of a project where students follow a business problem from formulation to solution using data analysis. Restricted to MBA students.

Prerequisite: BUS/ST 350
Typically offered in Fall, Spring, and Summer

MBA 507  **Data-Driven Managerial Decisions 2** (1 credit hours)
Continuation of a series of business cases and problems where data analysis is part of the decision making process. Estimation of linear relationships among variables, with applications to finance, management, marketing, and operations. Proficiency with Excel methods commonly used for estimation. Completion of a project where students follow a business problem from formulation to solution using the methods covered the course. Restricted to MBA students.

Prerequisite: MBA 506
Typically offered in Fall, Spring, and Summer

MBA 510  **Critical Thinking for Managers** (1 credit hours)
Structure for critically analyzing and evaluating an issue, claim, text, or speech from a management perspective. Systematic analysis and evaluation of information, concepts, and ideas in order to identify underlying assumptions, purposes, and questions. Synthesis of this knowledge to logically form conclusions and recognize implications. Communication of arguments and beliefs and recognition of common language barriers in the written and spoken word. For online sections, must be enrolled in MBA program.

Typically offered in Fall and Spring

MBA 511  **Data Security and Privacy** (3 credit hours)
Data security and privacy necessary for today’s business environment. Common vulnerabilities, securing data, encryption, policies, privacy management, standards, and compliance.

Typically offered in Fall and Spring

MBA 515  **Enterprise Resource Planning Systems** (3 credit hours)

Typically offered in Fall and Spring

MBA 516  **Ethics and Fraud Examination** (3 credit hours)
Examination of business ethics and occupational fraud cases, including asset misappropriation, corruption, and fraudulent financial reporting. Theories about fraud, prevalence of and effects of fraud, in the US and globally. Fraud examination skills including investigation, data analysis, and interviewing. Identification of common schemes and development of internal controls to prevent and detect fraud. Business ethics and socio-political responses to occupational fraud.

Typically offered in Spring and Summer

MBA 518  **Enterprise Risk Management** (3 credit hours)
Integrated approach to managing the risks that can prevent an organization from achieving its objectives, both financial and nonfinancial. Core elements of an effective enterprise risk management process. Links to management strategy. Risk assessment methodologies.

Typically offered in Fall only

MBA 519  **Enterprise Risk Management Practicum** (3 credit hours)
Applied approach to managing the risks that can prevent an organization from achieving its objectives, both financial and nonfinancial, by working in teams to address real problems in real organizations.

Prerequisite: MBA 518
Typically offered in Spring only

MBA 520  **Financial Management of Corporations** (2 credit hours)
Financial decision making at profit-motivated businesses: decisions about what to produce and how and decisions about how to finance the assets needed for production. Cash as the basis of asset valuation. Capital budgeting decisions under certainty and uncertainty.

Prerequisite: MBA 501 Financial Accounting for Decision Makers
Typically offered in Fall, Spring, and Summer

MBA 521  **Advanced Corporate Finance** (3 credit hours)
Overview of financial management. Evaluation of projects and valuation of real assets using traditional discounted cash flow analysis and real options. Role of financial leverage; optimal capital structure. Conflicts between security holders and management; stockholder-bondholder conflicts; financial distress, bankruptcy and reorganization; corporate control and restructuring; corporate governance issues.

Prerequisite: MBA 520
Typically offered in Fall and Spring

MBA 522  **Financial Modeling** (3 credit hours)
This course examines models for capital budgeting, equity and bond valuation, capital structure, dividend policy, among other topics, using spreadsheet analyses. The course will take a very hands-on approach in building spreadsheet models. The course also includes sensitivity analysis, pro-forma analysis and using financial statements.

Prerequisite: MBA 520
Typically offered in Fall only

MBA 523  **Investment Theory and Practice** (3 credit hours)
Advanced topics in investments with a focus on underlying theory and practical application using real world data. Stock valuation models, bond valuation, derivatives, portfolio performance evaluation, investment strategies, efficient market theory and other current issues in investment finance.

Prerequisite: MBA 520
Typically offered in Fall and Spring
MBA 524  **Equity Valuation**  (3 credit hours)
Advanced quantitative course on applied equity valuation. Students conduct stock valuation analysis which is then used to select stocks for the student-managed SunTrust MBA fund. Topics include the investment decision making process, empirical evidence on securities returns, forecasting financial statements, industry and macro-economic analysis, valuation models, portfolio performance evaluation and performance attribution. Students will also learn how to write computer programs using SAS software in order to generate statistical tests of investment strategies using "big financial data."
Prerequisite: MBA 520  
*Typically offered in Spring and Summer*

MBA 525  **Taxes and Business Strategy**  (3 credit hours)
Importance of tax considerations in business decisions. Framework for understanding how taxes affect business strategy and financing decisions in a wide variety of settings.
*Typically offered in Spring only*

MBA 526  **International Finance**  (3 credit hours)
Theory and practice of financial management in the international arena, including spot and forward markets for foreign exchange, currency futures and options contracts, international arbitrage conditions, foreign exchange exposure, foreign trade financing instruments, direct and portfolio investment abroad, and the role of country risk in determining investments.
Prerequisite: MBA 520  
*Typically offered in Fall only*

MBA 528/FIM 528/MA 528/ECG 528  **Options and Derivatives Pricing**  (3 credit hours)
The course covers (i) structure and operation of derivative markets, (ii) valuation of derivatives, (iii) hedging of derivatives, and (iv) applications of derivatives in areas of risk management and financial engineering. Models and pricing techniques include Black-Scholes model, binomial trees, Monte-Carlo simulation. Specific topics include simple no-arbitrage pricing relations for futures/forward contracts; put-call parity relationship; delta, gamma, and vega hedging; implied volatility and statistical properties; dynamic hedging strategies; interest-rate risk, pricing of fixed-income product; credit risk, pricing of defaultable securities.
Prerequisites: MA 341 and MA 405 and MA 421  
*Typically offered in Fall only*

MBA 530  **Leading People**  (3 credit hours)
This course is about the fundamentals of leading people, a critical aspect of every management position and leadership role. The course will focus at three levels of analysis: the individual, the group and the organization. Students will gain exposure to topics and issues in the field of organizational behavior and human resource management. These include knowing about and dealing with individual differences, international and cultural issues, working in groups (both virtually and geographically co-located), motivation, leadership, organizational structures and cultures, change management, empowerment, delegation, communication, and management ethics. Restricted to MBA students.
*Typically offered in Spring only*

MBA 531  **Leading People 1**  (1 credit hour)
This one-credit course is designed for part-time and online students and serves as the first part of the Leading People series. The Leading People series focuses at three levels of analysis: the individual, the group and the organization. In this series, students will gain exposure to topics and issues in the field of organizational behavior and human resource management. Content covered in part 1 addresses team leadership and change management. This course also includes instruction on improving communication skills, making presentations, leading from strengths, and emotional intelligence. Restricted to MBA students. Students may not receive credit in MBA 530 and MBA 531.
Restriction: Restricted to MBA students. Students may not receive credit in MBA 530 and MBA 531.  
*Typically offered in Fall and Spring*

MBA 532  **Leading People 2**  (2 credit hours)
This two-credit course is designed for part-time and online students and serves as the second part of the Leading People series. The Leading People series focuses at three levels of analysis: the individual, the group and the organization. Students will gain exposure to topics and issues in the field of organizational behavior and human resource management. Content covered in this course includes dealing with individual differences, international and cultural issues, working in groups (both virtually and geographically co-located), motivation, leadership, organizational structures and cultures, empowerment, delegation, and management ethics. Restricted to MBA students. Students may not receive credit in MBA 530 and MBA 532.
Restriction: Restricted to MBA students. Students may not receive credit in MBA 530 and MBA 532.  
*Typically offered in Spring and Summer*

MBA 533  **Negotiation and Conflict Management**  (3 credit hours)
Course emphasizes ensuring that the organization benefits from inevitable conflicts that occur. It provides skills in diagnosis, negotiation, and building trust and cooperative working relationships in organizations.
*Typically offered in Fall only*

MBA 534  **Core Concepts of Human Capital Management**  (3 credit hours)
The course will cover the core concepts behind successfully acquiring, deploying and motivating talent to achieve organization competitiveness. Students will think about the challenges of managing human assets, learn basic HRM concepts and then create practical solutions to typical HCM problems. At the end of this course, students will demonstrate a basic understanding of the topics of equal opportunity, diversity, recruiting and selection, performance evaluation, performance goal setting, performance coaching and feedback, competitive compensation and benefits, fair discipline and termination processes and strategic talent management and succession programs.
*Typically offered in Fall only*

MBA 535  **Leading Teams**  (1 credit hour)
More and more organizations are using team-based work to accomplish tasks. This course provides the latest, evidence-based best practices for working in, and leading, teams in organizations. The course is designed to be activity-driven and hands-on to give students the opportunity to practice and improve their team skills.
*Typically offered in Fall only*
MBA 536  **Experience Innovation and Strategic Design**  (3 credit hours)
Successful innovation involves creating more valuable experiences for users and customers. The course covers key concepts and methodologies for experience-based innovation, drawing on design and creativity frameworks to fully understand customer experiences. Course activities include exercises and a project to practice innovation and "design-thinking" tools and techniques in a business context. Relevant strategic perspectives for designing innovative products and services are addressed through case studies and other managerial readings with practical business application. The importance of a multi-disciplinary approach to experience innovation is emphasized, such that the course is suitable for students in all disciplines with an interest in innovation.

*Typically offered in Spring only*

MBA 538  **Women as Leaders**  (1 credit hours)
This course focuses on helping women uncover and reflect on their leadership styles so that they can become more empowered leaders, take responsibility for recognizing the potential in people and ideas, and have the courage to develop that potential.

*Typically offered in Spring only*

MBA 539  **Jenkins Leadership Challenge**  (1 credit hours)
Leadership skills are highly valued in today's business environment. This is the capstone course for the Jenkins MBA Leadership Certificate. In other classes in the leadership series, students have learned what a successful leader is, what a successful leader does, and how a successful leader deals with contingencies in an effective way. In this class participants will review the Five Practices of Exemplary Leadership and select behaviors in their own leadership practice that need to be adjusted for stronger leadership performance. Students will then plan and execute a personal leadership challenge to address these behaviors. Course content includes a leadership assessment, lectures and readings, required participation in group coaching, periodic individual reflections, development of videos for leadership challenge proposals and testimonials, and a final paper that reflects on the student's journey through the leadership program and identifies plans for the future.

Prerequisite: MBA 510 and MBA 530 or MBA 531 and MBA 532.

*Typically offered in Fall and Spring*

MBA 540  **Principles of Operations and Supply Chain Management**  (2 credit hours)
Design and management of operations and supply chains. Analysis of strategies, processes, planning and control, and advanced techniques using a variety of managerial frameworks and quantitative tools. Restricted to MBA students.

Prerequisite: MBA 507

*Typically offered in Fall, Spring, and Summer*

MBA 541  **Supply Management**  (3 credit hours)
Major themes and strategies of supply management relationships. The focus is on establishing a basis for collaborative relationships with suppliers through focused market intelligence research, relationship assessment and management, negotiation, collaborative contracting, and on-going management of relationships in global supply chains. Emphasis on the importance of collaboration through the application of practical tools and approaches that drive mutually beneficial outcomes. Core processes around initial exploration and assessment of supply chain relationships, establishing metrics/expectations for the relationship, crafting and managing contracts, and sustaining continuous performance improvement in sourcing, logistics and operations. Every student will participate in a team-based supply chain project with an organization and will learn the team-based, deadline-driven nature of supply chain initiatives in a real-company setting.

Co-requisite: MBA 540 Operations and Supply Chain Management

*Typically offered in Fall and Spring*

MBA 542  **Supply Chain Logistics**  (3 credit hours)
Effective logistics decision-making using a variety of conceptual frameworks and quantitative tools. Relationship between logistics and broader issues of managing the entire supply chain and fulfilling the strategic objectives of a firm.

*Typically offered in Fall and Spring*

MBA 543  **Planning and Control Systems**  (3 credit hours)
Design and management of planning and control systems within the organization and across the supply chain. Business planning, master production scheduling, material requirements planning, just-in-time and theory of constraints. Enterprise resource planning (ERP) and business-to-business (B2B) systems. Impact of information technologies on planning and control systems. Major project using state-of-the-art ERP system.

*Typically offered in Spring only*

MBA 544  **Decision Making under Uncertainty**  (3 credit hours)
Structured framework for modeling and analyzing business decisions in the presence of uncertainty and complex interactions among decision parameters. Topics include decision models, value of information and control, risk attitude, spreadsheet applications, and decision analysis cycle. Interactive case study.

*Typically offered in Fall, Spring, and Summer*

MBA 548  **Analytical Supply Chain Management**  (3 credit hours)
The objective of the course is to build an understanding of how to manage and improve the performance (efficiency and responsiveness) of operations and supply chains through decision making that is based on analysis and facts, rather than intuition. The course introduces fundamental aspects of operations and supply chain management as well as analytical modeling tools and techniques that can be used to support decision making (e.g., optimization, regression analysis, simulation). The approach taken in the course is entirely example-based and hands-on, since all these techniques will be implemented in Excel, either with Excel's built-in tools or with Excel add-ins.

Prerequisites: MBA 507 and MBA 540

*Typically offered in Fall only*
MBA 549  Supply Chain Management Practicum  (3 credit hours)
Research project examining supply chain management issues at an organization, usually a member of the Supply Chain Resource Cooperative. Projects will typically focus on procurement, logistics, materials management, operations, or integrated supply chain issues.

Prerequisite: MBA 540
Typically offered in Fall and Spring

MBA 551  Predictive Analytics for Business and Big Data  (3 credit hours)
This course is designed around the full analytics lifecycle which encompasses the business problem, the data, the analysis, and the decision. Students will learn to identify and clearly explain business problems that can be addressed with analytics. They will learn to determine which analytic methods are best suited to solve particular problems and clearly explain the results of an analytic model and how those results might impact the business bottom line. Analytical methods to be covered include data, visualization, a review of regression analysis; logistic regression; classification and regression trees (including boosting and bagging methodologies); and clustering (segmentation) methods. Students will also develop at least a beginning proficiency with several statistical software packages including Tableau, JMP, R, and SAS Enterprise Miner. Emphasis will be placed on analyzing real data and understanding how analytical thinking can be applied to solve big data problems.

Prerequisites: MBA 506 and MBA 507
Typically offered in Fall, Spring, and Summer

MBA 552  Data Engineering, Management and Warehousing  (3 credit hours)
This course examines how to collect and process data to make it useful, how to validate, protect, and process data to make it available, and how to create a place to properly store data.

Typically offered in Fall, Spring, and Summer

MBA 555  Product Design and Development  (4 credit hours)
Total product realization process, including customer needs analysis, product design and engineering, manufacturability assessment and marketing plan development. Definition of relevant market, design and engineering principles, financial considerations and manufacturing aspects of product development process. Application and integration of business, design and engineering methodologies, concepts and tools on actual product design and development project.

Typically offered in Fall only

MBA 559  Business Analytics Practicum  (3 credit hours)
This course focuses on solving a real-world business problem that includes a heavy data analytic component. The business problem will vary according to the client but could include problems from finance, human resources, marketing, finance, supply chain, or other management areas.

Prerequisite: MBA 506 and MBA 507 and MBA 551
Typically offered in Fall and Spring

MBA 560  Marketing Management and Strategy  (2 credit hours)
Market segmentation, targeting, and positioning. Channels of distribution, promotion strategy, product development strategy, and pricing strategy. Relationship marketing and marketing strategy. Applications in high-tech environments. Restricted to MBA students.

Typically offered in Fall, Spring, and Summer

MBA 561  Consumer Behavior  (3 credit hours)
Consumer perception of products and brands, including the role of product design and development of consumer attitudes. Analysis of how consumers make decisions and how those decisions can be influenced by messaging, pricing, and emotions.

Typically offered in Fall and Spring

MBA 562  Research Methods In Marketing  (3 credit hours)
A systematic approach to structure, implementation and analysis of marketing research for decision making. Models of consumer demand and firm behavior analyzed in a marketing context.

Typically offered in Fall only

MBA 563  Product and Brand Management  (3 credit hours)

Typically offered in Fall and Spring

MBA 564  Business Relationship Management  (3 credit hours)
Strategic, successful management of the multitude of business relationships that contemporary managers face. Universal and idiosyncratic business relationship skills to allow technically-oriented managers such as engineers and scientists to interact with a variety of constituents. Integrated perspective of marketing communications as a process of successfully interacting with each constituency with the goal of fostering long-term satisfaction and loyalty, which ultimately translates to sustainable competitive advantage.

Typically offered in Fall and Spring

MBA 565  Marketing Analytics  (3 credit hours)
Analytical techniques to convert a wealth of data on customers and markets into insights to guide business decisions. Taking a hands-on and systematic approach on the steps involved in harnessing knowledge from data, the course covers the various data techniques and steps involved in data- and model-driven management decisions. Techniques include market response models, conjoint analysis, discrete choice models.

Prerequisites: MBA 507 and MBA 560
Typically offered in Fall and Spring

MBA 566  Digital Marketing  (3 credit hours)
This course covers the basics of digital marketing from an analytics perspective. Each channel of digital marketing, such as search engine optimization, social, mobile, web, email, and video, are examined and their relationship to overall firm marketing strategy is explored.

Typically offered in Spring only
MBA 570  Opportunity Evaluation and Value Creation (3 credit hours)
First course in a two-course entrepreneurship sequence focusing on opportunities outside the technology arena. Management of the innovative activities of a firm (new and/or existing) to facilitate entrepreneurship—the discovery, evaluation, and exploitation of opportunities to create value. Generation and screening of new product/process ideas or concepts. Transformation of such ideas into products, processes, or services that satisfies stakeholders (e.g., customers, employees). Topics include self-assessment of personal aspirations, skills, and competencies, as well as opportunity identification/evaluation, business model design, and launching and scaling ventures.
Credit not allowed in MBA 570 if the student has already taken MBA 576 or MBA 577.
Typically offered in Fall and Spring

MBA 571  High Growth Entrepreneurship (3 credit hours)
Second course in a two-course entrepreneurship sequence focusing on opportunities outside the technology arena. Theoretical and practical, team-based, approach to the evaluation and assessment of opportunities for value creation. Emphasis on how to discover, validate, and then execute on an action plan to create value. Credit not allowed if the student has already taken MBA 576 or MBA 577.
Prerequisite: MBA 570. Credit not allowed if the student has already taken MBA 576 or MBA 577.
Typically offered in Fall and Spring

MBA 572  Venture Opportunity Analysis Analytics (3 credit hours)
Application of the process-based model for new business startups to multiple clients. Emphasis is placed on data gathering, data analysis and data interpretation in the context of evaluating opportunities for new business. Students work in teams on a variety of projects with technology commercialization clients such as Wolfpack Investment Network and Office of Technology Commercialization and New Ventures.
Typically offered in Fall and Spring

MBA 576/MSE 576  Technology Entrepreneurship and Commercialization I (3 credit hours)
First course in a two-course entrepreneurship sequence focusing on opportunities for technology commercialization. Evaluation of commercialization of technologies in the context of new business startups. Emphasis is placed on creating value through technology portfolio evaluation and fundamentals of technology-based new business startups. This includes development of value propositions and strong technology-product-market linkages. The process-based approach is appropriate for new business startup as well as entrepreneurship in existing organizations through spinoffs, licensing, or new product development. Credit not allowed for MBA 576 if the student has already taken MBA 570 or MBA 571.
Credit not allowed in MBA 576 if the student has already taken MBA 570 or MBA 571
Typically offered in Fall and Spring

MBA 577/MSE 577  Technology Entrepreneurship and Commercialization II (3 credit hours)
Continuation of evaluation of technologies for commercialization through new business startups. Emphasis is placed on creating value through strong technology-products-markets linkages using the TEC algorithm. Topics include industry and market testing of assumptions, legal forms of new business startups, funding sources and creating a quality, integrative new business startup plan. Credit not allowed in 577 for students who have already taken 570 or 571.
Prerequisite: MBA/MSE 576. Credit not allowed in 577 for students who have already taken 570 or 571.
Typically offered in Fall and Spring

MBA 578  Venture Launch (3 credit hours)
Immersion in the activities of opportunity exploitation. Students work in groups to plan and execute the launch of a new value creating entity. Strategy formulation and strategy implementation for a new business startup. Includes all aspects of value creation.
Prerequisite: MBA 571 or MBA 577
Typically offered in Fall and Spring

MBA 579  Entrepreneurship Clinic Practicum (3 credit hours)
Inspired by the university teaching hospital model, the NC State Entrepreneurship Clinic is a place where students, faculty, entrepreneurs, and service providers go to teach, learn and build the next generation of businesses in Raleigh. Each person in this class will take on the role of "Clinic Lead" managing groups of undergraduate students working with clients of the NC State Entrepreneurship Clinic during the semester. Developing ideas, evaluating options, and providing insights to emerging ventures.
Typically offered in Fall and Spring

MBA 580  Creating Value in Organizations (3 credit hours)
Process-based approach to creating high value in existing organizations by understanding strategy formulation and implementation. The approach will also be applied to entrepreneurs in new venture startups as well as organizations managing innovation and growth.
Typically offered in Fall, Spring, and Summer

MBA 582  Sustainability and Business (3 credit hours)
Explore the current sustainability trends. Learn how businesses are integrating sustainability into their strategies. Gain an understanding of the tools businesses are using to operate businesses in a sustainability manner. Experience current and evolving sustainability trends.
Typically offered in Fall only

MBA 585  Current Topics in BioSciences Management (3 credit hours)
Business processes and strategies across the global BioSciences value chain, including the R&D realities, product life cycles, key elements of product discovery and development, intellectual property, regulatory trials, government approval, production, sourcing, logistics, sales, marketing and customer service. The complete value chain of a new biotechnology-based product.
Typically offered in Spring only
MBA 586 Legal, Regulatory and Ethical Issues in Life Science Industries (3 credit hours)  
Exploration of unique environment in which biotechnology research is conducted and resultant drugs and products are sold. Legal restraints affecting pharmaceutical marketing and reimbursement options; regulatory issues; pre-clinical research. Laws limit

Typically offered in Fall only

MBA 589 Jenkins Consulting Practicum (3 credit hours)  
This class provides the opportunity to learn about business consulting and be part of a consulting team, helping real clients with real business challenges and market opportunities. Students will help their client organization by understanding a problem, conducting analyses, and suggesting relevant, actionable steps that clients can take to become more competitive or achieve important goals. Projects will deal with creative, complex, risky, and ambiguous issues involved in developing new products/services, serving new markets, achieving quality standards, or creating new business models in an enterprise setting.

Restriction: MBA Students Only  
Typically offered in Fall, Spring, and Summer

MBA 590 Special Topics In Business Management (1-6 credit hours)  
Presentation of material not normally available in regular courses offerings or offering of new courses on a trial basis.

MBA 610 Special Topics in Business Administration (1-6 credit hours)  
Special topics course dealing with issues not covered in regularly scheduled courses. Restricted to MBA students.

MBA 630 Independent Study In Business Management (1-3 credit hours)  
Detailed investigation of topics of particular interest to graduate students under faculty direction on a tutorial basis. Determination of credits and content by faculty member in consultation with department head.

Typically offered in Fall, Spring, and Summer

Business Management (BUS)

BUS 225 Personal Finance (3 credit hours)  
Economic and financial strategies used to accumulate, manage and protect personal assets. Emphasizing income generation, expense reduction, investment selection, and wealth creation to meet future needs and goals. Topics include investing (mutual funds, stocks, etc.), annuities, insurance, retirement planning, and estate planning.

Typically offered in Fall, Spring, and Summer

BUS 295 Special Topics in Business Management (1-6 credit hours)  
Experimental course development. Special topics in Business Management at the introductory level.

Typically offered in Fall, Spring, and Summer

BUS 320 Financial Management (3 credit hours)  
Financial decision making by businesses, including capital structure and dividend decisions, capital budgeting and working capital management. Basic financial concepts are covered such as risk and return measurement, portfolio theory and the time value of money.

Prerequisite: ACC 210  
Typically offered in Fall, Spring, and Summer

BUS 340 Information Systems Management (3 credit hours)  
Fundamentals of information systems development and use in organizational setting. Information systems (IS), concepts, hardware, software, telecommunications, database management, IS development, applications and management in telecommunications, database management, various business processes, global issues, security and ethical challenges.

Typically offered in Fall, Spring, and Summer

BUS 350/ST 350 Economics and Business Statistics (3 credit hours)  
Introduction to statistics applied to management, accounting, and economic problems. Emphasis on statistical estimation, inference, simple and multiple regression, and analysis of variance. Use of computers to apply statistical methods to problems encountered in management and economics.

Prerequisite: MA 114  
Typically offered in Fall, Spring, and Summer

BUS 351 Predictive Analytics for Business (3 credit hours)  
This course builds on BUS/ST 350 with an emphasis on the application of statistical methods using software. The course uses analytical methods and tools to drive actionable business decisions. Students will be exposed to a variety of statistical and machine learning methods including linear regression, logistic regression, decision analysis, classification trees, clustering techniques, optimization, monte carlo simulation, and statistical forecasting.

Prerequisites: BUS 340 and (BUS/ST 350, or ST 312, or ST 370, or ST 372); Corequisite: ST 307  
Typically offered in Fall and Spring

BUS 360 Marketing Methods (3 credit hours)  
Examination of decisions affecting marketing of goods and services in consumer, industrial and international markets. Emphasis on the role of marketing in a managerial context. Areas studied include: the activities of marketing research, identification of marketing opportunities, and the development of marketing mix strategies including the decisions concerning pricing, distribution, promotion and product design.

Prerequisite: MIE 201, Sophomore standing  
Typically offered in Fall, Spring, and Summer

BUS 370 Operations and Supply Chain Management (3 credit hours)  
Concepts in planning, controlling, and managing the operations function of manufacturing and service firms. Topics include operations strategy, process choice decisions, forecasting, production planning and control, and trends in operations management. Common tools for informed decision-making in these areas.

Typically offered in Fall, Spring, and Summer

BUS 420 Financial Management of Corporations (3 credit hours)  
Advanced theory and practice of corporate financial management. Topics covered include: asset management, evaluating financial statements, capital budgeting, alternative investments, cash flow management, equity valuation, and financing. Corporate financial policy decisions will include: cost of capital, capital structure, and dividend policy decisions.

Prerequisite: BUS 360 and (BUS/ST 350, or ST 312, or ST 370, or ST 372)  
Typically offered in Fall, Spring, and Summer
**BUS 422 Investments and Portfolio Management** (3 credit hours)  
Analysis of the investment process, dichotomized into security analysis and portfolio management. Background information on financial assets, securities markets, and risk-return concepts. Analysis of valuation theory and techniques, modern portfolio theory and portfolio performance.  
Prerequisite: BUS 360 and (BUS/ST 350, or ST 312, or ST 370, or ST 372)  
Typically offered in Fall and Spring

**BUS 425 Advanced Personal Financial Management** (3 credit hours)  
Detailed economic, financial and legal analysis of risk management, retirement planning, investments, and estate planning. Additional emphasis on professional financial planning for those interested in personal finance as a career.  
Prerequisite: BUS 320  
Typically offered in Fall and Spring

**BUS 426 International Financial Management** (3 credit hours)  
Prerequisite: BUS 320 and (BUS/ST 350 or ST 312 or ST 370 or ST 372)  
Typically offered in Spring only

**BUS 428 Financial Analytics** (3 credit hours)  
Advanced course examining the use of big data analytics in finance. The focus will be on the application of these tools in the areas of asset management and equity valuation. Topics covered include risk-return tradeoff, financial intermediaries in asset management (e.g., mutual funds, hedge funds, etc.), stock valuation models, and using financial statement information in stock selection / asset management. Students will complete a semester-long project involving data analysis (e.g., write an equity research report on a publicly traded U.S. firm, backtest an investment strategy, etc.).  
Prerequisite: BUS 320  
Typically offered in Spring only

**BUS 429 Financial Modeling** (3 credit hours)  
BUS 429 is 'corporate finance in Excel.' Starting from the theoretical base gained in BUS320, students work through problems in time value of money, capital budgeting, and valuation (among other things) using spreadsheet analyses. The course will take a very hands-on approach in building financial spreadsheet models. Microsoft Excel is the primary tool we will use to implement these financial models and the course will go into detail on the proficient use of Excel.  
Prerequisite: BUS 320  
Typically offered in Spring only

**BUS 440 Database Management** (3 credit hours)  
The fundamentals of database management within business applications. Data structures, user requirements, structured query language, query by example, application development, user interface design.  
Prerequisite: ACC 340 or BUS 340  
Typically offered in Fall and Spring

**BUS 441 Business Data Communications and Networking** (3 credit hours)  
The fundamentals of computer networking and the use of computer networks in business applications. Client-server networks, architecture, network hardware and software, key issues in network management, network security, and the fundamentals of telecommunications.  
Prerequisite: ACC 340 or BUS 340  
Typically offered in Fall and Spring

**BUS 442 Information Systems Development** (3 credit hours)  
This course provides concepts and skills necessary for designing, developing, and deploying information systems (applications) to aid in business and managerial decisions. It includes hands-on experience with development (coding) theory and concepts, object-oriented algorithm design and development concepts, graphical user interface design concepts, and SQL and data structures using the C# programming language and the Microsoft .NET IDE.  
Prerequisite: ACC 340 or BUS 340  
Typically offered in Fall and Spring

**BUS 443 Web Development for Business Applications** (3 credit hours)  
This course provides current technologies for designing and developing interactive, web-based systems for business. Topics may include current programming languages, server-side programming, client-side programming, server-side scripting, database integration, and more. Design concepts will be implemented through team projects.  
Prerequisite: BUS 442; Corequisite: BUS 440  
Typically offered in Fall and Spring

**BUS 444 Systems Analysis and Design** (3 credit hours)  
This course provides an overview of methods for developing Information Systems. Principles and techniques of systems analysis and design are introduced so that students can successfully cope with the complexities of developing information systems. Topics include software development frameworks, project management, requirements analysis, systems analysis techniques, and systems design. Systems analysis and design methods covered include agile software engineering, structured analysis and design, and object-oriented analysis and design techniques.  
Prerequisite: ACC 340 or BUS 340  
Typically offered in Fall and Spring

**BUS 449 Information Technology Capstone** (3 credit hours)  
This is a completely project-oriented course. Students will work on real applications for national or local firm(s) to solve "live" IT problems. Students will work in teams to develop client deliverables and present their final work to an appropriate panel.  
Prerequisite: BUS 440 or 441 or 442 or 443 or 444.  
Typically offered in Spring only
BUS 458 Analytics: From Data to Decisions  (3 credit hours)
Students will develop and apply their data analytics skills by analyzing case studies built around real business problems and real data. Case studies are designed around the full analytics lifecycle which encompasses the business problem, data, analysis, and decision. Students will learn to identify and explain business problems that can be addressed with analytics. They will also learn to determine which analytic methods are best suited to solve particular problems and will evaluate the impact of applying analytic methods. Finally, they will learn to explain the results of an analytic model and how those results impact the business "bottom line."
Prerequisite: BUS 351
Typically offered in Fall and Spring

BUS 459 Business Analytics Practicum  (3 credit hours)
Advanced application of business analytics skills, tools and methodologies to solve business issues and problems. Small teams of students will undertake projects to identify business issues, confirm the information needed to address the issues, and apply the required data analytics tools and methodologies. The projects will include interaction with business personnel, refinement of business issues, gathering information, development of business analytics models, and presentation of results through data visualization. Each project will culminate with the student team presenting their findings and recommendations to the organization.
Prerequisites: BUS 351 and BUS 458
Typically offered in Fall and Spring

BUS 460 Consumer Behavior  (3 credit hours)
The consumer decision process, with emphasis on consumer decision making, satisfaction/dissatisfaction factors, perception, learning, group influences, and marketing strategy implications. Restricted to majors within the College of Management.
Prerequisite: BUS 360
Typically offered in Fall and Spring

BUS 461 Channel and Retail Marketing  (3 credit hours)
Retailing composes a substantial component of the US economy, creating millions of jobs. Marketing channels are where marketing mix strategy and tactics ultimately impact customers and produce sales. This course is designed to prepare students for roles such as buying, merchandising, store management, professional selling, distribution, inventory management or other retailing-oriented careers. Emphasis will be placed on developing students relevant skill sets in key areas such as retail metrics, site analysis, pricing tactics, merchandising strategy, and customer relationship management. Relevant aspects of consumer behavior and organizational leadership in a retail setting will be covered.
Prerequisite: BUS 360
Typically offered in Fall and Spring

BUS 462 Marketing Research  (3 credit hours)
The use, collection, organization and analysis of information pertinent to marketing decisions. Use of qualitative and quantitative data in the solution of specific marketing problems.
Prerequisite: BUS 360 and (BUS/ST 350, or ST 312, or ST 370, or ST 372)
Typically offered in Fall and Spring

BUS 464 International Marketing  (3 credit hours)
Explores moving from a national marketing approach to a global marketing strategy, and discusses competitive advantages and challenges in making the transition. Both traditional countries of Western Europe and emerging markets will be examined. Students will analyze culture considerations when evaluating the impact on local business strategies. In addition to learning the impact on the world's economy through globalization, emphasis will also be placed on developing necessary professional skills.
Prerequisite: BUS 360
Typically offered in Spring only

BUS 465 Traditional and Digital Brand Promotion  (3 credit hours)
This course focuses on advertising and integrated brand promotions, spanning both traditional and digital media. Emphasis is on the brand. Includes development of marketing communications strategy and campaign materials, from consumer insight generation to creative execution.
Prerequisite: BUS 360
Typically offered in Fall and Spring

BUS 466 Personal Selling  (3 credit hours)
Revolves around the art of people-to-people interaction, which applies not only to the business-to-business sales environment but is also applicable to other professions. The selling process will be examined along with activities necessary to be successful in sales. With a common thread of developing and nurturing relationships, students will examine building partnerships, implications of ethical and legal issues, adapting the approach to the situation and identifying social styles with associated behaviors. Attention will also be focused on the steps involved in the sales cycle and how to be successful in their execution.
Prerequisite: BUS 360
Typically offered in Fall and Spring

BUS 467 Product and Brand Management  (3 credit hours)
Provides an in-depth understanding of marketing planning and implementation involved in product and brand management. The course places emphasis on developing specific marketing strategies to support the creation and launch of new products and to succeed
Prerequisite: BUS 360
Typically offered in Fall and Spring

BUS 468 Marketing Strategy  (3 credit hours)
This course is designed to build on the core marketing principles you learned in your introductory marketing course and to enhance your understanding of their strategic implications.
Prerequisite: BUS 360
Typically offered in Spring only

BUS 469 Digital Marketing Practicum  (3 credit hours)
This course provides you with an introduction to the digital marketplace through an experiential learning approach. After conducting a client audit, your team will develop a digital marketing campaign including appropriate major digital platforms. Post-campaign metrics and data analytics will be utilized to measure campaign effectiveness and future marketing strategy. The course pedagogy emphasizes class discussion, industry expert lectures, digital simulation, and a client digital project.
Prerequisite: BUS 360
Typically offered in Fall and Spring
BUS 470 Operations Modeling and Analysis (3 credit hours)
Tools, techniques, and strategies used for analyzing and improving business operations, including process mapping, capacity analysis, demand forecasting, and quality analysis and improvement. Emphasis on Excel as a tool for analysis, particularly on Excel functions and modules relevant to operations analysis.
Prerequisite: BUS 370 and (BUS/ST 350 or ST 305 or ST 312 or ST 370 or ST 372)
Typically offered in Fall and Spring

BUS 472 Operations Planning and Control Systems (3 credit hours)
Design and management of operations planning and control systems for manufacturing and service firms. Forecasting, capacity management, production and workforce scheduling, project management, just-in-time and time-based competition, the impact of information technologies on planning and control systems.
Prerequisite: BUS 370; Co-requisite: BUS 470
Typically offered in Fall and Spring

BUS 473 Supply Chain Strategy (3 credit hours)
THERE ARE NO PLANS TO OFFER THIS COURSE IN THE FORESEEABLE FUTURE. Purchasing, materials management, and logistics. Purchasing systems, supplier-based strategies, price-cost management, value analysis. Inventory strategies, quantity and quality decisions, materials planning. Logistics strategies for services and manufacturing.
Prerequisite: BUS 370; Co-requisite: BUS 470
Typically offered in Spring only

BUS 474 Logistics Management (3 credit hours)
Management of physical flows of goods between firms, management of inventories that support those flows, and assessment of the effects of freight transportation choices on these management activities. A variety of conceptual frameworks and quantitative tools are used to formulate the basis for effective logistics decision making and relate those decisions to broader issues in managing the entire supply chain and fulfilling the strategic objectives of a firm. A nominal fee for simulation software may be required.
Prerequisite: BUS 370; Co-requisite: BUS 470
Typically offered in Fall and Spring

BUS 475 Purchasing and Supply Management (3 credit hours)
This course is designed to help students develop knowledge of basic principles in purchasing and supply management. Students will be able to explain the potential contributions of these efforts of the competitiveness of the firm.
Prerequisite: BUS 370; Co-requisite: BUS 470
Typically offered in Fall and Spring

BUS 476 Decision Modeling and Analysis (3 credit hours)
Structured framework and process for modeling and analyzing business decisions. Business decisions are frequently made difficult by the presence of uncertainty and complex interactions among key drivers of the decision. In today's global environment the stakes of bad outcomes may be too high to justify learning by experience. Filled with in-depth insights and practical advice, this course covers the essential tools and techniques to improve your skills, such as: decision trees, influence diagrams, spreadsheet-based decision modeling, Monte Carlo simulation, demand forecasting, and methods to obtain and model decision-relevant data from subject matter experts in an unbiased manner.
Prerequisite: BUS 340 and (BUS/ST 350, or ST 312, or ST 370, or ST 372)
Typically offered in Fall and Spring

BUS 479 Supply Chain Management Undergraduate Practicum (3 credit hours)
This course is comprised of a team-based project working on a Supply Chain Resource Consortium (SCRC) partner company's supply chain management issues. These projects vary in scope as are company's supply chain issues and improvement initiatives. Stude
Prerequisite: BUS 370 and one 400-level Operations/Supply Chain Management course
Typically offered in Fall and Spring

BUS 495 Special Topics in Business Management (1-6 credit hours)
Presentation of material not normally available in regular course offerings, or offering of new courses on a trial basis.

BUS 498 Independent Study in Business Management (1-6 credit hours)
Detailed investigation of topics of particular interest to advanced undergraduates under faculty direction on a tutorial basis. Credits and content determined by faculty member in consultation with Department Head. Individualized/Independent Study and

BUS 501 Strategic Management Foundations (3 credit hours)
This course is designed to help students with an engineering or scientific undergraduate degree understand the world of business. The class will cover key business functions including finance, marketing, operations, strategy, organizational behavior. Students will undertake a semester-long group project to design and plan for a new company or new product within an existing company. Restricted to students with an engineering, scientific, or other technical background.

Typically offered in Fall, Spring, and Summer

BUS 554 Project Management (3 credit hours)
Life cycle view of organizing and managing technical projects, including project selection, planning, and execution. Methods for managing and controlling project costs, schedules, and scope. Techniques for assessing project risk. Use of popular project management software tools. Application of project management tools and methods to product development, software, and process reengineering projects.

Typically offered in Spring and Summer
BU571 High Growth Entrepreneurship (3 credit hours)
Second course in a two-course entrepreneurship sequence focusing on opportunities outside the technology arena. Theoretical and practical, team-based, approach to the evaluation and assessment of opportunities for value creation. Emphasis on how to discover, validate, and then execute on an action plan to create value. Credit not allowed if the student has already taken MBA 576 or MBA 577.

Prerequisite: MBA 570. Credit not allowed if the student has already taken MBA 576 or MBA 577.

Typically offered in Fall and Spring

BUS 585/TTM 585 Market Research in Textiles (3 credit hours)
A study and analysis of quantitative methods employed in market research in the textile industry. Function of market research and its proper orientation to management and decision making.

Prerequisite: TAM (EC) 482

Typically offered in Fall, Spring, and Summer

BUS 590 Special Topics in Business Management (1-6 credit hours)
Presentation of material not normally available in regular courses offerings or offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

BUS 610 SP Topics Bus Mgmt (1-6 credit hours)

BUS 630 Independent Study in Business Management (1-3 credit hours)
Detailed investigation of topics of particular interest to graduate students under faculty direction on a tutorial basis. Determination of credits and content by faculty member in consultation with department head.

Typically offered in Fall, Spring, and Summer

BUS 790 Special Topics in Business Management (1-6 credit hours)
Presentation of material not normally available in regular courses offerings or offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

Chemical Engineering (CHE)

CHE 205 Chemical Process Principles (4 credit hours)
Engineering methods of treating material balances, stoichiometry, phase equilibrium calculations, thermophysics, thermochemistry and the first law of thermodynamics. Introduction to equation solving packages and spreadsheets for solving problems related to chemical engineering calculations.

Prerequisite: Grade of C or better in MA 241, PY 205, and (CH 201 or CH 221 or CH 225)

Typically offered in Fall, Spring, and Summer

CHE 225 Introduction to Chemical Engineering Analysis (3 credit hours)
Introduction of mathematical and computational tools for analyzing chemical engineering problems. Sequential modular and equation-based simulation of steady-state chemical processes using advanced spreadsheet methods and multivariate root-finding algorithms.

Prerequisite: C- or better in CHE 205 and MA 242; Corequisite: MA 341

Typically offered in Spring and Summer

CHE 311 Transport Processes I (3 credit hours)
Fundamental aspects of momentum and heat transfer, and the use of these fundamentals in solving problems in transport operations.

Prerequisite: Grade of C- or better in both CHE 225 and MA 341

Typically offered in Fall, Spring, and Summer

CHE 312 Transport Processes II (3 credit hours)
Fundamental aspects of mass transfer and the use of these basic principles in solving problems in transport operations.

Prerequisite: Grade of C- or better in CHE 311

Typically offered in Fall and Spring

CHE 315 Chemical Process Thermodynamics (3 credit hours)
Laws of thermodynamics and their application to chemical engineering problems, both in theory and in practice. Criteria of equilibrium in physical and chemical changes. Behavior of real fluids, including mixtures.

Prerequisite: Grade of C- or better in CHE 225

Typically offered in Fall and Spring

CHE 316 Thermodynamics of Chemical and Phase Equilibria (3 credit hours)
Systematic study of chemical reaction equilibria and phase equilibria. Use of fugacity, activity and chemical potential concepts for predicting the effect of such variables as temperature, pressure on equilibrium compositions. Methods for measuring and estimating thermodynamic properties important to equilibrium calculation in real systems.

Prerequisite: Grade of C- or better in CHE 315

Typically offered in Fall, Spring, and Summer

CHE 330 Chemical Engineering Lab I (4 credit hours)
Laboratory experiments in unit operations of heat transfer and fluid flow. Laboratory safety, technical report writing, statistics, experimental design, error analysis and instrumentation.

Prerequisite: CHE 311

Typically offered in Fall and Spring

CHE 331 Chemical Engineering Lab II (2 credit hours)
Laboratory experiments in mass transfer and reaction kinetics. Experimental planning, technical report writing and oral presentations are emphasized.

Prerequisite: CHE 312, CHE 330

Typically offered in Fall and Spring

CHE 395 Professional Development Seminar (1 credit hour)
Professional development and topics of current interest in chemical engineering.

Typically offered in Fall and Spring

CHE 435/TE 435 Process Systems Analysis and Control (3 credit hours)
Dynamic analysis and continuous control of chemical and material engineering processes. Process modeling; stability analysis, design and selection of control schemes. Solution of differential equations using Laplace transform techniques.

Prerequisite: (MA 341 and TE 205) or CHE 312

Typically offered in Fall and Spring
CHE 446 Design and Analysis of Chemical Reactors (3 credit hours)
Characterization and measurement of the rates of homogeneous and heterogeneous reactions. Design and analysis of chemical reactors. Credit cannot be received for both CHE 446 and CHE 546.
Prerequisite: CHE 316
Typically offered in Fall only

CHE 447 Bioreactor Engineering (3 credit hours)
Design and analysis of chemical reactors with emphasis on enzyme-catalyzed reactions, microbial fermentation, and animal cell culture. Empirical kinetics of enzymatic reactions and cell growth. Design and scale-up of suspension bioreactors. Immobilized-enzyme and immobilized-cell bioreactors, including the classical Thiele reaction-diffusion analysis.
Prerequisite: CHE 312 and CHE 316; Corequisite: BCH 451
Typically offered in Fall only

CHE 448/BEC 448/BEC 548/CHE 548 Bioreactor Design (2 credit hours)
This course will cover critical aspects of bioreactor design, including design of reactors for enzyme-catalyzed reactions, fermentation of microorganisms, and scale-up considerations for bioreactors. Hands-on experiments involving fermentation of microorganisms and scale-up of bioreactors will be included. Students cannot get credit for both CHE 448 and CHE 454.
Typically offered in Spring only

CHE 450 Chemical Engineering Design I (3 credit hours)
Prerequisite: CHE 312; Corequisite: CHE 446 or CHE 447
Typically offered in Fall only

CHE 451 Chemical Engineering Design II (3 credit hours)
Chemical process design and optimization. The interplay of economic and technical factors in process development, site selection, project design, and production management. Comprehensive design problems.
Prerequisite: CHE 450, and (CHE 446 or CHE 447)
Typically offered in Spring only

CHE 452/CHE 552 Biomolecular Engineering (2 credit hours)
This course will cover modern methods in biomolecule design, including gene expression regulators, RNA structure, protein structure, and metabolic networks. Current methods in genetic engineering and ?omics-based analysis will be discussed, followed by a critical review of current literature on the applications of these methods to engineering microbes, cells, and multi-species communities. Hands-on assignments involving computational design will be included.
Typically offered in Spring only

CHE 460 Nano-Electronic Materials (3 credit hours)
Plasma and thermal inorganic chemical processes in semiconductor device fabrication. Thin films and electronic devices. Kinetics and chemical transport in electronic materials synthesis, modification and etching. Plasma physics and chemistry, reactors and process diagnostics. Credit for both CHE 460 and CHE 760 is not allowed.
Prerequisite: CHE 311 and CHE 315

CHE 461 Polymer Sciences and Technology (3 credit hours)
Concepts and techniques for polymerization of macromolecules. Structure, properties, and applications of commercially important polymers.
Prerequisite: (CH 223 or CH 227) and CHE 316
Typically offered in Fall only

CHE 462/CHE 562/BEC 462/BEC 562 Fundamentals of Bio-Nanotechnology (3 credit hours)
Concepts of nanotechnology are applied in the synthesis, characterization, selection and application of biomaterials on the nanoscale. Emphasis will be given to hands-on experience with nanostructured biomaterials; students will also be familiarized with the potential impact of these materials on different aspects of society and potential hazards associated with their preparation and application.
Prerequisite: MA 241 and PY 208 and (CH 223 or CH 227)
Typically offered in Spring only

CHE 463/BEC 463/BIT 563/CHE 563/BEC 563/BIT 463 Fermentation of Recombinant Microorganisms (2 credit hours)
Introduction to fermentation and protein chemistry. Theory behind laboratory techniques and overview of industrial scale expression systems. Laboratory sessions involve use of microbial expression vectors, fermentation systems, and large-scale purification of recombinant protein. Half semester course, first part.
Prerequisite: CH 223 or CH 227; Corequisite: (BIT 410 or BCH 452 or MB 352 or BEC 363)
Typically offered in Fall and Spring

CHE 465 Colloidal and Nanoscale Engineering (3 credit hours)
The first part of this course will present the fundamentals of nanoscale colloidal processes, including interactions and self-assembly of particles, surfactants and biomolecules. The applications of these fundamentals to the nanotechnology and engineering on the nanoscale will be discussed. The nanoscience has led to the development of many new technologies with relevance to chemical engineering, including microfluidics, lab-on-a-chip, bioarrays and bioassays. These emerging technologies will be presented and discussed in the second half of this course.
Prerequisite: C- or better in CHE 311 and CHE 315.
Typically offered in Fall and Spring

CHE 467 Polymer Rheology (3 credit hours)
Theoretical principles and experimental techniques associated with flow and deformation of polymer systems. Systems include: melts and solutions, suspension, gels, emulsions, and thixotropic materials.
Prerequisite: CHE 311
Typically offered in Spring only
CHE 468/CHE 568/ECE 568/ECE 468 Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems (3 credit hours)
Conventional and emerging nano-manufacturing techniques and their applications in the fabrication of various structures and devices. Review of techniques for patterning, deposition, and etching of thin films including emerging techniques such as an imprint and soft lithography and other unconventional techniques. Electronic and mechanical properties of 0 to 3-D nanostructures and their applications in nano-electronics, MEMS/NEMS devices, sensing, energy harvesting, storage, flexible electronics and nano-medicine. Credit for both ECE/CHE 468 and ECE/CHE 568 is not allowed.

Prerequisite: E 304
Typically offered in Fall only

CHE 475/CHE 575 Advances in Pollution Prevention: Environmental Management for the Future (3 credit hours)
Design of industrial processes which minimize or eliminate wastes. Regulations and the corporate organization of current pollution prevention efforts. Current pollution prevention research. Product life cycle analysis and the application to design of

Prerequisite: PY 208, MA 341
Typically offered in Spring only

CHE 488/BEC 588/BCE 488 Animal Cell Culture Engineering (2 credit hours)
Design and operation of animal cell culture bioreactors for therapeutic protein production. Topics include: batch, fed-batch and perfusion bioreactors, agitation and aeration for mixing and oxygen mass transfer, bioreactor monitoring and control, optimizing bioreactor performance, single-use [disposal] bioreactors, and the production of gene therapy vectors. This is a half-semester course. Time outside of the regularly scheduled class time may be required.

Typically offered in Spring only

CHE 495 Honors Thesis Preparation (1 credit hours)
Development and presentation of Honors Thesis in Chemical Engineering and discussion of graduate school selection and preparation.

Prerequisite: CHE 497, Senior standing
Typically offered in Spring only

CHE 497 Chemical Engineering Projects I (3 credit hours)
Introduction to chemical engineering research through experimental, theoretical and literature studies. Oral and written presentation of reports.

Prerequisite: Junior standing
Typically offered in Fall, Spring, and Summer

CHE 498 Chemical Engineering Projects II (1-3 credit hours)
Projects in research, design or development in various areas of chemical engineering.

Prerequisite: Junior standing
Typically offered in Fall, Spring, and Summer

CHE 525 Process System Analysis and Control (3 credit hours)
Dynamic analysis and continuous control of chemical engineering processes. Process modeling; stability analysis, design and selection of control schemes. Solution of differential equations using Laplace transform techniques. Credit for both CHE 425 and CHE 525 is not allowed.

Prerequisite: CHE 312
Typically offered in Spring only

CHE 543 Polymer Science and Technology (3 credit hours)
Concepts and techniques for polymerization of macromolecules. Structure, properties, and applications of commercially important polymers.

Prerequisite: CHE 223, CHE 316
Typically offered in Fall and Summer

CHE 546 Design and Analysis of Chemical Reactors (3 credit hours)
Characterization and measurement of rates of homogeneous and heterogeneous reactions. Design and analysis of chemical reactors. Credit for both CHE 446 and CHE 546 is not allowed.

Prerequisite: CHE 316
Typically offered in Fall only

CHE 548/CHE 448/BEC 448/BEC 548 Bioreactor Design (2 credit hours)
This course will cover critical aspects of bioreactor design, including design of reactors for enzyme-catalyzed reactions, fermentation of microorganisms, and scale-up considerations for bioreactors. Hands-on experiments involving fermentation of microorganisms and scale-up of bioreactors will be included. Students cannot get credit for both CHE 448 and CHE 548.

Typically offered in Spring only

CHE 551 Biochemical Engineering (3 credit hours)
Enzyme and microbial kinetics and reactor designs for processes involving enzymes and single and mixed cultures. Samples drawn from full range of applications: food processing, single cell proteins, tissue culture and vaccines, monoclonal antibodies, recombinant DNA and hybridomas, artificial organs, biological waste treatment and environmental processes.

Prerequisite: CHE 312 and (CHE 446 or CHE 447)
Typically offered in Spring only

CHE 552/CHE 452 Biomolecular Engineering (2 credit hours)
This course will cover modern methods in biomolecule design, including gene expression regulators, RNA structure, protein structure, and metabolic networks. Current methods in genetic engineering and ?omics-based analysis will be discussed, followed by a critical review of current literature on the applications of these methods to engineering microbes, cells, and multi-species communities. Hands-on assignments involving computational design will be included.

Typically offered in Spring only
CHE 560  Chemical Processing Of Electronic Materials  (3 credit hours)
Plasma and thermal inorganic chemical processes in semiconductor device fabrication. Thin films and electronic devices. Kinetics and chemical transport in electronic materials synthesis, modification and etching. Plasma physics and chemistry, reactors and process diagnostics. Credit for both CHE 460 and CHE 560 is not allowed.
Prerequisite: CHE 312 and CHE 446
Typically offered in Spring only

CHE 562/BEC 462/CHE 462 Fundamentals of Bio-Nanotechnology  (3 credit hours)
Concepts of nanotechnology are applied in the synthesis, characterization, recognition and application of biomaterials on the nanoscale. Emphasis will be given to hands-on experience with nanostructured biomaterials; students will also become familiarized with the potential impact of these materials on different aspects of society and potential hazards associated with their preparation and application.
Prerequisite: MA 241 and PY 208 and (CH 223 or CH 227)
Typically offered in Spring only

CHE 563/BIC 463/BIC 463/BIC 463/BIC 563 Fermentation of Recombinant Microorganisms  (2 credit hours)
Introduction to fermentation and protein chemistry. Theory behind laboratory techniques and overview of industrial scale expression systems. Laboratory sessions involve use of microbial expression vectors, fermentation systems, and large-scale purification of recombinant protein. Half semester course, first part.
Prerequisite: CH 223 or CH 227; Corequisite: (BIT 410 or BCH 452 or MB 352 or BEC 363)
Typically offered in Fall and Spring

CHE 566/ECE 468/ECE 468/CHE 468 Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems  (3 credit hours)
Conventional and emerging nano-manufacturing techniques and their applications in the fabrication of various structures and devices. Review of techniques for patterning, deposition, and etching of thin films including emerging techniques such as an imprint and soft lithography and other unconventional techniques. Electronic and mechanical properties of 0 to 3-D nanostructures and their applications in nano-electronics, MEMS/NEMS devices, sensing, energy harvesting, storage, flexible electronics and nano-medicine. Credit for both ECE/CHE 468 and ECE/CHE 568 is not allowed.
Prerequisite: E 304
Typically offered in Fall only

CHE 575/CHE 475 Advances in Pollution Prevention: Environmental Management for the Future  (3 credit hours)
Design of industrial processes which minimize or eliminate wastes. Regulations and the corporate organization of current pollution prevention efforts. Current pollution prevention research. Product life cycle analysis and the application to design of
Prerequisite: PY 208, MA 341
Typically offered in Spring only

CHE 577/BEC 577 Advanced Biomanufacturing and Biocatalysis  (3 credit hours)
Overview of biomanufacturing using microorganisms (bacteria, yeast, fungi), eukaryotic cells (hybridomas, insect, plant, CHO) and recombinant enzymes focusing on methods used in industry. Course will emphasize process design for optimization of heterologous protein expression, metabolic/cell line engineering, metabolomics, protein engineering to alter enzymes and antibodies. Pathway engineering strategies include developing microbes to produce new therapeutic compounds or overproduce primary metabolites, antibiotics, biotherapeutics, therapeutic enzymes, diagnostics, recombinant vaccines, and biopharmaceuticals. Utilization of immobilized biocatalysts, and microbial kinetics are covered.
Graduate standing in engineering or life-science graduate program
Typically offered in Spring only

CHE 588/BEC 488/CHE 488/BEC 588 Animal Cell Culture Engineering  (2 credit hours)
Design and operation of animal cell culture bioreactors for therapeutic protein production. Topics include: batch, fed-batch and perfusion bioreactors, agitation and aeration for mixing and oxygen mass transfer, bioreactor monitoring and control, optimizing bioreactor performance, single-use [disposal] bioreactors, and the production of gene therapy vectors. This is a half-semester course. Time outside of the regularly scheduled class time may be required.
Typically offered in Spring only

CHE 596 Special Topics in Chemical Engineering  (1-3 credit hours)
Typically offered in Fall and Spring

CHE 597 Chemical Engineering Projects  (1-3 credit hours)
Independent study of some phase of chemical engineering or related field.
Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

CHE 601 Seminar  (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.
Typically offered in Fall and Spring

CHE 610 Special Topics  (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

CHE 685 Master's Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master’s student
Typically offered in Fall only

CHE 689 Non-Thesis Master Continuous Registration - Full Time Registration  (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.
Prerequisite: Master's student
Typically offered in Fall and Spring
CHE 690 **Master's Examination** (1-9 credit hours)
For students in non-thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.
Prerequisite: Master's student
Typically offered in Fall only

CHE 693 **Master's Supervised Research** (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CHE 695 **Master's Thesis Research** (1-9 credit hours)
Thesis research.
Prerequisite: Master's student
Typically offered in Summer only

CHE 696 **Summer Thesis Research** (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CHE 697 **Advanced Chemical Engineering Projects** (1-12 credit hours)
Independent study of some phase of chemical engineering or related field.
Prerequisite: Graduate standing in CHE
Typically offered in Fall, Spring, and Summer

CHE 699 **Master's Thesis Preparation** (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CHE 701 **Introduction to Chemical Engineering Research** (2 credit hours)
Introduction to graduate research guidelines and practices. Topics include research ethics, electronic literature searching, research proposal structure, technical writing styles, research problem identification, advisor expectations, intellectual property and patents, laboratory notebooks, proposal creation and oral presentation. Graduate standing in chemical engineering or permission of instructor.
Typically offered in Fall only

CHE 702 **Chemical Engineering Research Proposition** (2 credit hours)
Preparation of a professional quality chemical engineering research proposal. Includes selecting a novel research topic, drafting and finalizing the proposal according to NSF formats, and orally presenting and defending the proposal to a faculty advisory committee. Ethics in proposal preparation.
Prerequisite: CHE 701
Typically offered in Spring only

CHE 711 **Chemical Engineering Process Modeling** (3 credit hours)
Applications of methods of mathematical analysis to formulation and solution of problems in transport phenomena, process dynamics and chemical reaction engineering.
Prerequisite: (CHE 312, MA 301 or MA 341) or equivalent
Typically offered in Fall only

CHE 713 **Thermodynamics I** (3 credit hours)
In-depth coverage of chemical engineering thermodynamics principles. Application of non-ideal fluid-phase chemical potentials to problems in phase and chemical reaction equilibria. Relations of molecular structure and intermolecular forces to macroscopic effects.
Prerequisite: CHE 316 or equivalent
Typically offered in Fall only

CHE 715 **Transport Phenomena** (3 credit hours)
a theoretical unified study of transport of momentum, energy and matter. Introduction to diffusional operations including coupled heat and mass transfer in light of the theory.
Prerequisite: CHE 311 or equivalent
Typically offered in Spring and Summer

CHE 717 **Chemical Reaction Engineering** (3 credit hours)
Rates and mechanisms of homogeneous and heterogeneous reactions. Design, analysis and scale-up of batch and continuous chemical reactors.
Prerequisite: CHE 446 or CHE 447 or equivalent
Typically offered in Fall only

CHE 718 **Advanced Chemical Reaction Engineering** (3 credit hours)
Topics relating to design, analysis and operation of homogeneous and heterogeneous chemical reactors.
Prerequisite: CHE 717

CHE 719 **Electrochemical Systems Analysis** (3 credit hours)
Electrochemical thermodynamics, electrochemical kinetics and catalysis, coupled charge and material transport in an electric field and electrophoretic effects. Design and analysis of electrochemical reactors. Survey of electrochemical industry.
Prerequisite: CHE 715, 717
Typically offered in Spring only

CHE 752 **Separation Processes For Biological Materials** (3 credit hours)
Definition and engineering analysis of major bioseparation techniques useful in product isolation and purification. Solid-liquid separation, crystallization, filtration, extraction, chromatography, membrane processes, distillation, drying, combined operations and process economics.
Prerequisite: CHE 721 or CHE 551

CHE 761/MSE 761 **Polymer Blends and Alloys** (3 credit hours)
Thermodynamics, morphological characteristics and properties of multiphase polymer systems composed of homopolymers or copolymers. Interfacial characteristics and modification of multicomponent polymer blends through emulsification and reactive blending. Microphase ordering in block copolymers, and emerging technologies employing these nanostructured materials. Conformational properties and dynamics of macromolecules constrained near an interface.
Prerequisite: CHE 316 or MAT 301
Typically offered in Fall only
CHE 775 Multi-Scale Modeling of Matter (3 credit hours)
Current methods for modeling liquids, soft matter (polymers, surfactant solutions, colloids, liquid crystals, etc), nano-structured materials (nanoparticles, nano-composites, nano-porous materials, etc.), biomolecular systems, and reacting systems at the electronic, atomistic, meso-scale and continuum levels. Graduate level thermodynamics and differential and integral calculus required.
Prerequisite: Graduate level thermodynamics, and differential and integral calculus
Typically offered in Spring only

CHE 796 Special Topics In Chemical Engineering (1-6 credit hours)
Directed reading of chemical engineering literature, introduction to research methodology, and lectures and seminar discussion on topics which vary from term to term.
Prerequisite: Graduate standing
Typically offered in Fall and Spring

CHE 797 Chemical Engineering Projects (1-3 credit hours)
Independent study of some phase of chemical engineering or related field.
Prerequisite: Graduate standing
Typically offered in Fall only

CHE 798 Advanced Chemical Engineering Projects (1-3 credit hours)
Independent study of some phase of chemical engineering or related field.
Prerequisite: Graduate standing in CHE
Typically offered in Fall, Spring, and Summer

CHE 801 Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.
Typically offered in Fall and Spring

CHE 810 Special Topics (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

CHE 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall only

CHE 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

CHE 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

CHE 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CHE 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Summer only

CHE 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Chemistry (CH)

CH 100 Chemistry and Society (4 credit hours)
Awareness and understanding of chemistry in everyday life for the non-science student. Non-mathematical treatment of essential fundamental concepts. Emphasis on practical applications of chemistry to consumer affairs, energy, medicine, food, sports, and pollution. Laboratory activities are designed to provide a personal experience with the concepts discussed in the course. Credit is not allowed for CH 100 if student has prior credit for CH 101.
R: Credit is not allowed for CH 100 if student has prior credit for CH 101.
GEP Natural Sciences
Typically offered in Fall and Spring

CH 101 Chemistry - A Molecular Science (3 credit hours)
A fundamental study of molecular bonding, structure, and reactivity. Principles of atomic structure, ionic and covalent bonding, reaction energetics, intermolecular forces, precipitation reactions, acid/base reactions, oxidation/reduction processes, and introductions to organic and inorganic chemistry.
Prereq: One yr of high school chemistry and successful completion of the Chem Placement Exam or Chem Modules Exam, or completion of CH 111 w/ C- or better. Coreq: CH 102. ADD BOTH CH 101 and CH 102 TO YOUR SHOPPING CART AND THEN ENROLL SIMULTANEOUSLY GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

CH 102 General Chemistry Laboratory (1 credit hours)
Laboratory experience to accompany CH 101. Introduction to basic laboratory equipment and skills.
Corequisite: CH 101
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer
**CH 103 General Chemistry I for Students in Chemical Sciences** (3 credit hours)
A study of the structure of atoms and the periodic trends of the elements, chemical bonding, the spatial and electronic structure of molecules, chemical reactions, quantification of materials and reactions, energy changes of reactions, and properties of gases. First half of a two semester sequence for students interested in a chemistry or closely related career. This course is open to 17CHEMBS, 17CHEMBA, 14EFY-14CHEI, 11BIOCHBS, 11LSFY-11BCHI, and 17MARSCBS-17MARSCCHM majors and to students with departmental approval. Students cannot receive credit for both CH 101 and CH 103.

Prerequisites: (Pass Chemistry Placement Exam, or Chemistry Placement Modules Exam, or CH 111 with a grade of C- or better) and eligibility for MA 107. Co-requisite: CH 104

**GEP Natural Sciences**
Typically offered in Fall only

**CH 104 General Chemistry Laboratory I for Students in Chemical Sciences** (1 credit hours)
Laboratory and computer-based experiments in chemical formulas, atomic structure, bonding, qualitative analysis, solutions, quantitative analysis of acids and bases, and calorimetry. First half of a two semester sequence for students interested in a chemistry or closely related career. This course is open to 17CHEMBS, 17CHEMBA, 14EFY-14CHEI, 11BIOCHBS, 11LSFY-11BCHI and 17MARSCBS-17MARSCCHM majors and to students with departmental approval. Students cannot receive credit for both CH 102 and CH 104.

Co-requisite: CH 103

**GEP Natural Sciences**
Typically offered in Fall only

**CH 111 Preparatory Chemistry** (3 credit hours)
Preparation for CH 101. Review of main topics from high school emphasizing nomenclature, vocabulary, the periodic table and problem solving. Emphasis on mathematical skills, data handling, reaction types, stoichiometry and solutions. Credit for CH 111 is not allowed if a student has prior credit in CH 101. Credit for CH 111 does not count towards graduation for students in curricula that require CH 101.

**GEP Natural Sciences**
Typically offered in Fall, Spring, and Summer

**CH 201 Chemistry - A Quantitative Science** (3 credit hours)
Detailed quantitative aspects of solutions, solution stoichiometry, thermodynamics, chemical equilibrium, acid-base equilibria, solubility equilibria, electrochemistry, chemical kinetics, and nuclear chemistry.

Prerequisite: CH 101 with grade C- or better, CH 102, and eligibility for MA 121 or higher. Corequisite: CH 202

**GEP Natural Sciences**
Typically offered in Fall, Spring, and Summer

**CH 202 Quantitative Chemistry Laboratory** (1 credit hours)
Laboratory experience to complement CH 201. Experimental exploration of thermodynamic, kinetic, and electrochemical behavior.

Prerequisite: CH 101, CH 102, Corequisite: CH 201

**GEP Natural Sciences**
Typically offered in Fall, Spring, and Summer

**CH 203 General Chemistry II for Students in Chemical Sciences** (3 credit hours)
A study of intermolecular forces between molecules, and their affect on the properties of solids, liquids and gases, and on phase changes. The interplay of energetics and chemical kinetics on equilibria, including gas phase, acid-base, redox, and solubility equilibria. Second half of a two semester sequence for students interested in a chemistry or closely related career. This course is open to 17CHEMBS, 17CHEMBA, 14EFY-14CHEI, 11BIOCHBS, 11LSFY-11BCHI, and 17MARSCBS-17MARSCCHM majors and to students with departmental approval. Students cannot receive credit for both CH 201 and CH 203.

Prerequisites: (CH 101 with a minimum of 3 grade points or CH 103), and (CH 102 or CH 104), and eligibility for MA 131 or higher; Co-requisite: CH 204

**GEP Natural Sciences**
Typically offered in Spring only

**CH 204 General Chemistry Laboratory II for Students in Chemical Sciences** (1 credit hours)
Laboratory experiments in solid state materials, preparation and analysis of an organic compound, separations, gases, solutions, equilibrium, acids and bases, and kinetics. Second half of a two semester sequence for students interested in a chemistry or closely related career. This course is open to 17CHEMBS, 17CHEMBA, 14EFY-14CHEI, 11BIOCHBS, 11LSFY-11BCHI, and 17MARSCBS-17MARSCCHM majors and to students with departmental approval. Students cannot receive credit for both CH 202 and CH 204.

Prerequisite: CH 104 with a minimum of C-. Co-requisite: CH 203

**GEP Natural Sciences**
Typically offered in Spring only

**CH 220 Introductory Organic Chemistry** (3 credit hours)
A one-semester course in the fundamental principles of organic chemistry. Preparation, reactions, and physical properties of alkanes, cycloalkanes, alcohols, alkyl halides, aromatic compounds, aldehydes, ketones, organic acids, acid derivatives, and amines. Credit is not allowed for both CH 220 and CH 221.

Prerequisite: CH 101. Corequisite: CH 222.

**Typically offered in Fall, Spring, and Summer**

**CH 221 Organic Chemistry I** (3 credit hours)
First half of two-semester sequence in the fundamentals of modern organic chemistry. Structure and bonding, stereochemistry, reactivity and synthesis of carbon compounds. Detailed coverage of aliphatic hydrocarbons, alcohols, ethers, and alkyl halides. Introduction to spectral techniques of IR, UV-vis, and NMR. Students cannot receive credit for both CH 221 and CH 225.

Prerequisite: CH 101 with a grade of C- or better and CH 102;
Corequisite: CH 222

**Typically offered in Fall, Spring, and Summer**

**CH 222 Organic Chemistry I Lab** (1 credit hours)
Laboratory experience to accompany CH 220 or CH 221. Introduction to basic organic laboratory equipment and techniques. Students cannot receive credit for both CH 222 and CH 226.

Prerequisite: CH 101 and CH 102; Corequisite: CH 220 or CH 221

**Typically offered in Fall, Spring, and Summer**
CH 223  Organic Chemistry II  (3 credit hours)  
Second half of two-semester sequence in the fundamentals of modern organic chemistry. Structure and bonding, stereochemistry, reactivity and synthesis of carbon compounds. Detailed coverage of aromatic hydrocarbons, condensation reagents, and selected biological chemistry topics such as carbohydrates, lipids, and amino acids. Students cannot receive credit for both CH 223 and CH 227.  
Prerequisite: CH 221 with a grade of C- or better and CH 222; Corequisite: CH 224  
Typically offered in Fall, Spring, and Summer

CH 224  Organic Chemistry II Lab  (1 credit hours)  
Laboratory experience to accompany CH 223. Introduction to basic organic laboratory equipment and techniques. Students cannot receive credit for both CH 224 and CH 228.  
Prerequisite: CH 221 and CH 222; Corequisite: CH 223  
Typically offered in Fall, Spring, and Summer

CH 225  Organic Chemistry I for Students in Chemical Sciences  (3 credit hours)  
First half of a two semester sequence in organic chemistry for students interested in a chemistry or closely related career. Structure and bonding, stereochemistry, reactivity and synthesis of aliphatic hydrocarbons, alcohols, ethers and alkyl halides. Introduction to IR, NMR, and mass spectral techniques. This course is open to 17CHEMBS, 17CHEMBA, 14EFY-14CHEI, 14CHEBS, 11BIOCHBS, 11LSFY-11BCHI, and 17MARCBS-17MARSCHM majors and to students with departmental approval. Students cannot receive credit for both CH 221 and CH 225.  
Prerequisites: (CH 201 or CH 203) and (CH 202 or CH 204); Co-requisite: CH 226  
Typically offered in Fall only

CH 226  Organic Chemistry Laboratory I for Students in Chemical Sciences  (1 credit hours)  
First half of a two semester laboratory sequence in organic chemistry for students interested in a chemistry or closely related career. Laboratory experiments in the determination of physical properties of organic compounds, separation of mixtures and purification of compounds, synthesis and spectroscopic characterization of organic compounds, and the execution of a multi-step synthesis. This course is open to 17CHEMBS, 17CHEMBA, 14EFY-14CHEI, 14CHEBS, 11BIOCHBS, 11LSFY-11BCHI and 17MARCBS-17MARSCHM majors and to students with departmental approval. Students cannot receive credit for both CH 222 and CH 226.  
Co-requisite: CH 225  
Typically offered in Fall only

CH 227  Organic Chemistry II for Students in Chemical Sciences  (3 credit hours)  
Second half of a two semester sequence in organic chemistry for students interested in a chemistry or other closely related career. Structure and bonding, stereochemistry, reactivity and synthesis of aromatic compounds. Condensation reactions and organic compounds of biological interest. This course is open to 17CHEMBS, 17CHEMBA, 14EFY-14CHEI, 14CHEBS, 11BIOCHBS, 11LSFY-11BCHI and 17MARCBS-17MARSCHM majors and to students with departmental approval. Students cannot receive credit for both CH 223 and CH 227.  
Prerequisites: (CH 221 B or better or CH 225) & (CH 222 or CH 226); Corequisite: CH 228; Restricted to:17CHEMBS, 17CHEMBA, 14CHEI, 14CHEBS, 11BIOCHBS, or 17MARSCHM majors or dept approval. Students cannot receive credit for both CH 223 and CH 227.  
Typically offered in Spring only

CH 228  Organic Chemistry Laboratory II for Students in Chemical Sciences  (1 credit hours)  
Second half of a two semester laboratory sequence in organic chemistry for students interested in a chemistry or closely related career. Laboratory experiments in multi-step organic synthesis, identification and characterization of compounds by spectroscopic methods. Searching the chemical literature. This course is open to 17CHEMBS, 17CHEMBA, 14EFY-14CHEI, 14CHEBS, 11BIOCHBS, 11LSFY-11BCHI and 17MARCBS-17MARSCHM majors and to students with departmental approval. Students cannot receive credit for both CH 224 and CH 228.  
Co-requisite: CH 227  
Typically offered in Spring only

CH 230  Computational Chemistry Lab I  (1 credit hours)  
An introduction to computational methods in the chemical sciences. A quantitative introduction to inter- and intramolecular forces in gas and condensed phases. Potential energy surfaces of molecules and chemical reactions. First of a two-semester sequen  
Prerequisite: CH 221 or CH 225; Co-requisite: MA 241  
Typically offered in Fall only

CH 232  Computational Chemistry Lab II  (1 credit hours)  
An introduction to computational methods in the chemical sciences. A computer-based introduction to quantum mechanics, including atomic and molecular orbitals and molecular orbital theory with applications to inorganic chemistry.  
Prerequisite: CH 221 or CH 225, Corequisite: MA 241  
Typically offered in Spring only

CH 295  Special Topics in Chemistry  (1-3 credit hours)  
Special topics in chemistry at the early undergraduate level. Trial offerings of new or experimental courses in chemistry. Enrollment requires permission of the department.  
Typically offered in Fall, Spring, and Summer
CH 403 Systematic Inorganic Chemistry II (3 credit hours)
Development and application of theoretical principles to the structure and energies of inorganic substances. Particular attention to the chemistry of coordination compounds of the transition elements. Special applications to bioinorganic chemistry, organometallic chemistry, and inorganic solid state chemistry.
Prerequisite: CH 401, CH 431
Typically offered in Fall and Spring

CH 415 Analytical Chemistry II (3 credit hours)
Methods of quantitative analysis based on electronic instrumentation. Signal processing and electronics, spectroscopy (atomic, x-ray fluorescence, infrared/Raman, surface), voltammetry, chromatography (gas, liquid), mass spectrometry as well as chemical transducers and statistical methods of data handling.
Prerequisite: CH 315 or PCC 412
Typically offered in Fall only

CH 431 Physical Chemistry I (3 credit hours)
Development of the basic concepts of quantum mechanics and wavefunctions as applied to atomic structure, to the translational, rotational and vibrational motion in molecules, and to molecular spectroscopy. Development of partition functions as applied to thermodynamic properties of materials. Cannot get credit for both CH 431 and CH 437.
Prerequisite: (CH 201 or CH 203) and MA 242 and (PY 203 or 208); Corequisite: MA 341
Typically offered in Fall and Spring

CH 433 Physical Chemistry II (3 credit hours)
A classical thermodynamic treatment of states of matter, activities and chemical potentials, energy changes, equilibria, and electrochemical processes. The kinetics of multi-step, catalytic and enzyme reactions.
Prerequisite: MA 341
Typically offered in Fall and Spring

CH 435 Introduction to Quantum Chemistry (3 credit hours)
An introduction to the basic principles of quantum theory and its application to atomic and molecular structure and spectroscopy.
Prerequisite: CH 431
Typically offered in Spring only

CH 437 Physical Chemistry for Engineers (4 credit hours)
Selected physicochemical principles including quantum theory, spectroscopy, statistical thermodynamics, and rates of chemical reactions. Credit may not be claimed for both CH 431 and CH 437.
Prerequisite: PY 208 and CHE 315 and MA 341
Typically offered in Fall and Spring

CH 441 Forensic Chemistry (3 credit hours)
Chemical identification (recognition), and chemical separation techniques (identification) used to demarcate class and individual characteristics relevant in legal claims.
Prerequisite: (CH 201 or CH 203) and (CH 223 or CH 227)
Typically offered in Spring only

CH 401 Systematic Inorganic Chemistry I (3 credit hours)
Descriptive chemistry of the elements with particular attention to their reactions in aqueous solution. Emphasis on the chemistry of the main group elements and the periodicity of their chemical properties. Introduction to transition element and coord
Prerequisite: (CH 201 or CH 203) with grade of C- or better.
Typically offered in Fall and Spring

CH 315 Quantitative Analysis (3 credit hours)
Introduce the fundamental principles and modern techniques of chemical analyses. This includes examination of electrolytic solutions, including acid-base, oxidation-reduction, and solubility equilibria, and introduction to spectrochemical, electrochemical, volumetric and chromatographic methods of analysis, modern chemical instrumentation, and interpretation of data.
Prerequisite: (CH 201 or CH 203) with a grade of C- or better, Corequisite: CH 316
Typically offered in Fall, Spring, and Summer

CH 316 Quantitative Analysis Laboratory (1 credit hours)
Application of spectrochemical, electrochemical, volumetric, and chromatographic methods of analysis for the identification and quantification of components in a mixture.
Prerequisite: (CH 201 or CH 203) and (CH 202 or CH 204); Corequisite: CH 315
Typically offered in Fall, Spring, and Summer

CH 331 Introductory Physical Chemistry (4 credit hours)
Fundamental physiochemical principles including chemical thermodynamics, physical and chemical equilibrium, electrochemistry and reaction kinetics. For students requiring only a single semester of physical chemistry.
Prerequisite: (CH 201 or CH 203) and (CH 202 and 204) and (MA 231 or 241) and (PY 205 or PY 211)
Typically offered in Fall, Spring, and Summer

CH 335/PSE 335 Principles of Green Chemistry (4 credit hours)
Introduction to the topic of green chemistry as an emerging field; Identification of hazards and classes; overview of sources; alternative solvents and reagents; sustainability of chemical reactions; alternative chemical reactions and pathways; alternat
Prerequisite: Grade of C or better in CH 101/102, CH 201/202 (or equivalent general chemistry series), and CH 221/22 (or equivalent)
Typically offered in Fall only

CH 345 Chemistry and War (3 credit hours)
This course will cover the influence of chemical discoveries on major military conflicts, from World War I to the present, as well as the effect that military conflicts during this time had on chemical discoveries. Topics will include but are not limited to: explosives, chemical weapons, nuclear weapons, military medicine, and chemical/biological weapons detection.
Prerequisites: CH 223 or CH 227
GEP Interdisciplinary Perspectives
Typically offered in Spring only

CH 315 Quantitative Analysis (3 credit hours)
Introduce the fundamental principles and modern techniques of chemical analyses. This includes examination of electrolytic solutions, including acid-base, oxidation-reduction, and solubility equilibria, and introduction to spectrochemical, electrochemical, volumetric and chromatographic methods of analysis, modern chemical instrumentation, and interpretation of data.
Prerequisite: (CH 201 or CH 203) with a grade of C- or better, Corequisite: CH 316
Typically offered in Fall, Spring, and Summer

CH 341 Physical Chemistry I (3 credit hours)
Development of the basic concepts of quantum mechanics and wavefunctions as applied to atomic structure, to the translational, rotational and vibrational motion in molecules, and to molecular spectroscopy. Development of partition functions as applied to thermodynamic properties of materials. Cannot get credit for both CH 431 and CH 437.
Prerequisite: (CH 201 or CH 203) and MA 242 and (PY 203 or 208); Corequisite: MA 341
Typically offered in Fall and Spring

CH 431 Physical Chemistry I (3 credit hours)
Development of the basic concepts of quantum mechanics and wavefunctions as applied to atomic structure, to the translational, rotational and vibrational motion in molecules, and to molecular spectroscopy. Development of partition functions as applied to thermodynamic properties of materials. Cannot get credit for both CH 431 and CH 437.
Prerequisite: (CH 201 or CH 203) and MA 242 and (PY 203 or 208); Corequisite: MA 341
Typically offered in Fall and Spring

CH 433 Physical Chemistry II (3 credit hours)
A classical thermodynamic treatment of states of matter, activities and chemical potentials, energy changes, equilibria, and electrochemical processes. The kinetics of multi-step, catalytic and enzyme reactions.
Prerequisite: MA 341
Typically offered in Fall and Spring

CH 435 Introduction to Quantum Chemistry (3 credit hours)
An introduction to the basic principles of quantum theory and its application to atomic and molecular structure and spectroscopy.
Prerequisite: CH 431
Typically offered in Spring only

CH 437 Physical Chemistry for Engineers (4 credit hours)
Selected physicochemical principles including quantum theory, spectroscopy, statistical thermodynamics, and rates of chemical reactions. Credit may not be claimed for both CH 431 and CH 437.
Prerequisite: PY 208 and CHE 315 and MA 341
Typically offered in Fall and Spring

CH 441 Forensic Chemistry (3 credit hours)
Chemical identification (recognition), and chemical separation techniques (identification) used to demarcate class and individual characteristics relevant in legal claims.
Prerequisite: (CH 201 or CH 203) and (CH 223 or CH 227)
Typically offered in Spring only
CH 442 Advanced Synthetic Techniques (4 credit hours)
An advanced laboratory class in the synthesis, separation and characterization of organic, inorganic, and polymeric materials. Techniques include reactions under inert atmosphere, column chromatography, fractional distillations, NMR spectroscopy, and other advanced procedures. Scientific writing is emphasized.
Prerequisite: CH 223 or CH 227, Corequisite: CH 401
Typically offered in Fall and Spring

CH 444 Advanced Synthetic Techniques II (4 credit hours)
An advanced laboratory class in the synthesis, separation and characterization of organic, inorganic, polymer and materials compounds. Techniques include literature searches, reactions, under inert atmosphere, column chromatography, fractional distillations, NMR spectroscopy, and other advanced procedures. This course builds upon the skills acquired in CH 442 and has significant independent work.
Prerequisite: CH 442
Typically offered in Spring only

CH 452 Advanced Measurement Techniques I (4 credit hours)
Modern analytical and physical chemistry laboratory techniques. Emphasis on statistical methods, chemical thermodynamics, chromatography, atomic and molecular spectroscopy, report writing, scientific methodology, and laboratory safety.
Prerequisites: CH 315 and CH 316 and 431, all with grade of C- or better.
Corequisites: CH 415 and CH 433
Typically offered in Spring only

CH 454 Advanced Measurement Techniques II (4 credit hours)
Advanced analytical techniques including Liquid Chromatography (HPLC), Gas Chromatography (GC), Atomic Absorption Spectroscopy (AAS), Spectrophotometry, Molecular Fluorescence, and Mass Spectrometry (MS). Physical aspects including time resolved spectrophotometric measurement of kinetics, dynamic fluorescence quenching and resonance Raman spectroscopy. Students will also participate in carrying out a project through consultation with the instructor and search of the literature.
Prerequisite: CH 452 with a grade of C- or better
Typically offered in Fall only

CH 463/CH 563 Molecular Origins of Life (3 credit hours)
Survey of the present state of understanding of the molecular mechanisms leading to the emergence of sustainable self-replicating systems in the prebiotic era on the early Earth, including historical context, experimental studies, and theoretical foundation. The course will include a focus on the fundamental chemistry of and mechanisms for the plausible prebiotic formation of diverse biomolecules (including amino acids, sugars, nucleotides, lipids, tetrapyrroles) and self-organizing chemistry leading to protocells, the proposed early progenitors of living cells. Credit will not be given for both CH 463 and CH 563.
Prerequisite: CH 442 or CH 451 or Permission of Instructor
Typically offered in Fall only

CH 499 Undergraduate Research in Chemistry (1-3 credit hours)
Independent investigation of a research problem under the supervision of a chemistry faculty member. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student.
Prerequisite: Two years of chemistry
Typically offered in Fall, Spring, and Summer

CH 563/CH 463 Molecular Origins of Life (3 credit hours)
Survey of the present state of understanding of the molecular mechanisms leading to the emergence of sustainable self-replicating systems in the prebiotic era on the early Earth, including historical context, experimental studies, and theoretical foundation. The course will include a focus on the fundamental chemistry of and mechanisms for the plausible prebiotic formation of diverse biomolecules (including amino acids, sugars, nucleotides, lipids, tetrapyrroles) and self-organizing chemistry leading to protocells, the proposed early progenitors of living cells. Credit will not be given for both CH 463 and CH 563.
Prerequisite: CH 351 or CH 451 or Permission of Instructor
Typically offered in Spring only

CH 572/BIT 572/BIO 572 Proteomics (3 credit hours)
Introduction and history of the field of proteomics followed by the principles and applications of proteomics technology to understand protein expression and protein post-transitional modifications. Laboratory sessions include growing yeast with stable-isotope labeled amino acids, protein purification, Western blots, protein identification and quantification, and protein bioinformatic analysis. This is a half-semester course.
Prerequisite: BIT 410 or BIT 510 or BCH 454 (or approval from the instructor)
Typically offered in Spring only

CH 601 Seminar (1 credit hours)
Review and discussion of scientific articles, progress reports on research and special problems of interest to chemists.
Prerequisite: Graduate standing in CH
Typically offered in Fall and Spring

CH 610 Special Topics In Chemistry (1-6 credit hours)
Detailed study of a particular problem or technique pertaining to chemistry.
Typically offered in Fall and Spring

CH 677 Advanced Chemistry Projects (1-3 credit hours)
Independent literature study of a current subject in chemistry. Required written critical literature review paper of selected subject.
Prerequisite: Graduate standing in CH
Typically offered in Fall only

CH 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall only
CH 690  Master’s Examination (1-9 credit hours)
For students in non-thesis master’s programs who have completed all
other requirements of the degree except preparing for and taking the final
master’s exam.
Prerequisite: Master’s student
Typically offered in Fall only

CH 693  Master’s Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of
the Graduate Faculty.
Prerequisite: Master’s student
Typically offered in Summer only

CH 695  Master’s Thesis Research (1-9 credit hours)
Thesis research.
Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

CH 696  Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course
work during a summer session and who will be devoting full time to thesis
research.
Prerequisite: Master’s student
Typically offered in Summer only

CH 699  Master’s Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-
time enrollment for the master’s degree and are writing and defending
their thesis.
Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

CH 701  Advanced Inorganic Chemistry I: Structure and Bonding (3
credit hours)
Study of periodic table/trends, symmetry and molecular orbital theory of
small molecules and extended structures, transition-metal coordination
complexes, acid/base and redox reactivity of polyatomic ions, solid-state
structures, and selected special topics.
Typically offered in Fall only

CH 703  Advanced Inorganic Chemistry II: Applications of Group
Theory to Bonding and Spectroscopy (3 credit hours)
This course uses group theory as the basis for developing molecular
orbital theory, vibrational spectroscopy, and electronic spectroscopy.
Together, these methods are used to discuss topics of current research
interest in inorganic chemistry.
Prerequisite: CH 701 or equivalent
Typically offered in Spring only

CH 705  Organometallic and Inorganic Reaction Mechanism (3 credit
hours)
Coverage of concepts of bonding and structure of transition metal
complexes with emphasis on the interaction of transition metal
fragments with organic ligands; study of experimental methods of
mechanistic study; treatment of inorganic and organometallic reactions
including metal-mediated organic synthesis, metal-catalyzed polymer
synthesis, and models of bioinorganic systems.
Prerequisite: Graduate standing
Typically offered in Spring only

CH 711  Advanced Analytical Chemistry I (3 credit hours)
First semester of two-semester integrated sequence covering advanced
methods for extraction and interpretation of chemical information from
electronic/optical signals in chemical analysis. Digital and analog
electronics, signal acquisition and processing, chemometrics, and
instrumentation.
Prerequisite: CH 433; CH 415
Typically offered in Fall only

CH 713  Advanced Analytical Chemistry II (2 credit hours)
Second semester of two-semester integrated sequence covering advanced methods for extracting and interpreting chemical information from
electronic/optical signals in chemical analysis. Digital and analog
electronics, signal acquisition and processing, chemometrics, and
instrumentation.
Prerequisite: CH 711
Typically offered in Spring only

CH 714  Electronics and Instrumentation Laboratory (1 credit hours)
Laboratory course covering operation and application of analog and
digital electronics in context of chemical instrumentation. Circuit
elements, integrated circuits, microprocessors and computers, data
acquisition systems, and signal processing.
Prerequisite: CH 711, Corequisite: CH 713
Typically offered in Spring only

CH 721  Advanced Organic Chemistry I (3 credit hours)
Introduction to physical organic chemistry. Topics include: bonding/
introductory molecular orbital theory, reactive intermediates, aromaticity,
pericyclic reactions, thermochemistry, linear free-energy relationships,
kinetics, and transition-state theory. Topics and concepts are related to
molecular reactivity and reaction mechanisms.
Prerequisite: CH 223 or CH 227 or CH 433 or CH 435
Typically offered in Fall only

CH 723  Advanced Organic Chemistry II (3 credit hours)
Introduction to acid-base theory and mechanistic organic chemistry as
applied to synthetically useful organic reactions.
Prerequisite: CH 721
Typically offered in Spring only

CH 725  Physical Methods in Organic Chemistry (3 credit hours)
Application of physical methods to the solution of structural problems
in organic chemistry. Methods discussed include electronic absorption
spectroscopy, vibrational spectroscopy, nuclear magnetic resonance, and
mass spectrometry.
Prerequisite: (CH 223 or CH 227) and CH 433 or CH 435
Typically offered in Fall only
**CH 727/BIO 727  Biological Mass Spectrometry** (3 credit hours)
Fundamentals of mass spectrometry including topics such as: mass, isotopic distributions, resolving power, mass accuracy. Ionization source topics: electron impact, chemical ionization, matrix-assisted laser desorption ionization, electrospray ionization and contemporary methods. Instrumentation and mass analyzers: quadrupole, time-of-flight, Fourier transform based mass analyzers; hybrid instruments such as a quadrupole orbitrap. Tandem mass spectrometry and dissociation. Applications: quantitation, small molecule analysis, and peptide sequencing.
Prerequisite: CH 223 or CH 227
Typically offered in Fall only

**CH 730  Advanced Physical Chemistry** (3 credit hours)
Survey of chemical thermodynamics and kinetics, with emphasis on reactions in liquid phase. Problem solving an important part of course. Designed for review and expansion on materials usually covered in a one-year undergraduate physical chemistry course.
Prerequisite: Graduate standing
Typically offered in Fall only

**CH 732  Advanced Physical Chemistry in Biological Applications** (3 credit hours)
Modern views on structure, function, and thermodynamic stability of biological macromolecules including proteins, nucleic acids, and biological membranes; theories and models of protein folding, high resolution experimental methods for structure determination of soluble and membrane proteins including solution and solid-state NMR spectroscopy.
Prerequisite: CH 431 and CH 433 and BCH 453 or equivalent.

**CH 734  Spectroscopic Methods in Chemical Biology** (3 credit hours)
Physical principles underlying the experimental spectroscopic methods used to study structure and dynamics of biological macromolecules. Detailed discussion of experimental techniques include high-resolution solution Nuclear Magnetic Resonance, Electron Paramagnetic Resonance in combination with spin labeling and spin trapping methods, and fluorescence spectroscopy, including single molecule methods and fluorescence microscopy. This course is offered every third semester from Spring 2010.
Prerequisite: CH 331 or CH 431, CH 433 or equivalent

**CH 735  Magnetic Resonance in Chemistry** (3 credit hours)
This course is focused on physical and quantum mechanical principles that make magnetic resonance the most important spectroscopic technique in chemistry. Detailed discussion of description of magnetic resonance phenomena and NMR and EPR experimental techniques covers both classical and quantum mechanical treatments. Students of diverse backgrounds will gain in-depth knowledge of modern magnetic resonance as applied to problems in chemistry, materials, and nanoscience, and biophysics.
Prerequisite: CH 331 or CH 431, CH 433 or equivalent

**CH 736  Chemical Spectroscopy** (3 credit hours)
Introduction to rotational, vibrational and electronic molecular spectroscopy from a quantum mechanical viewpoint. Emphasis on the elucidation of structure, bonding and excited state properties of organic and inorganic molecules.
Prerequisite: CH 435
Typically offered in Spring only

**CH 737  Quantum Chemistry** (3 credit hours)
Elements of wave mechanics applied to stationary energy states and time-dependent phenomena. Applications of quantum theory to chemistry, particularly chemical bonds.
Prerequisite: MA 301, CH 435 or PY 407
Typically offered in Fall only

**CH 738  Quantum Chemistry** (3 credit hours)
Thermodynamics and kinetics of electrode reactions presented as well as experimental methods for studying them. Particular emphasis on measurement of standard potential and establishing number of electrons transferred. Applications of electrochemistry.
Prerequisite: CH 431 or CH 433
Typically offered in Spring only

**CH 743  Chemical Separation** (3 credit hours)
Basic principles of methods in chemical separation including gas chromatography, liquid chromatography, etc. Theory, instrumentation and applications of various chromatographic and electrophoretic techniques.
Prerequisite: CH 415, CH 416, Corequisite: CH 610 or 810
Typically offered in Fall only

**CH 744  Nanobiotechnology** (3 credit hours)
An introduction to nanobiotechnology, with a focus on biological applications such as bioimaging and biosensing. Principles underlying methods of nanomaterials fabrication and characterization will be introduced, and major characterization techniques will be discussed. Au nanoparticles, quantum dots, and carbon nanotubes will be used as representative examples of novel nanomaterials with unique properties. The strengths and weaknesses of various nanomaterials in biological applications will be compared through in-class discussions.
Typically offered in Spring only

**CH 747  Analytical Spectroscopy** (3 credit hours)
This is a graduate level course for analytical spectroscopy and instrumentation. The course covers the fundamentals of light-matter interaction, concepts and methodology of selected spectroscopic methods, components and working principles of optical instruments, and factors that affect the quality of optical measurements.
Prerequisite: CH 315 and CH 316 or equivalent
Typically offered in Fall only

**CH 755  Organic Reaction Mechanisms** (3 credit hours)
Effects of structure and substituents on direction and rates of organic reactions.
Prerequisite: CH 723, CH 433
Typically offered in Fall only
CH 770 Bioinorganic Chemistry (3 credit hours)
The interface between inorganic and biological chemistry will be explored, focusing on the catalytic processes in metalloenzymes, and with an emphasis on the diverse roles of transition metals in biology. The physical methods required for the study of bioinorganic systems will be introduced, with application toward determining enzymatic mechanisms. Selected topics will include heme chemistry, nitrogen fixation, C-H bond activation, electron transfer, oxygen transport, metal ion uptake and toxicity, drug activation and/or metabolism by metalloenzymes, and metalloids.

Prerequisite: CH 201 or equivalent
Typically offered in Fall only

CH 772 Solid State Chemistry (3 credit hours)
Selected topics in solid-state chemistry including: extended symmetry, structure, bonding, characterizations, and special topics. Graduate standing in Chemistry required.

Prerequisite: CH 701 or equivalent
Typically offered in Spring only

CH 775 Special Topics in Chemistry (1-6 credit hours)
Typically offered in Fall and Spring

CH 801 Seminar (1 credit hours)
Review and discussion of scientific articles, progress reports on research and special problems of interest to chemists.

Prerequisite: Graduate standing in CH
Typically offered in Fall and Spring

CH 810 Special Topics In Chemistry (1-6 credit hours)
Detailed study of a particular problem or technique pertaining to chemistry.

Typically offered in Fall only

CH 815 Advanced Topics In Chemistry (1-3 credit hours)
Critical study in one of branches of chemistry.

Typically offered in Fall and Spring

CH 877 Advanced Chemistry Projects (1-3 credit hours)
Independent literature study of a current subject in chemistry. Required written critical review paper of selected subject.

Prerequisite: Graduate standing in CH. 1-3
Typically offered in Fall only

CH 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning but the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CH 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall only

CH 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall only

CH 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CH 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

CH 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Civil Engineering (CE)

CE 214 Engineering Mechanics-Statics (3 credit hours)
Basic force concepts and equilibrium analysis; distributed forces; centroids; moments of inertia; application to structural elements. Credit will not be given for both CE 214 and MAE 206.

Grade of C or better in PY 205 and MA 241; Co-requisite: MA 242.
Typically offered in Fall, Spring, and Summer
CE 215 Engineering Mechanics-Dynamics (3 credit hours)
Kinematics and kinetics of particles; mass flow; vibrations; plane
kinematics and kinetics of rigid bodies; selected topics from three-
dimensional rigid body dynamics, and orbital motion.
Prerequisite: Minimum GPA 2.5, Grade of C- or better in CE 214, and
MA 242
Typically offered in Fall, Spring, and Summer

CE 225 Mechanics of Solids (3 credit hours)
Elementary analysis of deformable solids subjected to force systems.
Concepts of stress and strain; one, two and three-dimensional stress-
strain relationships for the linear elastic solid. Statically determine
and indeterminate axial force, torsion and bending members. Stress
transformations, pressure vessels, combined loadings. Introduction to
column buckling.
Grade of C- or better in CE 214; MA 242.
Typically offered in Fall, Spring, and Summer

CE 250 Introduction to Sustainable Infrastructure (3 credit hours)
History and future of civil infrastructure; engineering problem solving;
environmental sustainability and life-cycle assessment; social
sustainability; engineering economics; problem-driven, sustainability-
focused case studies related to different aspects of civil infrastructure.
CE, ENE, or CON majors only; co-requisite: CSC 111 and CE 214.
Typically offered in Fall and Spring

CE 263 Introduction to Construction Engineering (3 credit hours)
Introduction to fundamental concepts in Construction Engineering and
Management including principles of project management; profit, risk, and
profitability; estimating, including WBS, productivities, costs, durations,
and fundamentals of equipment selection and utilization; scheduling
using both CPM and Linear scheduling techniques; contract methods
and control principles; professional and legal aspects of construction;
fundamentals of leadership; and basic construction safety.
Corequisites: CE 214 and CE 250; R: CON Majors Only.
Typically offered in Spring only

CE 282 Hydraulics (3 credit hours)
Fluid properties; mass, energy and momentum conservation laws;
dimensional analysis and modeling; laminar and turbulent flows; surface
and form resistance; flow in pipes and open channels; elementary
hydrodynamics; fluid measurements; characteristics of hydraulic
machines. Credit will not be given for both CE 282 and MAE 308.
Prerequisite: C- or better in CE 214; Corequisites: MA 341 or MA 305 or
ST 370
Typically offered in Fall, Spring, and Summer

CE 297 Current Topics in Civil Engineering (1-4 credit hours)
Presentation of material not normally available in regular course
offerings, or offering of new courses on a trial basis. Credits and content
determined by faculty member in consultation with Department Head.
Typically offered in Fall, Spring, and Summer

CE 301 Civil Engineering Surveying and Geomatics (3 credit hours)
Plane surveying, topographical surveying, horizontal and vertical curves,
topographic surveys, construction surveys, earthwork, route surveying.
Data collection using sight-based, laser-based, and global positioning
system equipment. Methods for analysis and presentation of surveying
and positioning data, including dealing with errors. Use and applications
of GPS information. Limited to CON and CE majors. Credit will not be
given for both BAE 325 and CE 301.
Junior standing; CON and CE Majors.
Typically offered in Fall and Spring

CE 305 Traffic Engineering (3 credit hours)
Integrated approach to planning, design, and operation of transportation
systems with an emphasis on highway and street systems. Roadway
design, traffic operations and performance, and control systems.
C- or better in CE 250; Corequisite: ST 370.
Typically offered in Fall and Spring

CE 324 Structural Behavior Measurement (1 credit hours)
Theory and application of strain, displacement, and acceleration
measurements. Verification of structural theories. Error Analysis. Bending
of determinant and indeterminate beams, twisting of circular tubes,
buckling of columns, and vibration of shear buildings.
Prerequisite: Grade of C- or better in CE 313
Typically offered in Fall and Spring

CE 325 Structural Analysis I (3 credit hours)
Analysis of determinate and indeterminate bars, trusses and frames using the matrix displacement method. Qualitative deflected
shapes and shear and bending moment diagrams. Implementation of
analysis procedures through computer programming and commercial
structural analysis software.
CSC 111 and C- or better in CE 225.
Typically offered in Fall and Spring

CE 327 Reinforced Concrete Design (3 credit hours)
Behavior, strength, and design of reinforced concrete members subjected
to moment, shear, and axial forces. Introduction to the design of
reinforced concrete structures.
Prerequisite: C- or better in CE 225
Typically offered in Fall and Spring

CE 332 Materials of Construction (3 credit hours)
Fundamental characteristics that govern material behavior. Properties
of metals, ceramics, polymers, fiber reinforced composites, aggregates,
portland cement concrete, and asphalt concrete. Portland cement
concrete and asphalt concrete mixture designs. Materials testing
according to established standards.
MSE 200 and C- or better in CE 225.
Typically offered in Fall and Spring

CE 339 Civil Engineering Systems (3 credit hours)
A broad perspective, systematic approach to civil planning, analysis,
evaluation and design for large scale projects in construction, structures,
transportation, water resources and other civil engineering areas.
CSC 111 and (MA 341 or MA 305); Junior standing.
Typically offered in Spring only
CE 342 Engineering Behavior of Soils and Foundations (4 credit hours)
Description, identification, and engineering classification of soils. The basic principles and mechanics of flow of water through soils, deformation and strength of soils, and the processes of consolidation and compaction. Effective stress concepts, stress and settlement analyses, and evaluation of shear strength. Methods of analysis and geotechnical engineering design concepts.
C- or better in CE 225 and CE 282. Typically offered in Fall and Spring

CE 356 Construction Equipment and Methods (3 credit hours)
Study of construction operations as dynamic production processes. Utilization of equipment and other resources to achieve highest levels of productivity, safety, and quality. Covers a wide range of traditional and state-of-the-art construction methods.
Corequisite: CE 263 and ST 370. Typically offered in Spring only

CE 367 Mechanical and Electrical Systems in Buildings (3 credit hours)
Introduction to mechanical and electrical systems in building construction. Includes HVAC, lighting and electrical systems, focusing on design concepts, equipment application, design of the construction process, and coordination using BIM, for modern building systems.
C- or better in CE 282. Typically offered in Spring only

CE 373 Fundamentals of Environmental Engineering (3 credit hours)
Concepts of sustainability and green engineering; energy and climate; overview of contaminants in water, air and terrestrial environments; introduction to water and wastewater treatment, air pollution control, and solid waste management.
Corequisites: CE 250 and (CHE 205 or CE 282). Typically offered in Fall and Spring

CE 378 Environmental Chemistry and Microbiology (4 credit hours)
Principles of Environmental Chemistry and Microbiology, experimental techniques for assessing water and air quality; sampling; statistical interpretation of data.
Prerequisite: Junior standing in Environmental Engineering, MEA 323 or SSC 442, and C- or better in CE 250 and CE 373; Corequisite: ST 370. Typically offered in Fall only

CE 381 Hydraulics Systems Measurements Lab (1 credit hours)
Introduction to experimental techniques for the analysis of hydraulic systems: measurement of viscosity, fluid pressures, velocity distributions, flow rates; investigations into the friction, momentum transfer, and turbulence on fluid flow.
Corequisite: CE 282. Typically offered in Fall and Spring

CE 383 Hydrology and Urban Water Systems (3 credit hours)
Study of engineering hydrology and design of elements of urban stormwater systems. Commonly encountered applications in urban stormwater management, flood control and groundwater engineering. Familiarization with effects of watershed development on quantity and quality of streamflow.
C- or better in CE 282; Corequisite: ST 370; CE, ENE, and CON Majors. Typically offered in Fall and Spring

CE 390 Engineering Economics (1 credit hours)
Fundamental principles of engineering economics and their application to civil engineering planning and evaluation. Time value of money, interest and equivalence, and methods for assessing the feasibility and relative economic value of alternatives.
CSC 111 and (MA 341 or MA 305); Junior standing. Typically offered in Fall and Spring

CE 400 Transportation Engineering Project (3 credit hours)
Integrated team approach to design of major transportation engineering projects. Professional topics in transportation engineering practice.
Prerequisite: CE 390, C- or better in CE 305, and one of the following courses: CE 401, 402, 403, or 413. Typically offered in Spring only

CE 401/CE 501 Transportation Systems Engineering (3 credit hours)
Multi-modal transportation systems; railroads, airports, highways, and other modes. Planning, analysis, and design. Fundamental concepts; supply, demand, flows, impacts, and network optimization.
Prerequisite: C- or better in CE 305. Typically offered in Fall only

CE 402/CE 502 Traffic Operations (3 credit hours)
Highway capacity; traffic control systems; intelligent vehicle/highway systems; and other advanced topics. Credit for both CE 402 and CE 502 is not allowed.
Prerequisite: C- or better in CE 305. Typically offered in Fall only

CE 403/CE 503 Highway Design (3 credit hours)
Corridor selection; highway alignment; design of roadsides, intersections, and interchanges. Completion of research paper for students taking course for graduate credit. Credit will not be given for both CE 403 and CE 503.
Prerequisite: C- or better in CE 305. Typically offered in Fall only

CE 405/CE 505 Railroad System Planning, Design, and Operation (3 credit hours)
Students will learn about railroad technology and how to plan, design, and operate rail systems especially the design of alignments, track, and terminals; and the operation of freight and passenger services (ranging from transit through commuter rail to intercity and high speed rail). Field trips are involved during non-scheduled class time. Students must be able, if necessary, to provide their own transportation.
Prerequisite: CE 305. Typically offered in Spring only
CE 413 Principles of Pavement Design  (3 credit hours)
Basic principles of analysis, design and performance of highway and airport pavements with critical evaluation of current design and maintenance strategies.

CE 332 and CE 342
Typically offered in Fall only

CE 420 Structural Engineering Project  (3 credit hours)
Planning, analysis and design of complete structural systems composed of steel and reinforced concrete. Professional topics in structural engineering practice.

CE 421 Structural Engineering Senior Project - Bridge Design  (3 credit hours)
This structural engineering senior project course covers the fundamentals of bridge analysis and design including conceptual design, superstructure analysis, AASHTO-LRFD bridge specifications, flat slab bridge design, pre-stressed concrete bridge design, strut and tie modeling, column design, and foundations. A series of three bridges will be designed including a cable stay or suspension pedestrian bridge, flat slab bridge, and girder bridge. At the conclusion of the course, students will be able to analyze and design simple, but complete concrete bridge structures.

Prerequisites: C or better in each of the following: CE 325, CE 327, and CE 342; Corequisite: CE 390
Typically offered in Fall and Spring

CE 425/CE 525 Structural Analysis II  (3 credit hours)
Analysis of beam, 2D and 3D truss, 2D and 3D frame and plane strain structures using the matrix displacement method. Introduction to the finite element method of analysis by deriving the element stiffness matrices using Virtual Work. Beam and frame elements include shearing deformation and geometric stiffness effects. Computer implementation of analysis procedures using MATLAB and commercial structural analysis software. Modeling issues including convergence, symmetry and antisymmetry. Introduction to structural dynamics. Credit not given for both CE 425 and CE 525.

Prerequisite: C- or better in CE 325
Typically offered in Fall only

CE 426 Structural Steel Design  (3 credit hours)
Design and behavior of structural steel members and their connections subjected to moment, shear, and axial forces. Introduction to the design of steel structures.

C- or better in CE 225.
Typically offered in Fall, Spring, and Summer

CE 435 Engineering Geology  (3 credit hours)
Application of both geology and geotechnical engineering to engineering projects. Illustrations of relevant materials properties and techniques utilized in describing subsurface conditions.

Prerequisite: MEA 101 and Junior standing in colleges of Agriculture and Life Sciences, Engineering, Natural Resources, College of Sciences or Textiles
Typically offered in Spring only

CE 437 Civil Engineering Computing  (3 credit hours)
Computational approaches to modeling with applications in construction, structures, transportation, water resources and other civil engineering areas; matrix computations, digital terrain modeling, network applications and algorithms, heuristic optimization.

Senior standing; CSC 111 and (MA 341 or MA 305).
Typically offered in Fall only

CE 440 Geotechnical Engineering Project  (3 credit hours)
Integrated team approach to design of building foundations involving site selection, analysis and design of shallow and deep foundations, establishment of performance criteria, economic analysis, identification of potential construction problems and matters regarding professional practice and ethics.

Prerequisite: C- or better in CE 342; Corequisite: CE 390
Typically offered in Fall only

CE 443 Seepage, Earth Embankments and Retaining Structures  (3 credit hours)
Review of shear strength concepts; ground water hydraulics; slope stability; lateral earth pressure problems; placement of fills.

C- or better in CE 342.
Typically offered in Spring only

CE 444 An Introduction to Foundation Engineering  (3 credit hours)
This course will cover the basics of subsurface analysis and foundation design. Subsurface analysis includes the planning and interpretation of site investigation programs, including insitu testing and sampling, and laboratory testing and data interpretation. Foundation design will include the study of shallow and deep foundations subject to a combination of vertical and lateral loads.

C- or better in CE 342.
Typically offered in Fall only

CE 450 Civil Engineering Project  (3 credit hours)
Integrated multi-disciplinary team approach to large-scale civil engineering design including topics from geotechnical engineering, land development, transportation engineering, and water resources engineering. Professional topics in civil engineering practice and ethics.

Prerequisite: CE 305 & CE 342 & CE 383; Corequisite: one of (CE 403, CE 413, CE 443, CE 444, or CE 488).
Typically offered in Fall and Spring

CE 463 Construction Estimating, Planning, and Control  (3 credit hours)
Overview of the construction industry; life cycle of construction projects, work breakdown structure, activity cost and time estimation, computerized planning and scheduling methods, resource leveling, time-cost tradeoff; computerized cost estimating, bidding and negotiation strategies; and cost/schedule control systems.

Prerequisite: CE 263 and CE 365 and TDE 220
Typically offered in Fall only
CE 464/CE 564  Legal Aspects of Contracting  (3 credit hours)  
Legal aspects of contract documents, drawings and specifications;  
owner-engineer-constructor relationships and responsibilities; bids  
and contract performance, Labor laws; governmental administrative  
and regulatory agencies; torts; business organizations; ethics and  
professionalism.  
Prerequisite: CE 463; Corequisite: CE 365  
Typically offered in Spring only

CE 466  Building Construction Engineering  (3 credit hours)  
Construction processes for buildings and other structures including codes  
and standards, structural and architectural components and systems,  
form work and bracing design, erection and assembly methods.  
Corequisite: CE 327  
Typically offered in Fall only

CE 468/CE 568  Construction Engineering Laboratory  (1 credit  
hours)  
Measurements with and calibration of measurement instruments used in  
construction engineering field tests for quality and safety of the  
construction process. Interpretation of ANSI, ASTM, ACI and AISC  
specifications and standards. Credit for both CE 468 and CE 568 is not  
allowed.  
Prerequisite: CE 332, Corequisite: CE 327 or CE 426  
Typically offered in Fall only

CE 469  Construction Engineering Project  (3 credit hours)  
Capstone course involving integrated team approach in the design of  
the construction process, utilizing computerized tools for cost  
estimation, planning, scheduling, process design, and management  
of two construction projects. Each student also selects an individual  
project. Lecture topics include: ethics, professionalism, marketing, bid  
presentations, business planning, finance, and other appropriate topics  
by guest speakers from industry.  
"Co-requisite: CE 464"  
Typically offered in Spring only

CE 476  Air Pollution Control  (3 credit hours)  
Introduction to air pollution control fundamentals and design.  
Fundamentals include the physics, chemistry and thermodynamics  
of pollutant formation, prevention and control. Design will include gas  
treatment, process modification, and feedstock modification. Pollutants to  
be addressed include sulfur dioxide, nitrogen oxides, particulate matter,  
volatile organic compounds, hydrocarbons, and air toxics. Credit for both  
CE 476 and CE 576 will not be given.  
CE 373 and MAE 201; Corequisite: ST 370 or CHE 450 (CHE majors)  
Typically offered in Fall only

CE 477  Principles of Solid Waste Engineering  (3 credit hours)  
Solid waste management including generation, storage, transportation,  
processing, land disposal and regulation. Processing alternatives  
including incineration and composting. Integration of policy alternatives  
with evaluation of engineering decisions.  
CE 250, CE 282 and CE 373  
Typically offered in Spring only

CE 478/CE 578  Energy and Climate  (3 credit hours)  
Interdisciplinary analysis of energy technology, natural resources, and the  
impact on anthropogenic climate change. Topics include basic climate  
science, energetics of natural and human systems, energy in fossil-fueled  
civilization, the impact of greenhouse gas emissions on climate, and  
technology and public policy options for addressing the climate challenge.  
The course is quantitative with a strong emphasis on engineering and  
science.  
Prerequisite: Senior standing  
Typically offered in Fall only

CE 479/MEA 479  Air Quality  (3 credit hours)  
Introduction to: risk assessment, health effects, and regulation of air  
pollutants; air pollution statistics; estimation of emissions; air quality  
meteorology; dispersion modeling for non-reactive pollutants; chemistry  
and models for tropospheric ozone formation; aqueous-phase chemistry,  
including the "acid rain" problem; integrated assessment of air quality  
problems; and the fundamentals and practical aspects of commonly used  
air quality models. Credit is allowed only for one of CE/MEA 479 or CE/  
MEA 579.  
CE 282 and CE 373; or CHE 311(CHE Majors); or MEA 421 (MEA  
Majors); Corequisite: ST 370; or ST 380 (MEA Majors)  
Typically offered in Spring only

CE 480  Water Resources Engineering Project  (3 credit hours)  
Engineering design of selected projects in water resources engineering  
involving interactions with other scientific and engineering disciplines.  
Discussion of ethical conduct and professional engineering practice.  
Projects will include site work, storm drainage, water supply, water  
transmission and water-quality issues.  
Corequisite: CE 390; Prerequisite: Grade of C- or better in CE 382 and  
CE 383  
Typically offered in Spring only

CE 481  Environmental Engineering Project  (3 credit hours)  
Engineering design of selected projects in environmental engineering  
involving interactions with other scientific and engineering disciplines.  
Discussion of ethical conduct and professional engineering practice.  
Prerequisite: CE 378, 383, 390, Corequisite: CE 484 and two of: CE 476,  
477, 479, 488  
Typically offered in Spring only

CE 484  Water Supply and Waste Water Systems  (3 credit hours)  
Elements of the design of water supply and wastewater disposal systems.  
CE 282 and CE 373  
Typically offered in Fall only

CE 487  Introduction to Coastal and Ocean Engineering  (3 credit hours)  
Introduction to the analysis of civil engineering projects in the ocean and  
along the coastline. Basic wave mechanics, tides, and ocean dynamics  
as applied to the understanding of coastal erosion control and other  
marine problems. An optional two-day field trip to the North Carolina  
Outer Banks at a nominal student expense is a regular feature of the  
course.  
Senior standing and CE 282  
Typically offered in Spring only
CE 488/CE 588 Water Resources Engineering (3 credit hours)
Extension of the concepts of fluid mechanics and hydraulics to applications in water supply, water transmission, water distribution networks and open channels to include water-supply reservoirs, pump and pipe selection, determinate and indeterminate pipe networks, and analysis of open channels with appurtenances.
Prerequisite: CE 339 and CE 383
Typically offered in Fall only

CE 493 Independent Study in Civil Engineering (1-4 credit hours)
Independent study of a topic in Civil Engineering. Topic and mode of study determined by faculty member(s) and student(s). Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses"
Typically offered in Fall only

CE 497 Current Topics in Civil Engineering (1-4 credit hours)
Presentation of material not normally available in regular course offerings or offering of new courses on a trial basis. Credits and content determined by faculty member in consultation with the Department Head.
Typically offered in Fall, Spring, and Summer

CE 498 Special Problems in Civil Engineering (1-4 credit hours)
Directed reading in the literature of civil engineering, introduction to research methodology, seminar discussion dealing with special civil engineering topics of current interest.
Prerequisite: Senior standing
Typically offered in Fall and Spring

CE 499 Undergraduate Research Thesis in Civil, Construction and Environmental Engineering (1-3 credit hours)
Faculty mentored research related to civil, construction or environmental engineering. A plan of work is required describing the independent research culminating in a thesis. Presentation at the NC State Undergraduate Research Symposium, or other similar venue, may be included. The student must identify a research advisor from within the CCEE faculty. Departmental approval is required.
Senior standing. Departmental Approval Required.
Typically offered in Fall, Spring, and Summer

CE 501/CE 401 Transportation Systems Engineering (3 credit hours)
Multi-modal transportation systems; railroads, airports, highways, and other modes. Planning, analysis, and design. Fundamental concepts; supply, demand, flows, impacts, and network optimization.
Prerequisite: C- or better in CE 305
Typically offered in Fall only

CE 502/CE 402 Traffic Operations (3 credit hours)
Highway capacity; traffic control systems; intelligent vehicle/highway systems; and other advanced topics. Credit for both CE 402 and CE 502 is not allowed.
Prerequisite: C- or better in CE 305
Typically offered in Fall only

CE 503/CE 403 Highway Design (3 credit hours)
Corridor selection; highway alignment; design of roadsides, intersections, and interchanges. Completion of research paper for students taking course for graduate credit. Credit will not be given for both CE 403 and CE 503.
Prerequisite: C- or better in CE 305
Typically offered in Spring only

CE 504 Airport Planning and Design (3 credit hours)
Analysis, planning and design of air transportation facilities.
Prerequisite: C- or better in CE 305
Typically offered in Fall only

CE 505/CE 405 Railroad System Planning, Design, and Operation (3 credit hours)
Students will learn about railroad technology and how to plan, design, and operate rail systems especially the design of alignments, track, and terminals; and the operation of freight and passenger services (ranging from transit through commuter rail to intercity and high speed rail). Field trips are involved during non-scheduled class time. Students must be able, if necessary, to provide their own transportation.
Prerequisite: CE 305
Typically offered in Spring only

CE 506 Transportation Engineering Data Collection and Analysis (3 credit hours)
Broad range of transportation engineering data collection and analysis applications encompassing the modes of highway, transit and pedestrian travel and the contexts of system planning, design and operation. Proposal preparation with primary focus on methodology and work plan development for addressing important research and practice questions.
Prerequisite: CE 305, ST 370
Typically offered in Fall only

CE 507 Sensors, Instrumentation, and Data Analytics for Transportation Networks (3 credit hours)
Students will learn about the use of sensors, instrumentation, and big data analysis in transportation systems to observe, monitor, and evaluate performance. This includes the technology employed, the deployment strategies, the challenges associated with obtaining high-quality data, the fusion of data from independent sources, the imputation of missing data elements, and evaluation of performance based on the data assembled. The highway mode is the principal focus, including analyses of travel times, delays, queue dynamics, and spatial and temporal demand patterns.
Typically offered in Spring only

CE 509 Highway Safety (3 credit hours)
Methods to reduce collisions and injuries on highways. Identifying promising locations, choosing appropriate countermeasures, and evaluating past projects. Understanding the institutional context and establishing appropriate highway design standards.
Prerequisite: CE 305, Corequisite: ST 370 or equivalent
Typically offered in Spring only
CE 515 Advanced Strength of Materials (3 credit hours)
Stresses and strains at a point; rosette analysis; torsion and unsymmetrical bending of open and closed sections; nonlinear and curved beams; stress concentration; beams on elastic foundations; shear deformation of beams; classical plasticity; fracture
Prerequisite: CE 225 or MAE 314
Typically offered in Fall only

CE 522 Theory and Design Of Prestressed Concrete (3 credit hours)
Principles and concepts of design in prestressed concrete including elastic and ultimate strength analyses for flexure, shear, torsion, bond and deflection. Principles of concordancy and linear transformation for indeterminate prestressed structures. Application of pre-stressing to tanks and shells.
Prerequisite: CE 327
Typically offered in Fall only

CE 523 Theory and Behavior Of Steel Structures (3 credit hours)
Theory and behavior of steel structures leading to the development of design requirements contained in current specifications; flexural, torsional and flexural-torsional buckling of columns; plastic analysis of beams and frames; lateral-torsional buckling of beams; stability and strength of flat plates; beam-columns.
Prerequisite: CE 426
Typically offered in Fall only

CE 524 Analysis and Design Of Masonry Structures (3 credit hours)
Theory and design of masonry arches, culverts, dams, foundations and masonry walls subjected to lateral loads.
Prerequisite: CE 327
Typically offered in Fall only

CE 525/CE 425 Structural Analysis II (3 credit hours)
Analysis of beam, 2D and 3D truss, 2D and 3D frame and plane strain structures using the matrix displacement method. Introduction to the finite element method of analysis by deriving the element stiffness matrices using Virtual Work. Beam and frame elements include shearing deformation and geometric stiffness effects. Computer implementation of analysis procedures using MATLAB and commercial structural analysis software. Modeling issues including convergence, symmetry and antisymmetry. Introduction to structural dynamics. Credit not given for both CE 425 and CE 525.
Prerequisite: C- or better in CE 325
Typically offered in Fall only

CE 526 Finite Element Method in Structural Engineering (3 credit hours)
Development of the finite element method with an emphasis on understanding the fundamental principles governing the analysis technique. Applications to two-dimensional solids with particular attention to applications in structural engineering. Typical m
Prerequisite: CE 515
Typically offered in Spring only

CE 527 Structural Dynamics (3 credit hours)
Analysis of single and multi-degree-of-freedom structures subjected to various types of excitations and initial conditions. Computational aspects of dynamic analysis. Introduction to approximate methods of analysis.
Prerequisite: CE 425 or CE 525
Typically offered in Spring only

CE 528/FB 528 Structural Design in Wood (3 credit hours)
Behavior, strength and design of wood structural members subjected to moment, shear and axial forces. Design of connections and introduction to design of wood structural systems.
Prerequisite: C- or better in CE 325
Typically offered in Fall only

CE 529 FRP Strengthening and Repair of Concrete Structures (3 credit hours)
Fundamental behavior of Fiber-Reinforced Polymer (FRP) strengthened/ repaired reinforced concrete structures. Creation of sustainable and resilient civil infrastructure by extending the useful life of existing structures using advances materials. Applica
Prerequisite: CE 327 and CE 325
Typically offered in Fall only

CE 530 Properties of Concrete and Advanced Cement-Based Composites (3 credit hours)
This course consists of three parts. First part covers basic properties of cements, mineral/chemical admixtures, and concrete production. Second part covers mechanical properties including compressive and tensile strength, multi-axial loading, composite models, and fracture mechanics. Models of porosity and microstructures are also discussed. Third part covers durability and deterioration mechanisms including corrosion of steel in concrete, mass transport, service life prediction. Advanced laboratory techniques are discussed. This course also covers emerging topics such as geopolymers and aluminate cements.
Prerequisite: CE 332 and CE 225
Typically offered in Spring only

CE 536 Introduction to Numerical Methods for Civil Engineers (3 credit hours)
Introduction to widely-used numerical methods through application to civil and environmental engineering problems. Emphasis will be on implementation and application rather than the mathematical theory behind the numerical methods.
Prerequisite: MA 302, MA 341, or MA 401
Typically offered in Spring and Summer

CE 537/OR 537 Computer Methods and Applications (3 credit hours)
Computational approaches to support civil planning, analysis, evaluation and design. Applications to various areas of civil engineering, including construction, structures, transportation and water resources.
Prerequisite: CSC 112 and (MA 341 or MA 305)
Typically offered in Fall only
CE 538  Information Technology and Modeling  (3 credit hours)
Computing research and advanced technologies of interest to civil engineers. Issues in the design and development of engineering software systems and engineering modeling of structures, assemblies, processes and phenomena. Additional topics from the most predominant and recent developments and advances in civil engineering computing.
Prerequisite: CE 390
Typically offered in Fall and Spring

CE 548  Engineering Properties Of Soils I  (3 credit hours)
Significant soil properties in earthwork engineering, including soil elasticity and soil mineralogy, hydraulic conductivity, stress-strain relations and shear strength, compressibility and compaction. Evaluating laboratory work including plasticity, triaxial compression, permeability, consolidation and compaction tests.
Prerequisite: CE 342
Typically offered in Fall only

CE 549  Soil and Site Improvement  (3 credit hours)
Principles and design methodologies for techniques related to densification, including dynamic compaction, vibro-compaction and compaction grouting; drainage, including wick drains, horizontal drains and dewatering; physical and chemical modification, including admixtures, chemical and cement grouting, soil mixing, jet grouting and soil freezing; and use of inclusions, including stone columns, soil nailing, and meta and geosynthetic reinforcement.
Prerequisite: CE 342
Typically offered in Spring only

CE 557  Engineering Measurement and Data Analysis  (3 credit hours)
The course will introduce students to fundamentals of experimental design, measurement systems and applied data analysis techniques and includes ‘hands-on’ laboratory exercises with sensors and computer-based data acquisition. Emphasis is on general concepts and their practical application towards engineering problems. The goal of the class is to build needed background, skills and vocabulary to develop students’ experimental practice rather than focusing on the underlying fundamentals of distinct areas. Students will develop more topic/media-specific knowledge through a team experimental project. Prerequisites include a course in statistics (e.g. ST 370, ST 515 or equivalent) and some coursework or experience involving scientific programming (e.g. CE 536 or 537; Matlab, Python, R, Igor Pro, IDL). Appropriate background can be determined via discussion with instructor.
Typically offered in Fall only

CE 561  Construction Project Management  (3 credit hours)
Construction project management and control using network based tools, time-money analysis and other quantitative and qualitative techniques. Planning and scheduling, critical path, lead-lag, resource allocation, uncertainty, cash flow and payment scheduling, change orders, project acceleration, coordination and communication, record keeping. Emphasis on computer-based techniques.
Prerequisite: CE 463

CE 562  Lean Construction Concepts and Methods  (3 credit hours)
Student teams apply concepts and methods in field studies of real project management processes and construction operations by using principles and methods in Lean Production, Construction, Design, Assembly, Supply, Production Control, and Work Process Design.
Prerequisite: CE 463
Typically offered in Fall only

CE 564/CE 464  Legal Aspects of Contracting  (3 credit hours)
Legal aspects of contract documents, drawings and specifications; owner-engineer-constructor relationships and responsibilities; bids and contract performance, Labor laws; governmental administrative and regulatory agencies; torts; business organizations; ethics and professionalism.
Prerequisite: CE 463; Corequisite: CE 365
Typically offered in Spring only

CE 565  Construction Safety Management  (3 credit hours)
Fundamentals of safety management principles. Detailed review of OSHA regulations and standards critical to construction engineers and managers who expect to design and administer safety related systems in a construction project. Analysis and design of example minimum safety requirements for application in construction field operations. Review of OSHA Standards for the Construction Industry, a review of selected sections of OSHA Standards for General Industry, a review of general principles of construction safety management.
Prerequisite: CE 465 or CE 466
Typically offered in Summer only

CE 566/CE 467  Legal Aspects of Contracting  (3 credit hours)
Legal aspects of contract documents, drawings and specifications; owner-engineer-constructor relationships and responsibilities; bids and contract performance, Labor laws; governmental administrative and regulatory agencies; torts; business organizations; ethics and professionalism.
Prerequisite: CE 463; Corequisite: CE 365
Typically offered in Spring only

CE 567  Risk and Financial Management in Construction  (3 credit hours)
Fundamental concepts in financial and risk analysis in construction; accounting and financial metrics in construction; risk assessment and risk management in construction including the cost of risk, decision making strategies, the role of sureties, effects of risk in project delivery methods and contract types; risk effects in project financing including a review of financing sources, considerations for financing local and international projects; and the impact of financial and risk management in strategic planning in construction.
Prerequisite: ACC 220, CE 463
Typically offered in Spring only

CE 568/CE 468  Construction Engineering Laboratory  (1 credit hours)
Measurements with and calibration of measurement instruments used in construction engineering field tests for quality and safety of the construction process. Interpretation of ANSI, ASTM, ACI and AISC specifications and standards. Credit for both CE 468 and CE 568 is not allowed.
Prerequisite: CE 332, Corequisite: CE 327 or CE 426
Typically offered in Spring only
CE 571  Physical Principles of Environmental Engineering  (3 credit hours)
Mass balances, equation of motion for small particles, small particle interactions, particle collision/fast coagulation, partitioning, adsorption isotherms, fluid mechanics, diffusion, interphase mass transport and resistance models, elementary/non-elementary reactions, residence time distributions.

Prerequisite: CE 282, Graduate standing
Typically offered in Spring only

CE 573  Biological Principles of Environmental Engineering  (3 credit hours)
Concepts in environmental microbiology including cell structure and function, phylogeny, survey of environmentally relevant microbial groups, metabolism under different redox conditions, catabolism of macromolecules, methods in microbial ecology. Relationships to engineering processes and systems will be emphasized.

Prerequisite: Graduate standing in CE, BAE, CHE, or SSC
Typically offered in Fall only

CE 574  Chemical Principles of Environmental Engineering  (3 credit hours)
Inorganic and organic environmental chemistry including acid-base equilibria, precipitation, complexation, redox reactions, and natural organic matter. The role of these factors in controlling the fate of contaminants in engineered treatment systems and natural environments.

Prerequisite: Graduate standing in CE, CHE, BAE, NE, MEA, SSC
Typically offered in Fall only

CE 576  Engineering Principles Of Air Pollution Control  (3 credit hours)
Introduction to air pollution control fundamentals and design. Fundamentals including physics, chemistry and thermodynamics of pollutant formation, prevention and control. Design including gas treatment and process and feedstock modification. Addressed pollutants including sulfur dioxide, nitrogen oxides, particulate matter, volatile organic compounds, hydrocarbons and air toxins. Investigation of current research. Credit for both CE 476 and CE 576 is not allowed.

Prerequisite: CE 375, CE 470, CHE 315 or MAE 301, Corequisite: ST 511 or 515
Typically offered in Fall only

CE 577  Engineering Principles Of Solid Waste Management  (3 credit hours)
Solid waste management including generation, storage, transportation, processing, land disposal and regulation. Processing alternatives including incineration and composting. Integration of policy alternatives with evaluation of engineering decisions. Investigation of current research. Credit is only allowed for one of CE 477 and CE 577.

Prerequisite: CE 373
Typically offered in Spring only

CE 578/CE 478  Energy and Climate  (3 credit hours)
Interdisciplinary analysis of energy technology, natural resources, and the impact on anthropogenic climate change. Topics include basic climate science, energetics of natural and human systems, energy in fossil-fueled civilization, the impact of greenhouse gas emissions on climate, and technology and public policy options for addressing the climate challenge. The course is quantitative with a strong emphasis on engineering and science.

Prerequisite: Senior standing
Typically offered in Fall only

CE 579  Principles of Air Quality Engineering  (3 credit hours)
Introduction to: risk assessment, health effects, and regulation of air pollutants; air pollution statistics; estimation of emissions; air quality meteorology; dispersion modeling for non-reactive pollutants; chemistry and models for tropospheric ozone formation; aqueous-phase chemistry, including the "acid rain" problem; integrated assessment of air quality problems; and the fundamentals and practical aspects of commonly used air quality models. Credit is allowed only for one of CE 479 or CE/MEA 579.

Prerequisite: CE 373, CE 382 or CHE 311(CHE Majors), or MEA 421(MEA Majors), Corequisite: ST 370, ST 380(MEA Majors)
Typically offered in Spring only

CE 581/MEA 581  Fluid Mechanics in Natural Environments  (3 credit hours)
Free surface flows of water and air occurring in natural fluid systems and influencing environmental transport and mixing. Review of fundamental principles of fluids, covering the scales relevant to both engineering and geo-physical applications. Topics and examples include waves, instability, stratification, turbulent boundary layers, jets and plumes, and open channel flows. Cannot receive credit for both CE 581 and MEA 581.

Prerequisite: CE 282 or MEA 463 or permission of instructor.
Typically offered in Fall only

CE 582  Coastal Hydrodynamics  (3 credit hours)
This course gives an introduction to water wave mechanics for engineers and scientists. Topics include wave generation, propagation, kinematics, transformation, breaking, forces, and dissipation.

Prerequisite: CE 282 or permission of instructor.
Typically offered in Spring only

CE 583  Engineering Aspects Of Coastal Processes  (3 credit hours)
Coastal environment, engineering aspects of mechanics of sediment movement, littoral drift, beach profiles, beach stability, meteorological effects, tidal inlets, inlet stability, shoaling, deltas, beach nourishment, mixing processes, pollution of coastal waters, interaction between shore processes and man-made structures, case studies.

C- or better in CE 282.
Typically offered in Spring only

CE 584  Hydraulics Of Ground Water  (3 credit hours)
Introduction to ground water hydraulics and hydrology. Hydrologic cycle, basic ground water hydraulics, numerical solution of governing equations, ground water hydrology of North Carolina, well design and construction, flow net development, and ground water contamination sources.

Prerequisite: CE 382
Typically offered in Fall only
CE 585  Principles of Surface Water Quality Modeling  (3 credit hours)
This course addresses how human inputs affect natural and engineered aquatic systems, through mathematical modeling of system dynamics. Course topics integrate physical, chemical, and biologic processes related to pollutants and lower food-web dynamics. Lectures and assignments cover both theory and application. Applications are relevant to informing management, protection, and restoration of inland and coastal waters.
Prerequisite courses include environmental processes (e.g., CE 373) and quantitative calculus-based hydrology (e.g., CE 383), or permission of instructor.
Typically offered in Spring only

CE 586  Engineering Hydrology  (3 credit hours)
Hydrologic principles underlying procedures for surface water modeling; applications of common hydrologic models to actual watersheds.
Prerequisite: CE 383
Typically offered in Fall only

CE 588/CE 488  Water Resources Engineering  (3 credit hours)
Extension of the concepts of fluid mechanics and hydraulics to applications in water supply, water transmission, water distribution networks and open channels to include water-supply reservoirs, pump and pipe selection, determine and indeterminate pipe networks, and analysis of open channels with appurtenances.
Prerequisite: CE 339 and CE 383
Typically offered in Fall only

CE 590  Special Topics In Civil Engineering  (1-6 credit hours)
New or special course on recent developments in some phase of civil engineering. Specific topics and prerequisites identified for each section and varied from term to term.
Typically offered in Fall and Spring

CE 591  Special Topics in Civil Engineering Computing  (1-6 credit hours)
New or special course on recent developments in some phase of civil engineering. Specific topics and prerequisites identified for each section and varied from term to term.
Typically offered in Fall and Spring

CE 592  Special Topics in Construction Engineering  (1-6 credit hours)
New or special course on recent developments in some phase of civil engineering. Specific topics and prerequisites identified for each section and varied from term to term.
Typically offered in Fall and Spring

CE 593  Special Topics in Geotechnical Engineering  (1-3 credit hours)
New or special course on recent developments in some phase of civil engineering. Specific topics and prerequisites identified for each section and varied from term to term.
Typically offered in Fall and Spring

CE 594  Special Topics in Structures and Mechanics  (1-6 credit hours)
New or special course on recent developments in some phase of civil engineering. Specific topics and prerequisites identified for each section and varied from term to term.
Typically offered in Fall and Spring

CE 595  Special Topics in Transportation Engineering  (1-6 credit hours)
New or special course on recent developments in some phase of civil engineering. Specific topics and prerequisites identified for each section and varied from term to term.
Typically offered in Fall and Spring

CE 596  Special Topics in Water Resource and Environmental Engineering  (1-6 credit hours)
New or special course on recent developments in some phase of civil engineering. Specific topics and prerequisites identified for each section and varied from term to term.
Typically offered in Fall and Spring

CE 603  Construction Engineering Seminar  (1 credit hours)
Discussions and reports of subjects in civil engineering and allied fields.
Typically offered in Fall and Spring

CE 605  Structures and Mechanics Seminar  (1 credit hours)
Discussions and reports of subjects in civil engineering and allied fields.
Typically offered in Fall and Spring

CE 607  Water Resource and Environmental Engineering Seminar  (1 credit hours)
Discussions and reports of subjects in civil engineering and allied fields.
Typically offered in Fall and Spring

CE 610  Special Topics CE  (1-6 credit hours)

CE 635  Advanced Reading In Civil Engineering  (1-3 credit hours)
Directed reading of advanced topics in some phase of civil engineering.
Prerequisite: Graduate standing
Typically offered in Summer only

CE 675  Civil Engineering Projects  (1-6 credit hours)
Research- or design-oriented independent study and investigation of a specific civil engineering topic, culminating in final written report.
Typically offered in Fall, Spring, and Summer

CE 685  Master’s Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 688</td>
<td>Non-Thesis Masters Continuous Registration - Half Time Registration</td>
<td>1</td>
<td>For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Prerequisite: Master's student Typically offered in Summer only</td>
</tr>
<tr>
<td>CE 689</td>
<td>Non-Thesis Master Continuous Registration - Full Time Registration</td>
<td>3</td>
<td>For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester. Prerequisite: Master's student Typically offered in Summer only</td>
</tr>
<tr>
<td>CE 693</td>
<td>Master's Supervised Research</td>
<td>1-9</td>
<td>Instruction in research and research under the mentorship of a member of the Graduate Faculty. Prerequisite: Master's student Typically offered in Summer only</td>
</tr>
<tr>
<td>CE 695</td>
<td>Master's Thesis Research</td>
<td>1-9</td>
<td>Thesis research. Prerequisite: Master's student Typically offered in Fall, Spring, and Summer</td>
</tr>
<tr>
<td>CE 696</td>
<td>Summer Thesis Research</td>
<td>1</td>
<td>For graduate students whose programs of work specify no formal coursework during a summer session and who will be devoting full time to thesis research. Prerequisite: Master's student Typically offered in Summer only</td>
</tr>
<tr>
<td>CE 699</td>
<td>Master's Thesis Preparation</td>
<td>1-9</td>
<td>For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis. Prerequisite: Master's student Typically offered in Summer only</td>
</tr>
<tr>
<td>CE 701</td>
<td>Urban Transportation Planning</td>
<td>3</td>
<td>Planning and design of urban transportation systems as related to comprehensive urban planning; principles of land use planning, urban thoroughfare planning and regional planning. Prerequisite: CE 501 Typically offered in Spring only</td>
</tr>
<tr>
<td>CE 702</td>
<td>Traffic Flow Theory</td>
<td>3</td>
<td>Stream flow, shock wave, queuing, and other macroscopic theories; car following, gap acceptance, and other microscopic theories; distributions of traffic stream parameters; building traffic simulation models. Prerequisite: CE 502, Corequisite: ST 370 Typically offered in Fall only</td>
</tr>
<tr>
<td>CE 703</td>
<td>Economic Analysis of Transportation Systems</td>
<td>3</td>
<td>Transportation economics in terms of its supply and demand, costs, pricing, and regulation, especially the way in which the theory of economics in the marketplace and for public and private firms applies to the transportation market given its unique characteristics. Typically offered in Fall only</td>
</tr>
<tr>
<td>CE 705</td>
<td>Intelligent Transportation Systems</td>
<td>3</td>
<td>Intelligent Transportation Systems (ITS) planning and human factor elements; application of monitoring, communications and information dissemination technologies to transportation systems; advanced traffic management for freeway and arterial systems; traveler information and public transportation systems; automated vehicle and highway systems. ITS evaluation methods and models. Prerequisite: CE 501 and CE 502 Typically offered in Fall only</td>
</tr>
<tr>
<td>CE 706</td>
<td>Advanced Traffic Control</td>
<td>3</td>
<td>Advanced signalized traffic control methods at intersections, arterials and networks. Applications of mathematical optimization techniques to signal timing and coordination. Use of traffic simulation and optimization models for signal evaluation and design. Roundabout analysis and design. Prerequisite: CE 502 Typically offered in Spring only</td>
</tr>
<tr>
<td>CE 707</td>
<td>Transportation Policy and Funding</td>
<td>3</td>
<td>Understanding and debating important current transportation policy issues in the U.S. Raising and allocating funds for building and maintaining the transportation system. Highway, public transit, rail, air, and other modes. Prerequisite: CE 501 or graduating in Economics or Public Administration Typically offered in Spring only</td>
</tr>
<tr>
<td>CE 708</td>
<td>Transportation Logistics Planning and Optimization</td>
<td>3</td>
<td>The mathematical treatment of transportation logistics from the perspective of infrastructure providers and system operators, including models used by freight service providers to determine how they will meet the demands for freight service. Private and common carrier operations are covered. Rail, truck, and air are the primary modes examined. Typically offered in Fall only</td>
</tr>
<tr>
<td>CE 714</td>
<td>Stress Waves</td>
<td>3</td>
<td>Theory of stress waves in solids. Origins and nature of longitudinal transverse and surface waves originating at an impact site or from other transient disturbances. Determination of stresses, particle velocities, wave velocities. Wave interaction with other waves and with boundaries and dissimilar materials. Modern instrumentation and seismic refraction exploration. Prerequisite: MA 341; CE 225 or PY 411 or MA 401 Typically offered in Fall only</td>
</tr>
<tr>
<td>CE 718</td>
<td>Constitutive Modeling of Engineering Materials</td>
<td>3</td>
<td>Stresses and strains (vectors, tensors and indicial notations), general theorems for elastic-plastic solids, constitutive modeling of metals and concrete, numerical implementations of plasticity models. Prerequisite: CE 515 (old CE 715) Typically offered in Spring only</td>
</tr>
</tbody>
</table>
CE 721 Matrix and Finite Element Structural Analysis (3 credit hours)
Prerequisite: CE 526
Typically offered in Spring only

CE 723 Advanced Structural Dynamics (3 credit hours)
Finite element formulation of equations of motion; advanced analysis techniques for discrete parameter systems; investigation of damping; analysis of continuous systems; applications to civil engineering structures.
Prerequisite: CE 527
Typically offered in Fall only

CE 724 Probabilistic Methods Of Structural Engineering (3 credit hours)
Prerequisite: MA 421
Typically offered in Fall only

CE 725 Earthquake Structural Engineering (3 credit hours)
effects of earthquakes on structures and of design of structures to resist earthquake motions; earthquake mechanisms and ground motions; response of structures to earthquake motions; behavior of materials, structural elements and assemblages subjected to earthquakes; principles of earthquake-resistant design practice; soil-structure interaction; and special topics.
Prerequisite: CE 527
Typically offered in Fall only

CE 726 Advanced Theory Of Concrete Structures (3 credit hours)
Prerequisite: CE 522
Typically offered in Spring only

CE 728 Performance Based Seismic Design of Bridges (3 credit hours)
This course covers the seismic analysis and design of bridge structures. The progression through the course follows six thematic areas, namely: Conceptual design; Analysis approaches; Capacity Design; Response Verification; Assessment and Retrofit of Bridges; and New (or underutilized) frontiers in bridge engineering. The emphasis during the course will be on the relationships between engineer’s choices, analysis, and design.
Prerequisite: CE 725
Typically offered in Spring only

CE 730 Mechanics and Failure of Quasi-Brittle Materials (3 credit hours)
This course is in three parts. Part one covers fundamentals of composites including estimating the mechanical and thermomechanical properties, failure of composites, laminate, and shear-lag model. Advanced topics including homogenization theories, Eigenstrain and Eigenstress, dilute, self-consistent and Mori-Tanaka methods are also covered. Part two covers fundamental of fracture mechanics including Griffith theory, stress field at crack tip, energy release rate, crack tip plasticity, and mixed mode fracture. Part three covers interface cracks, cracks approaching an interface, and fracture of composites.
Prerequisite: CE 515 and Corequisite: CE 526
Typically offered in Fall only

CE 737 Computer-Aided Engineering Systems (3 credit hours)
Design and implementation issues for building real-world computer-aided engineering systems. Engineering data modeling; data definition, query and manipulation methodologies; application program interfaces; problem-oriented languages and software supervisors; and knowledge-based systems to support engineering design and decision making.
Prerequisite: CE 537 or 538
Typically offered in Spring only

CE 741 Geomechanics of Stress Deformation (3 credit hours)
Concepts of volume change and effective stress, stress-strain behavior of clays and sands, stress path and failure conditions; mechanic interaction between solids and water, problems in elasticity and plasticity pertaining to stress distribution, elastic, consolidation and secondary settlements, and tolerance limits to deformation levels.
Prerequisite: CE 440, or CE 443 or CE 548

CE 742 Deformation and Instability of Soils (3 credit hours)
Prerequisite: CE 440, or CE 443 or CE 548

CE 744 Foundation Engineering (3 credit hours)
Subsoil investigations; excavations; design of sheeting and bracing systems; control of water; footing, grillage and pile foundations; caisson and cofferdam methods of construction.
Prerequisite: CE 342
Typically offered in Spring only
CE 746 Soil Dynamics and Earthquake Engineering (3 credit hours)  
Dynamics of discrete and continuous systems with application to soil  
dynamics: dynamic soil properties, analysis of foundation vibration,  
construction-induced vibration, dynamic soil-structure interaction.  
Geotechnical earthquake engineering: ground motion characteristics,  
dynamic response of soil sites, effect of local site conditions on design  
ground motion, liquefaction of soils.  
Prerequisite: CE 440, or CE 443 or CE 548  
Typically offered in Spring only  
CE 747 Geosynthetics in Geotechnical Engineering (3 credit hours)  
Introduction to use, manufacturing techniques, design and construction  
of geosynthetics in geotechnical engineering applications; design  
and analysis of geotextiles, geonets, geogrids and geomembranes in  
pavements base and subbase reinforcement, reinforced walls, slopes,  
moisture barriers, dams and hazardous impoundment, landfill liners and  
covers.  
Prerequisite: CE 548  
Typically offered in Fall only  
CE 751 Theory Of Concrete Mixtures (3 credit hours)  
In-depth study of theory of portland cement concrete mixtures including  
types and properties of portland special cements; chemical reactions;  
brief examination of history of mixture design; detailed study of current  
design methods; properties of fresh a  
Prerequisite: CE 332  
Typically offered in Fall only  
CE 755 Highway Pavement Design (3 credit hours)  
Theoretical analysis and design of highway pavements with  
critical evaluation of current design practices. Pavement materials  
characterization; stresses and strains in pavements; traffic consideration;  
pavement performance models; and actual thickness  
Prerequisite: CE 342  
Typically offered in Fall only  
CE 757 Pavement Management Systems (3 credit hours)  
Fundamental concepts in process of pavement management at both  
network level and project level. Distress identification and evaluation;  
concepts and methods for rehabilitation and maintenance techniques;  
nondestructive testing of pavements; performance  
Prerequisite: CE 755  
Typically offered in Spring only  
CE 758 Multiscale Characterization of Asphalt Materials (3 credit  
hours)  
Multiscale characterization of asphalt concrete. Chemical, rheological,  
and damage characterization of asphalt binder; asphalt binder oxidative  
aging; asphalt modification; asphalt emulsions; asphalt mastics; fine  
aggregate matrix; coarse aggregate structure. Graduate course on  
Asphalt and Bituminous Materials or consent by the instructor.  
Typically offered in Spring only  
CE 759 Inelastic Behavior Of Construction Materials (3 credit  
hours)  
Application of principles of linear and nonlinear viscoelasticity, fracture  
mechanics and damage mechanics to modeling inelastic behavior of  
construction materials. Mechanical analog of time-dependent response;  
linear and nonlinear elastic-viscoelastic correspondence principles; time-  
temperature superposition; stress intensity factor; energy release rate; J-  
integral; and continuum damage mechanics.  
Prerequisite: CE 515  
Typically offered in Spring only  
CE 761 Design Of Temporary Structures in Construction (3 credit  
hours)  
Computer-based analysis of temporary structures in construction and  
their design, safety and control. Emphasis on concrete formwork,  
falswork, earth support, cofferdams, underpinning, lifting and rigging.  
Prerequisite: CE 522 or CE 744 or CE 766  
Typically offered in Fall only  
CE 762 Construction Productivity (3 credit hours)  
Methods of collecting, assembling and analyzing construction productivity  
data in order to increase construction productivity. Applications of  
methods improvement techniques such as time-lapse photography, flow  
charts, process charts and time standards to improvement of construction  
productivity. Safety and human factors in construction and their relation to  
construction productivity.  
Prerequisite: CE 463  
Typically offered in Spring only  
CE 763 Materials Management In Construction (3 credit hours)  
Fundamental concepts and methods; construction specific models for  
integrated materials management; computer usage; vendor analysis and  
“best-buy;” materials requirement planning and control; management of  
material waste; automated materials tracking;  
Prerequisite: CE 463, CE 465  
CE 765 Construction Equipment Systems (3 credit hours)  
Analysis of heavy construction processes as systems in order to  
optimize the selection and employment of construction equipment.  
Considerations in system design, cost and productivity estimation,  
operational procedures, safety and maintenance. Computer applications  
utilizing analytical and simulation techniques.  
Prerequisite: CE 761 or 762  
Typically offered in Spring only  
CE 766 Building Construction Systems (3 credit hours)  
Construction engineering of conventional and industrialized building  
systems. Emphasis in areas of structural systems utilizing cast-in-  
place concrete, precast concrete, prestressed concrete, structural steel,  
cold-formed steel, masonry, timber, composite and mixed materials.  
Mechanisms for resisting and transmitting loads, detailing, fabrication,  
transportation, erection, stability, shoring, quality control and integration  
of service systems.  
Prerequisite: CE 466 or CE 327 or Graduate standing in ARC  
Typically offered in Fall and Spring
CE 771 Physical-Chemical Water Treatment Processes (3 credit hours)
Physical-chemical treatment processes for the treatment of water, including sedimentation, flotation, filtration, coagulation, oxidation, disinfection, precipitation, adsorption, and membrane treatment processes. Current issues in drinking water quality and treatment are discussed.
Prerequisite: CE 574, Corequisite: CE 571
Typically offered in Spring only

CE 772/NE 772 Environmental Exposure and Risk Analysis (3 credit hours)
Course covers the identification, transport, and fate of hazardous substances in the environment; quantification of human exposures to such substances; dose-response analysis; and uncertainty and variability analysis. The general risk assessment framework, study design aspects for exposure assessment, and quantitative methods for estimating the consequences and probability of adverse health outcomes are emphasized.
Prerequisite: ST 511 or 515
Typically offered in Spring only

CE 774 Environmental Bioprocess Technology (3 credit hours)
Principles of microbiological, biochemical, and biophysical processes used in environmental waste treatment and remediation processes, with particular emphasis on water quality control processes.
Prerequisite: CE 573, CE 574
Typically offered in Spring only

CE 775 Modeling and Analysis Of Environmental Systems (3 credit hours)
Prerequisite: CE 339 and CE 282
Typically offered in Fall only

CE 776 Advanced Water Management Systems (3 credit hours)
Application of systems analysis methods to design, analysis and management of water resources and environmental engineering.
Prerequisite: CE 339, CE 775
Typically offered in Spring only

CE 777 Stochastic Methods in Water Resources and Environmental Engineering (3 credit hours)
Stochastic modeling, water resources and environmental data analysis, Dimension reduction, estimation and detection of periodicities in water resources and environmental data, parametric and non-parametric methods in water and environmental modeling.
Prerequisite: CE 586 or ST 515
Typically offered in Spring only

CE 779 Advanced Air Quality (3 credit hours)
Local, regional and global scale chemical interactions, transport and behavior of trace gases (sulfur carbon, nitrogen, hydrocarbon, and photo-chemical oxidants) in the atmosphere. covers three primary elements of air quality: anthropogenic and natural emissions of trace gases; interactions of the pollutants in the atmosphere; and monitoring and sampling of gaseous and particulate pollutants.
Prerequisite: (CH 201 or CH 203) and MEA(CE) 479
Typically offered in Spring only

CE 784 Ground Water Contaminant Transport (3 credit hours)
Introduction to movement and attenuation of contaminants in the subsurface. Common contaminant sources; advection and dispersion; numerical modeling of contaminant transport; chemical and biological processes in the subsurface; and ground water restoration
Prerequisite: CE 584 and 574
Typically offered in Spring only

CE 786 Hydroclimatology (3 credit hours)
Hydroclimatology, El-Nino southern oscillation, climate and streamflow forecasting, forecast verification measures, downscaling, Budyko's Framework, long-term water balance, data assimilation, ensemble Kalman Filter.
Prerequisite: CE 586
Typically offered in Spring only

CE 790 Advanced Topics In Civil Engineering (1-3 credit hours)
New or special course on advanced developments in some phase of civil engineering. Specific topics and prerequisites identified for each section and varied from term to term.
Typically offered in Fall and Spring

CE 791 Advanced Topics in Civil Engineering Computing (1-3 credit hours)
Typically offered in Fall and Spring

CE 792 Advanced Topics in Construction Engineering (1-3 credit hours)
Typically offered in Fall and Spring

CE 793 Advanced Topics in Geotechnical Engineering (1-3 credit hours)
Typically offered in Fall and Spring

CE 794 Advanced Topics in Structures and Mechanics (1-3 credit hours)
Typically offered in Fall and Spring

CE 795 Advanced Topics in Transportation Engineering (1-3 credit hours)
Typically offered in Fall and Spring

CE 796 Advanced Topics in Water Resource and Environmental Engineering (1-3 credit hours)
Typically offered in Fall and Spring

CE 803 Advanced Construction Engineering Seminar (1 credit hours)
Typically offered in Fall and Spring

CE 805 Advanced Structures and Mechanics Seminar (1 credit hours)
Typically offered in Fall and Spring
**College of Natural Resources (CNR)**

**CE 807 Advanced Water Resource and Environmental Engineering Seminar** (1 credit hours)  
Typically offered in Fall and Spring

**CE 839 Advanced Reading In Civil Engineering** (1-3 credit hours)  
Directed reading of advanced topics in some phase of civil engineering.  
Prerequisite: Graduate standing  
Typically offered in Fall, Spring, and Summer

**CE 885 Doctoral Supervised Teaching** (1-3 credit hours)  
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.  
Prerequisite: Doctoral student  
Typically offered in Summer only

**CE 890 Doctoral Preliminary Examination** (1-9 credit hours)  
For students who are preparing for and taking written and/or oral preliminary exams.  
Prerequisite: Doctoral student  
Typically offered in Summer only

**CE 893 Doctoral Supervised Research** (1-9 credit hours)  
Instruction in research and research under the mentorship of a member of the Graduate Faculty.  
Prerequisite: Doctoral student  
Typically offered in Summer only

**CE 895 Doctoral Dissertation Research** (1-9 credit hours)  
Dissertation research.  
Prerequisite: Doctoral student  
Typically offered in Fall, Spring, and Summer

**CE 896 Summer Dissertation Research** (1 credit hours)  
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.  
Prerequisite: Doctoral student  
Typically offered in Fall, Spring, and Summer

**CE 899 Doctoral Thesis Preparation** (1-9 credit hours)  
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.  
Prerequisite: Doctoral student  
Typically offered in Fall and Summer

**CNR 250 Diversity and Environmental Justice** (3 credit hours)  
Differences between people can impact how they see one another and engage with one another. In this class we talk about those differences and address numerous facets of diversity to pique the curiosity of the students. As we learn together, we investigate content that can influence dynamics (how we feel) and we explore different ways to investigate environmental justice issues. This course is designed to create a safe learning environment for reflection, engagement, risk-taking, and the development of personal awareness while looking at how each individual can improve environmental justice. 75% of the seats will be restricted for CNR students.  
GEP Interdisciplinary Perspectives, GEP U.S. Diversity  
Typically offered in Fall and Spring

**CNR 295 Special Topics in College of Natural Resources** (1-3 credit hours)  
Special topics in the College of Natural Resources at the 200 level for offering of courses on an experimental basis.  
Typically offered in Fall, Spring, and Summer

**CNR 490 Senior Honors Seminar** (2 credit hours)  
Oral presentations of the results of the senior honors projects. Additional special seminars and group discussions to enrich and broaden student perspectives.  
Prerequisite: 4 credit hours of Independent Study  
Typically offered in Fall, Spring, and Summer

**College of Sciences (COS)**

**COS 100 Science of Change** (2 credit hours)  
This course will examine change, both scientific and personal. Students will reflect on change in the past and looking forward as they transition to college life and scientific careers. Case studies, readings and discussions about global change topics will be used to highlight the scientific approaches of disciplines represented in the College of Sciences. In-class activities and out-of-class reflections will be used to practice skills necessary for success in college and career.  
Restriction: New freshmen (NFR) in the College of Sciences only  
GEP Interdisciplinary Perspectives  
Typically offered in Fall only

**COS 295 Special Topics in the College of Sciences** (1-3 credit hours)  
Special topics in the College of Sciences at the early undergraduate level. Available as directed individual or group study.  
Typically offered in Fall, Spring, and Summer

**COS 498 Spec Topics in the College of Sciences 2** (3 credit hours)  
Special Topics for advanced undergraduates will be selected from the mathematical, physical, and biological sciences.
Communication (COM)

COM 110 Public Speaking (3 credit hours)
Research skills, topic selection, speech organization, skills in speech delivery. Listening for analysis and evaluation of in-class speech presentation.

GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

COM 112 Interpersonal Communication (3 credit hours)
Interpersonal communication competence: self-concept, language and culture, self-disclosure, active listening, verbal and nonverbal communication, and conflict management.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

COM 200 Communication Media in a Changing World (3 credit hours)
Traces ongoing evolution of communication media. Examines the place and influence of the major media companies that control access to and the content of the contemporary mediascape. Challenges students to examine their use of media from cellphone, to computer, to music and gaming platforms. Restricted to non-Communication majors.

R: Non-COM majors only

GEP Humanities
Typically offered in Fall, Spring, and Summer

COM 201 Introduction to Persuasion Theory (3 credit hours)
Impacts of persuasive communication on attitudes and behavior. Uses humanistic and social scientific theories to explain the persuasive process.

Typically offered in Fall, Spring, and Summer

COM 202 Small Group Communication (3 credit hours)
Theory and practice of effective communication in small groups, including: stages of group development, role emergence, leadership functions, decision making strategies, conflict management, and the significance of power.

Typically offered in Fall and Spring

COM 211 Argumentation and Advocacy (3 credit hours)
Theory-based analysis of public argument in specialized settings of law, politics, academic debate, business and organizations, and interpersonal relations.

GEP Humanities
Typically offered in Fall, Spring, and Summer

COM 226 Introduction to Public Relations (3 credit hours)
Public relations as a communication function of organizations. Public relations process, principles, history, and practice. Analysis of environmental, organizational, communication, and audience influences on public relations practice; career opportunities.

Typically offered in Fall, Spring, and Summer

COM 230 Introduction to Communication Theory (3 credit hours)
Micro- and macro-analytic theories used in the study of human communication: perspectives and assumptions of major theories; utility and application of major theories; contexts, cultures, and media.

R: Communication Majors
Typically offered in Fall, Spring, and Summer

COM 240 Communication Inquiry (3 credit hours)
Qualitative and quantitative methods of inquiry in communication: types of questions; strategies for answering questions; nature of evidence; advantages and disadvantages of different methods; reference tools in the field; and channels of distribution

Prerequisite: Communication Majors
Typically offered in Fall, Spring, and Summer

COM 250 Communication and Technology (3 credit hours)
Examination of past, current, and future intersections of technology, culture, and communication in everyday life. Impact of communication technology policies. Analysis of communication technologies in interpersonal, organizational, societal, and global contexts. Development of technology skills for the competent communicator.

Prerequisite: Communication Majors. Credit is not allowed for both COM 250 and COM 200

Typically offered in Fall, Spring, and Summer

COM 257 Media History and Theory (3 credit hours)
Historical development and social implications of telecommunications, print, photography, film, broadcasting, and computer-mediated communication. Theoretical and methodological approaches to the field of communication media: media history; media economics and policy; media effects and power; media as producers of meaning; media audiences; media technologies; and roles of the media in social, cultural, and political change.

Prerequisite: COM 230

Typically offered in Fall and Spring

COM 267 Electronic Media Writing: Theory and Practice (3 credit hours)
Media writing as a social practice. Roles of writing and writers in media production processes. Social, political, economic, and professional conditions that enable or constrain writing and the writer. Specific media writing genres and formats. Research and preparation for media writing. Students write research-based scripts for news, commentary, and fictional genres in radio, television, film, and emerging media.

Prerequisite: COM 230

Typically offered in Fall, Spring, and Summer
COM 289  Science Communication and Public Engagement  (3 credit hours)  
This course is an introduction to the principles and practices of communicating scientific and technological issues to public audiences, through interpersonal discussion, mass media, social media, and other means. It is open to students in all majors who want to deepen and broaden their understanding of how citizens make sense of science and technology in their everyday lives. The course features a mixture of theory-based readings and discussion with practical skill-building for communication in real-world contexts. Equal emphasis is given to humanities and social science perspectives. The application of communication concepts to controversial science contexts is emphasized, including case studies of issues such as GMOs, climate change, vaccines, and gene editing. Theoretical perspectives covered include argumentation and debate; audience analysis (through quantitative survey data and metrics); philosophy and ethics of communicating science; using narratives, framing, and metaphors to communicate science; and the cultural image of science in popular media.

GEP Humanities, GEP Interdisciplinary Perspectives, GEP Social Sciences
Typically offered in Fall, Spring, and Summer

COM 292  Language, Communication, and Culture  (3 credit hours)  
We use different modes of communication depending on whether we are participating in classroom discussion, talking with our parents or boss, hanging out with our friends, or visiting a different country. However, rarely do we have the opportunity to consciously reflect upon our communicative behaviors. In this class we will unpack some of the ways culture and society influence our communication, as well as how our communication affects the culture and the society in which we live. Becoming aware of the effect that our words, shared meanings, and contexts have on how we express ourselves can be the difference between positive and negative communicative experiences.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

COM 296  Communication Internship-Non-Local  (1 credit hours)  
Non-local directed work experience for Communication majors with supervision from the work site and the University. COM 296 may be taken more than once only with the permission of the Internship Director and the Assoc. Dept. Head. Individualized/Indepen

R: Communication Majors
Typically offered in Fall, Spring, and Summer

COM 298  Special Projects in Communication  (1-3 credit hours)  
A special projects course to be utilized for guided research or experimental classes at the sophomore level, topic determined by instructor.

Typically offered in Fall and Spring

COM 301  Presentational Speaking  (3 credit hours)  
Design, organization and delivery of oral presentations for policy determination, policy implementation, and sales.

Prerequisite: COM 110
Typically offered in Spring only

COM 307  Digital Audio Production  (3 credit hours)  
Basic principles of digital audio production, including studio operation, performing, writing and producing.

Prerequisite: COM 267
Typically offered in Fall and Spring

COM 316  Public Relations Writing  (3 credit hours)  
Communication processes and procedures of public relations programs. Media techniques, preparation of materials, channels of distribution.

Prerequisite: COM 226 and ENG 316
Typically offered in Fall and Spring

COM 317  Television Production  (3 credit hours)  
Basic techniques of television studio production, including producing, writing, directing and electronic graphics production.

Prerequisite: COM 267
Typically offered in Fall and Spring

COM 321/ENG 321  Survey of Rhetorical Theory  (3 credit hours)  
Principles of rhetorical theory from its classical origins through the modern period to the present time. Key concepts and theories that provide a critical understanding of the processes of persuasive symbol use.

Prerequisite: Sophomore standing and above

COM 322  Nonverbal Communication  (3 credit hours)  
Theory and research in nonverbal communication, including: environment; space; physical appearance, movement; eyes and facial expressions; and vocal cues. Nonverbal communication in personal, workplace and cross-cultural setting.

Prerequisite: COM 112
Typically offered in Fall and Spring

COM 327  Critical Analysis of Communication Media  (3 credit hours)  
Theoretical frameworks, methods, and aims of various approaches to critical analysis of the media. Critiques of power over media production; social biases of informational, fictional, and hybrid media content; and historical forms of audiences and the public. Critical awareness of the media’s effects in politics, public culture, and everyday life.

Prerequisite: COM 240 and COM 257, Corequisite: COM 240
Typically offered in Fall and Spring

COM 332  Relational Communication  (3 credit hours)  
Communication patterns in the development and deterioration of interpersonal relationships. Functional and dysfunctional communication behaviors in family relationships.

Prerequisite: COM 112
Typically offered in Fall and Spring

COM 336  Newsletter Writing and Production  (3 credit hours)  
Newsletters are an important part of the corporate, non-profit, government, and small business portfolio of communication tools. Just about all organizations use newsletters - print or electronic - to reach their audiences with their key messages. Many young public relations practitioners start their careers working on newsletters for their organization or their clients. Students in this course will work collaboratively to write and produce a newsletter as well as other public relations publications.

Typically offered in Fall and Spring
COM 342 Qualitative Research Methods in Communication  (3 credit hours)
Introduction to qualitative methods in communication research. Research paradigms, research ethics, research design, qualitative data collection, data analysis and interpretation, written and multimedia reporting of research results. Students are responsible for providing their own transportation to research sites for fieldwork.
Prerequisite: COM 240
Typically offered in Fall and Spring

COM 346 Case Studies in Public Relations  (3 credit hours)
Application of theory, principles, and problem-solving techniques used in public relations to organizational case studies.
Prerequisite: COM 226 and COM 230
Typically offered in Fall and Spring

COM 357 Digital Video Production  (3 credit hours)
Principles of producing, directing, and editing techniques for digital video. Students script, storyboard, shoot, and edit short video projects.
Prerequisite: COM 267
Typically offered in Fall and Spring

COM 362/WGS 362 Communication and Gender  (3 credit hours)
Effects of gender on the interpersonal communication process. Construction of gendered identities via communication practices. Examination of theories of gender and the role of gender in organizational, institutional, and media communication practices.
Prerequisite: Junior standing, COM 112
Typically offered in Fall only

COM 364/ENG 364 History of Film to 1940  (3 credit hours)
Technological developments and aesthetic movements that shaped international cinema production from the beginning of the industry to 1940. Formal evolution in camera movement, editing, sound, narrative form, and the documentary. The rise to prominence of Hollywood and international cinemas in historical, economic, and cultural contexts.
Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

COM 367 Multimedia Production and Digital Culture  (3 credit hours)
Production lab and seminar combined. Digital production of visual images, audio, and video for the web. Readings in theories of visual communication and electronic culture. Critical analysis of assumptions underlying development and deployment of electronic media, and their social, economic and political impact. Development of practical skills and critical thinking.
Prerequisite: COM 267
Typically offered in Fall and Spring

COM 374/ENG 374 History of Film From 1940  (3 credit hours)
Technological developments and aesthetic movements that have shaped international cinema production from 1940 to the present. Evolution in camera movement, editing, sound, narrative form, and the documentary. Post-war Hollywood cinema and international film industries (both established and emerging) in historical, economic and cultural context.
Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Spring only

COM 386 Quantitative Communication Research Methods  (3 credit hours)
Design and implementation of communication research methods, including experimental and survey research procedures. Use of computer software for statistical analysis.
Prerequisite: COM 240
Typically offered in Fall, Spring, and Summer

COM 392/HSS 392 International and Crosscultural Communication  (3 credit hours)
Patterns and problems of verbal and non-verbal forms of crosscultural communication. Avoidance and management of cultural conflict arising from awareness of characteristics and crosscultural communication. Impact on communication of differing cultural paradigms, research ethics, research design, qualitative data collection, data analysis and interpretation, written and multimedia reporting of research results. Students are responsible for providing their own transportation to research sites for fieldwork.

GEP Global Knowledge, GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Summer

COM 395/ENG 395 Studies in Rhetoric and Digital Media  (3 credit hours)
Study of the influence of emerging technologies on rhetorical theory and practice. Rhetorical analysis of texts, including visual and audio texts. Invention and construction of digital media texts as a means of engaging rhetorical theory and analysis. Topics vary to adapt to emerging technologies and changing vernacular practices.
Prerequisite: ENG 101
GEP Humanities
Typically offered in Fall and Spring

COM 402 Advanced Group Communication  (3 credit hours)
Communication processes and outcomes in groups with complex, strategic, and critical public or corporate functions. Focus on participating in, intervening in, leading, and constructing group processes. Advanced theory with application.
Prerequisite: COM 202
Typically offered in Spring only

COM 407 Advanced Digital Audio  (3 credit hours)
Advanced multichannel techniques for audio production. Studio acoustics, audio signal processing, and advanced microphone techniques, writing, and performing.
Prerequisite: COM 307
Typically offered in Fall only

COM 411/ENG 411 Rhetorical Criticism  (3 credit hours)
Rhetorical analysis of public speeches, social movements, political campaigns, popular music, advertising, and religious communication. Neo-Aristotelian criticism, movement studies, genre criticism, dramatic analysis, content analysis, fantasy theme analysis.
Prerequisite: Junior standing

COM 417 Advanced Topics in Communication and Race  (3 credit hours)
Advanced topics seminar examining construction of racial and ethnic identities through communication practices. Exploration of theories of race and identity and the ways communication works to construct, undermine, and reinforce understanding across social groups.
Prerequisite: COM 257, Corequisite: COM 250
GEP U.S. Diversity
Typically offered in Fall and Spring
COM 421 Communication Law (3 credit hours)
Explores the historical, philosophical, and legal foundations of communication rights and responsibilities. Philosophies and regulations affecting sources, messages, channels, receivers, and situations provide the central focus of the course.
Prerequisite: Junior standing.
Typically offered in Fall only

COM 427 Game Studies (3 credit hours)
Exploration of inter-relations among mobile technologies (cell phones, PDAs), location-based activities, and playful/social spaces. Investigates three main areas: (1) the definition of basic gaming concepts (community, narrative, play, and space); (2) the history of games as social events, with particular emphasis on multi-user domains (MUDs); and (3) the definition of games, which use the physical space as the game environment, such as pervasive games, location-based games, and hybrid realitygames. Discussion of inter-connections among games, education, and art. Jr/Sr Standing.
Prerequisite: COM 250 or STS 214
Typically offered in Fall only

COM 431 Communication in Political Campaigns (3 credit hours)
Roles of analysis and criticism of oral communication in political campaigns; analysis of special political communication situations; ghostwriting, news conferences, negative advertising.
Prerequisite: COM 110 or COM 201
Typically offered in Fall only

COM 436 Environmental Communication (3 credit hours)
Critical analysis of environmental discourse in organizational, mass media, political, cultural, and international contexts. Investigates public participation in environmental advocacy and deliberation; environmental conflict management; rhetorical constructions of nature and human relationships with nature; environmental justice; environmental risk communication; and competing ecological paradigms.
Prerequisite: COM 230 or STS 214
Typically offered in Fall only

COM 437 Advanced Digital Video (3 credit hours)
Hands-on experience in digital video production. Production of instructional videotapes. Practical experience in all phases of production process, including pre-production organization and critical analysis of final product.
Prerequisite: COM 357
Typically offered in Spring only

COM 441 Ethical Issues in Communication (3 credit hours)
Critical analysis of ethical problems in interpersonal and public communication practices.
Prerequisite: COM 110, 112
Typically offered in Fall and Spring

COM 442 Communication and Conflict Management (3 credit hours)
Examination of conflict styles and theories; conflict management strategies such as negotiation and third party intervention; and relevant contexts for conflict such as workplace, families, and interpersonal relationships. Practical, theoretical and critical analyses of conflict and negotiation in variety of contexts.
Prerequisite: COM 112
Typically offered in Fall only

COM 444 Film Production (3 credit hours)
Prerequisite: COM 267 or ENG 330
Typically offered in Fall and Spring

COM 447 Communication and Globalization (3 credit hours)
History and current trends in globalization of media, information, and telecommunications technologies, organizations, policies, and contents. Political cultural implications of globalization, including debates over corporate vs. public control of global communication, U.S. dominance vs. international cooperation, and the global influence of American culture. Internet-based group research projects on globalization in collaboration with students in other countries.
Corequisite: COM 327 or instructor's permission
GEP Global Knowledge
Typically offered in Summer only

COM 451 Visual Rhetoric (3 credit hours)
Examine the rhetorical strategies employed in various primarily visual forms of communication including advertising, photography, digital images, visual art, and public commemorative artifacts and sites. Explore the concepts and methods used to rhetorically analyze and interpret visual images and artifacts. Includes one or more required field trips to which students will provide own transportation.
Prerequisite: COM 201 or COM 321
Typically offered in Spring only

COM 455 Organizational Communication (3 credit hours)
Role of human communication in organizations, the assumptions inherent in management philosophies about effective communication, and an investigation of the relationships among communication, job satisfaction, productivity, development, and employee motivation.
Prerequisite: COM 230
Typically offered in Fall and Spring

COM 457 Media and the Family (3 credit hours)
Impact of mediated messages upon children and the family unit. Origins of the empirical literature and continuing research. Assessment of the qualitative literature. Implications of commercial structure of the media industries on the structure and di
Corequisite: COM 327
Typically offered in Fall only
COM 466 Nonprofit Leadership & Development (3 credit hours)
Nonprofit Leadership and Development is a service-learning course in which students will be expected to make a commitment to service in a local nonprofit organization for 30 hours. Students will critically examine theories of communication and leadership with concentration on issues pertaining to nonprofits such as working with executive boards, volunteer management, and resource development. Students are responsible for transportation and purchase of internship insurance.

Typically offered in Fall and Spring

COM 467 Advanced Topics in Gender and Communication (3 credit hours)
Advanced Topics seminar examining construction of gender identities through communication practices. History and analysis of gender representations. Theoretical and critical approaches to social, political, and economic impact of gender constructions.

Prerequisite: COM 327 or COM 362
Typically offered in Fall and Spring

COM 476 Public Relations Campaigns (3 credit hours)
Management of the public relations function in organizations and public relations counseling; communication theory and nature of materials emanating from public relations departments and counseling firms, practical analysis and development of public relations publicity and campaigns.

Prerequisite: COM 226, COM 316, COM 386 and Corequisite: COM 346
(Note: COM 346 may be taken as a prerequisite or co-requisite)
Typically offered in Fall and Spring

COM 477 Mobile Communication (3 credit hours)
Mobile communication technologies and their influence on communication patterns and social behavior. Conceptualization of cell phones beyond mobile telephones, as internet access points and gaming devices. History, current uses and future perspectives for the social use of mobile interfaces. The creation of new mobile communities. The influence of mobile images on communication and the creation of mobile networks. Use of mobile phones across cultures and places, such as Asia, Scandinavia, Africa, and Latin America.

Prerequisite: COM 250 or STS 214
Typically offered in Fall only

COM 479/COM 579 Climate Change Communication (3 credit hours)
An exploration of the communication successes and failures surrounding climate change and public opinion. Topics addressed include: agenda setting, media effects, framing, data visualizations, fear responses, naming, risk communication and theory, argumentation and refutation, and persuasion as well as issues and current events related to the challenges associated with communicating climate change to multiple stakeholders.

Typically offered in Fall only

COM 484 Advanced Television Production (3 credit hours)
Television program production utilizing advanced production techniques. Emphasis on refinement of writing, producing, and directing skills through work in TV studio on production of sophisticated program formats.

Prerequisite: COM 317
Typically offered in Spring only

COM 487 Internet and Society (3 credit hours)
Exploration of major issues involved in the growth of computer-mediated communication and information technologies. Construction of self and body; relation of information technology to social, civic, and political life; gender, race, and class as continuing critical points; knowledge and intellectual property; the implications of software and design on the nature of communication, knowledge, and information.

Prerequisite: COM 250 or COM 257 or STS 214
Typically offered in Spring only

COM 493 Advanced Topics in Public Relations (3 credit hours)
This course addresses current trends and recent development in the public relations profession through extensive analysis of industry practices. Course content will change each semester subject to faculty availability, but may include topics such as social media, media relations, crisis communication, international public relations, and other public relations specializations. Juniors and Seniors only.

Typically offered in Fall and Spring

COM 496 Communication Internship (3 credit hours)
Directed work experience for Communication majors with supervision from the work site and the University. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the

Prerequisite: Junior standing, Communication Majors
Typically offered in Fall, Spring, and Summer

COM 497 Advanced Topics in Media Studies (3 credit hours)
This course examines special topics in media studies through intensive study of media history, theory, research, methods and/or practice. Course content will change each semester subject to faculty expertise.

Prerequisite: COM 250 or COM 257 or COM 357
Typically offered in Fall and Spring

COM 498 Advanced Topic in Communication (1-3 credit hours)
Advanced study of contemporary theories, methods, practices, processes, or issues related to the field of communication. Topic varies.

Prerequisite: Junior or senior standing
Typically offered in Fall and Spring

COM 499 Advanced Independent Research (1-3 credit hours)
Special projects in communication developed under the direction of a faculty member on a tutorial basis. Must have permission of department to enroll. May enroll only twice. Individualized/Independent Study and Research courses require a Course Agreement

Prerequisite: Nine credits in Communication courses. Junior standing or Senior standing in Communication
Typically offered in Fall and Spring

COM 506/ENG 506 Verbal Data Analysis (3 credit hours)
Research strategies for understanding how spoken and written language shapes activities (e.g., design, instruction, counseling, gaming interactions, e-commerce, etc.). Tracking patterns used of language as verbal data (e.g., grammatically topically, thematically), formulating research questions, and designing studies to answer those questions through quantitative descriptive means. Sampling, collecting and managing data, developing coding schemes, achieving reliability, using descriptive statistical measures, and reporting the results.

Typically offered in Fall only
COM 508/GES 508 Emerging Technologies and Society (3 credit hours)
Provides frameworks for understanding emerging technologies and their social, political, and cultural contexts. Presents historical case studies, ethnographic accounts, and theoretical perspectives that introduce students to ways of thinking about science and technology, nature and culture, and democracy and expertise. Graduate standing is required.

Typically offered in Spring only

COM 514/ENG 514 History Of Rhetoric (3 credit hours)
Historical development of rhetorical theory with attention to contemporaneous rhetorical practice and philosophical trends. Major focus on the classical period with briefer coverage of medieval, Renaissance, 18th-century, and 19th-century developments. Implications for contemporary theory and practice, including pedagogical practice.

Typically offered in Fall only

COM 516/ENG 516 Rhetorical Criticism: Theory and Practice (3 credit hours)
Development, achievements, limitation of major critical methods in the 20th century, including neo-Aristotelian, generic, metaphoric, dramatistic, feminist, social-movement, fantasy-theme and postmodern approaches. Criticism of political discourse, institutional discourse, discourses of law, medicine, religion, education, science, the media. Relations between rhetorical and literary criticism and other forms of cultural analysis.

Prerequisite: Graduate Standing or the equivalent of COM/ENG 321 or COM/ENG 411
Typically offered in Spring only

COM 521 Communication and Globalization (3 credit hours)
Economic, political, cultural dimensions of globalization. Role of information and communication technologies, networks, institutions, and practices in human social organization.

Prerequisite: Graduate standing
Typically offered in Summer only

COM 522 Critical Approaches to Organizational Communication (3 credit hours)
Overview of critical and interpretive organizational communication research studies. Application of insights to enriching and transforming working lives.

Prerequisite: Graduate standing
Typically offered in Spring only

COM 523 International and Intercultural Communication (3 credit hours)
Survey of intercultural, cross-cultural, and international communication theories and issues.

Prerequisite: Graduate standing
Typically offered in Spring only

COM 525 Group/Team Communication (3 credit hours)
Comprehensive review of principles, theory, research, and practices involving group/team communication; associated with decision making, conflict management, relationship building, and evaluation of group/team effectiveness. Emphasis on guidelines for effective communication in groups and teams. Graduate standing required.

Prerequisite: Graduate standing
Typically offered in Fall only

COM 526 Media Economics (3 credit hours)
This course provides an overview of economic perspectives on media and communication, particularly examining cases, topics, and controversies that stem from the many linkages between media and the economy. It reviews a range of perspectives on the economy of media, including the critical political economic approaches commonly employed in the field of communication, but also emerging neoclassical, behavioral, institutional, and heterodox approaches to economics, as applied to a range of possible topics. These may include: media ownership and the economics of journalism; labor and social media; data and surveillance economies; copyright and intellectual property; piracy, sharing, and collaboration; digital gift economies; social media celebrity and influencers; bitcoin and other virtual currencies; debt, credit, and algorithmic calculation; microfinance apps; "on-demand" platforms such as Uber and Lyft; automation and the future of employment; global supply chains in the manufacture of technology; the disposal of waste; consumerism and unsustainable energy use.

Prerequisite: Graduate standing
Typically offered in Spring only

COM 527 Seminar in Organizational Conflict Management (3 credit hours)
Examination of conflict antecedents, interventions, outcomes through multiple texts, journal articles. Emphasis on workplace conflict, organizational outcomes, dispute system design. Evaluation through participation in class discussion, independent papers, research project, presentation.

Prerequisite: Graduate standing
Typically offered in Summer only

COM 528 Communication Culture and Technology (3 credit hours)

Prerequisite: Graduate standing
Typically offered in Spring only

COM 529 Communication Campaigns (3 credit hours)
Prepares students to design, implement, monitor, and evaluate a successful communication campaign for a health, public relations, or political organization that is grounded in sound theoretical approaches. The students conduct focus groups for audience research and professionally present a campaign plan to a real client for any of the mentioned types of organizations. The course emphasizes theoretical and hands on practical skills to developing successful communication campaigns.

Typically offered in Spring only

COM 530 Interpersonal Communication in Science and Technology Organizations (3 credit hours)
Blends theory and research to understand and analyze interpersonal communication practices and issues within organizations, including managing impressions and conversations, engaging in active listening, managing conflict, influencing others, and communicating in teams. Focus on developing and maintaining effective interpersonal at work and improving student's communication competence.

Prerequisite: Graduate standing
Typically offered in Summer only
COM 532 Communication Consulting (3 credit hours)
This course provides an introduction to the art and methods of consulting particularly as applied to communication problems in organizational settings. It also provides students the opportunity to develop and/or refine training and facilitation skills.

Typically offered in Fall only

COM 536 Environmental Communication (3 credit hours)
Critical analysis of environmental discourse in organizational, mass media, political, cultural, and international contexts. Investigates public participation in environmental advocacy and deliberation; environmental conflict management; rhetorical constructions of nature and human relationships with nature; environmental justice; environmental risk communication; and competing ecological paradigms. Must hold graduate standing.

Typically offered in Spring only

COM 537 Gaming and Social Networks (3 credit hours)
Exploration of inter-relations among mobile technologies (cell phones, PDAs), location-based activities, and playful/social spaces. Investigates: (1) the definition of basic gaming concepts (community, narrative, play, and space); (2) the history of games as social environments, with particular emphasis on multi-user domains (MUDs); and (3) the definition of games, which use the physical space as the game environment, such as pervasive games, location-based games, and hybrid reality games. Discussion of inter-connections among games, education, and art. By permission of department.

Typically offered in Fall only

COM 538 Risk Communication (3 credit hours)
Comprehensive review of principles, theory, research, and practices involving consensus building; associated with environmental, health and safety; enabling analysis and management of risks. Emphasis on risks associated with emerging science and technology. No quantitative experience necessary. Graduate standing required.

Typically offered in Fall only

COM 539/PA 539 Fund Development (3 credit hours)
Identifies and assesses techniques and best practices of fund development, annual giving, capital campaigns, endowments. Topics include setting achievable goals, organizing and staffing a fund development campaign, and identifying donors. Discusses links between fund development and organization mission and governance, ethical issues, and government regulations. PBS status or Graduate standing.

COM 540 Critical and Interpretive Inquiry in Communication (3 credit hours)
Theoretical foundations and analytical techniques in critical and interpretive communication research. Analysis of culture and power in communicative practices, texts, technologies, production, and reception. Historical, political economic, archival, contextual, interpretive, rhetorical, and cultural modes of analysis and critique are highlighted. Graduate standing required.

Typically offered in Fall and Spring

COM 541 Quantitative Research Methods in Applied Communication (3 credit hours)
Introduction to research methods in applied communication. Knowledge of design, implementation, and analysis of various quantitative research methods.

Prerequisite: Graduate standing
Typically offered in Spring only

COM 542 Qualitative Research Methods in Applied Communication (3 credit hours)
Theoretical and practical dimensions of conducting qualitative research. Issues include asking good questions, field observation, ethics, focus groups, interviews, representation of data, analyzing texts and discourse, writing qualitative reports.

Prerequisite: Graduate standing
Typically offered in Spring only

COM 543 Visual Content Analysis (3 credit hours)
Research methods class in social science-oriented quantitative or qualitative analysis. Students will advance visual research by developing and/or testing theoretical concepts for visual media. Readings will focus on analytic techniques and concepts for still or moving images in digital or traditional media. Contexts include social media, organizational websites, blogs, online news sites, films, games, mobile media, and more. Students use qualitative and quantitative analysis software. Graduate standing required.

Typically offered in Fall only

COM 544 Nonprofit Marketing and Public Relations (3 credit hours)
Survey of the marketing and public relations principles and practices applicable to nonprofit organizations.

COM 547 Mobile Media and Communication (3 credit hours)
Mobile communication technologies and their influence on communication patterns and social behavior. Conceptualization of cell phones beyond mobile telephones, as Internet access points and gaming devices. History, current uses and future perspectives for the social use of mobile interfaces. The creation of new mobile communities. The influence of mobile images on communication and the creation of mobile networks. Use of mobile phones across cultures and places, such as Asia, Scandinavia, Africa, and Latin America. Permission of department.

COM 554/ENG 554 Contemporary Rhetorical Theory (3 credit hours)
Contemporary rhetorical theory covering the 20th and 21st centuries. Conceptual connections with and disruptions of the classical tradition and its, successors; relationship between rhetorical theory and philosophical trends, institutional histories, socioeconomic circumstances, and pedagogical needs. Attention to current issues such as the revival of invention, rhetorical agency, and ethics.

Typically offered in Spring only

COM 556 Seminar In Organizational Communication (3 credit hours)
Theoretic and applied approaches for studying communication perspectives of organizational behavior. Topics relate communication with organizational theories, research methods, leadership, power, attraction, conflict and theory development.

Prerequisite: Advanced Undergraduate standing or Graduate standing
Typically offered in Spring only

COM 561 Human Communication Theory (3 credit hours)
The role of theory in study of human communication. General social scientific theories as well as context-based theories including interpersonal, public, group, organizational and mass communication contexts.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall only
COM 562 Communication and Social Change (3 credit hours)
Examine persuasive theories and methods including compliance gaining techniques. Evaluate effectiveness of public communication campaigns directed at social change.

Prerequisite: Graduate standing
Typically offered in Fall only

COM 563 Public Relations Theory (3 credit hours)
Study the theoretical body of knowledge in public relations and its application to practice. Graduate Standing required.

Typically offered in Spring only

COM 566 Seminar in Crisis Communication (3 credit hours)
Working within theoretical perspectives of communication, conflict management and organizational designs, a theoretical understanding for crisis communication, including thorough guidelines for strategic communication planning for, managing and evaluating crises.

Typically offered in Spring only

COM 579/COM 479 Climate Change Communication (3 credit hours)
An exploration of the communication successes and failures surrounding climate change and public opinion. Topics addressed include: agenda setting, media effects, framing, data visualizations, fear responses, naming, risk communication and theory, argumentation and refutation, and persuasion as well as issues and current events related to the challenges associated with communicating climate change to multiple stakeholders.

Typically offered in Fall only

COM 581/ENG 581 Visual Rhetoric: Theory and Criticism (3 credit hours)
Application of visual theory to rhetoric and of rhetorical theory to visual forms of communication. Discussion and analysis may include advertising, photography, news and informational media, political communication, instructional material, scientific visualization, visual arts, public commemorative artifacts, internet and other digital media.

R: Graduate Students Only
Typically offered in Spring only

COM 585 Teaching College Communication (3 credit hours)
Introduction to communication education theory and research. Course divided into primary parts: 1) education theory and philosophy and 2) instructional design theory and practice.

Prerequisite: Graduate standing
Typically offered in Fall only

COM 587 Internet & Society (3 credit hours)
Overview of the development of the internet and its social uses, including the historical context that led to the development of the ARPANET and the World Wide Web. Analysis of the transition from mainframes to personal computers, to the internet of things. Treatment of principal social and communication issues related to the use of the internet, such as digital privacy, digital divide, net neutrality, and civic engagement. Development of mobile internet, social networking sites and location-based social networks.

Typically offered in Fall only

COM 598 Special Topics in Communication (1-6 credit hours)
Detailed investigation of a special topic in communication. No more than 6 hrs. may be used as credit toward graduation with master's degree.

Typically offered in Fall, Spring, and Summer

COM 630 Independent Study in Communication (1-3 credit hours)
Special projects course to be utilized for guided research at graduate level. Topic determined by instructor. No more than 6 hrs. may be used as credit toward graduation with master's degree.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

COM 650 Communication Internship (1-6 credit hours)
The internship experience provides the students the opportunity to practice professional communication skills in a workplace setting under the supervision of a communication practitioner. Restricted to MS in Communication students.

Prerequisite: Acceptance into MS in Communication Program
Typically offered in Fall, Spring, and Summer

COM 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Summer

COM 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall and Spring

COM 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall and Spring

COM 695 MR Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

COM 696 Summer Thesis Research (1 credit hours)
Typically offered in Summer only
COM 798 Special Topics in Communication (3-6 credit hours)
Intensive exploration of specialized or emerging topics in an area of communication theory, rhetoric, media, or other aspect of Communication studies. Emphasis on student research and writing. May be used to test and develop new courses. May be repeated for credit. Doctoral students only.

Typically offered in Fall and Spring

COM 810 Directed Readings in Communication (1-6 credit hours)
Intensive study of a specific topic from various specializations of the Communication faculty. Negotiation between the student and the director for variable credit and approved by Director of Graduate Studies. May be repeated for credit. Doctoral students only.

Typically offered in Fall, Spring, and Summer

COM 896 Summer Dissertation Res (1 credit hours)

CRD 701 History and Theory of Media Technologies (3 credit hours)
Foundational study of media and technology through examination of historical perspectives on technological change. Discussion of media theory, media archaeology, feminist theory, political economy, cultural studies, and functionalist perspectives on technology. Examination of media and power, social movements, alternative media, technology and development, participatory communication, technological diffusion. Research paper and seminar presentation.

Prerequisite: Doctoral student
Typically offered in Fall only

CRD 702 Rhetoric and Digital Media (3 credit hours)
Critical study and evaluation of the conceptual vocabulary of rhetoric and its relationship to digital communication and digital media.

Prerequisite: COM/ENG 514 or 516 or ENG 515, Doctoral student
Typically offered in Fall only

CRD 703 Communication Networks (3 credit hours)
Intensive study of theories, histories, and practices of networked communication. Emergence, development, acceptance, and dissolution of a variety of networks organized around information and communication technologies. Survey of network theory and methods for studying networks, networked communication practices, and their effects on issues such as identity, labor, organization, power, etc. Research/applications project developed in consultation with the instructor.

Restriction: CRDM students only
Typically offered in Spring only

CRD 704 Communication, Technologies, and Pedagogy (3 credit hours)
History, theory, research, and practice of integrating technology in higher education. Design, implementation, and critique of instructional strategies; ethical and professional issues; effects on the practices of teaching and learning and the development of communication abilities.

Prerequisite: Doctoral student
Typically offered in Fall only

CRD 790 Scholarly and Professional Paths in Disciplinary and Interdisciplinary Research (3 credit hours)
This seminar aims to 1) foster discussion about disciplinarity and interdisciplinarity, particularly in fields relevant to research in communication, rhetoric and digital media; and 2) develop and sharpen participants’ theoretical and methodological positionings as they prepare to pursue their professional goals.

Prerequisite: CRD 701, 702, 703, 704, Doctoral student
Typically offered in Spring only

CRD 791 Special Topics in Communication, Rhetoric, and Digital Media (3-6 credit hours)
An intensive seminar examining a particular topic or issue in the communication and rhetoric of digital media.

Prerequisite: CRD 701
Typically offered in Fall and Spring

CRD 809 Colloquium in Communication, Rhetoric, and Digital Media (1 credit hours)
Professional development, ethical inquiry, and discussion and evaluation of interdisciplinary research in a colloquium setting. In successive fall semesters, students participate in three one-credit colloquia that include faculty and students from across the program.

Prerequisite: Doctoral student
Typically offered in Fall only

CRD 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

CRD 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

CRD 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Typically offered in Fall, Spring, and Summer

CRD 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

CRD 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only
CRD 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Comparative Biological Science (CBS)

CBS 493 Undergraduate Research in Biomedical Sciences (1-3 credit hours)
A learning experience in College of Veterinary Medicine within an academic framework that utilizes campus facilities and resources for supervised undergraduate research. Arrangements must be initiated by the student and be approved by a faculty adviser, the college Undergraduate Research Coordinator, and the Associate Dean of Research Training and Graduate Programs. Students who enroll in this course are required in this course to complete and submit an Agreement for Non-Standard Courses form through Registration and Records.
Requisite: Sophomore Standing or Above
Typically offered in Fall and Spring

CBS 510 Animal Production Topics (1-3 credit hours)
Students will be provided with experience in management of production animals with an emphasis on the veterinary aspects of population health. Experience will come in the form of hands-on experiences and working through relevant literature to specific areas.
Typically offered in Fall and Spring

CBS 550 Population Medicine Forum (1 credit hour)
Population medicine forum is a seminar-based class during which current topics in population health are presented and discussed. Topics covered include: outbreak investigation, observational epidemiologic research, risk analysis, spatial analysis, the application of unique diagnostic technologies and epidemiologic modeling.
Typically offered in Fall and Spring

CBS 565 Fundamentals of Biomedical Sciences (3 credit hours)
Introductory course for students interested in gaining a broad understanding of: comparative genomics, comparative immunology, comparative physiology, pharmacokinetics, emerging zoonotic diseases, epidemiology and translational research models and methods. This course also provides an overview of current technologies relevant to comparative biomedical research and a foundation for implementing the scientific method (e.g., experimental design, data analyses, statistics). Priority will be given to first-year students in CBS graduate program; enrollment of all students requires consent of instructor.
Typically offered in Fall only

CBS 570 Methods in Biomedical Sciences (1 credit hour)
Introductory course for students interested in gaining a broad understanding of various laboratory methods used in molecular, cellular and "omics" based biomedical research.
Typically offered in Fall only

CBS 579 Advanced Specialty Training (1-3 credit hours)
This course is designed to give students clinical experience and training to understand basic health management strategies, handle clinical evaluations, use diagnostic tools to facilitate accurate diagnosis, and develop prevention and/or treatment plans for health management. This course is restricted to Students in the SVM program.
Typically offered in Fall and Spring

CBS 580 Clinical Veterinary Epidemiology (3 credit hours)
To expose students to the concepts and principles of epidemiology from the perspective of assessing health and disease in animal and human populations, and the measures to control disease status. Specifically to study the principles and concepts of veterinary epidemiology, to learn basic epidemiology methodology, critically review major veterinary care studies, and enhance oral and written communication skills.
Prerequisite: ST 511
Typically offered in Fall only

CBS 586 One Health: From Philosophy to Practice (2 credit hours)
Graduate/professional seminar (with team project) addressing intersections of veterinary medicine, human medicine, and environmental health. Co-listed at UNC CH Gillings School of Global Public Health and Duke University School of Medicine. Includes participants from these three institutions, plus related private-sector members, non-governmental organizations, and government professionals. Its purpose is to facilitate understanding of one health as a system of systems, and promote cross-campus and cross-discipline interactions. Weekly evening course held at NC Biotechnology Center, RTP. Requires graduate student standing at NCSU or professional student standing within the College of Veterinary Medicine. Limit: 15 students per university.
Typically offered in Fall only

CBS 611 Principles of Collaboration and Team Science (2 credit hours)
The focus of this course is exploring how to effectively communicate as a member of a cross-disciplinary team. Specifically, this course offers strategies and techniques about engaging in team science to pursue complex research questions, work effectively with team members, identify and address unconscious bias, and assess team performance in order to produce high impact research outcomes. To that end, we will examine aspects of group process and communication related to professional relationship development, teamwork, leadership, and conflict resolution.
Typically offered in Spring only

CBS 615 Advanced Animal Production Topics (1-3 credit hours)
Students will be provided with practice and experience in advanced topics related to management of production animals with an emphasis on the veterinary aspects of population health. Actual in-the-field, hands-on practice and investigation of relevant literature will provide the basis for study of advanced animal production topics. Course is restricted to students in the SVM program
Prerequisite: SVM 510
Typically offered in Fall and Spring
CBS 624 Special Problems in Gastrointestinal Physiology (1 credit hours)
1 credit for a 1-hour in depth discussion session of current journal articles presented by students on the subject of gastrointestinal physiology. Journals recommended include the American Journal of Physiology, Gut and Gastroenterology. Each session will focus on one student’s selected paper. MS students are expected to present 1 paper, and PhD students are expected to present up to 2 papers each semester. Students should be enrolled in a graduate course of study in a field related to or focused on physiology. Undergraduate students require special permission.

Typically offered in Fall and Spring

CBS 635 MR Advanced Reading (1-3 credit hours)
Typically offered in Fall and Spring

CBS 649 Issues in Preventive Medicine and Public Health (1 credit hours)
Issues in Preventive Medicine and Public Health is a literature review course designed to assist students with their preparation for careers in public health, ecosystem health, biosecurity and public policy, disaster management, and application for Board Certification in the American College of Preventive Veterinary Medicine. Permission by course instructor required for enrollment.

Prerequisite: A prior degree in veterinary medicine or public health

CBS 650 Population Medicine Forum (1 credit hours)
Population medicine forum is a seminar-based class during which current topics in population health are presented and discussed. Topics covered include: Outbreak investigation, observational epidemiologic research, risk analysis, spatial analysis, the application of unique diagnostic technologies and epidemiologic modeling.

Typically offered in Fall and Spring

CBS 662 Professional Conduct in Biomedical Research (1 credit hours)
Plagiarism, authorship, fraud, safety, sexual harassment, IACUC, consulting agreements, serving as an expert witness, contacting elected officials, working with press, human subjects committee, and related topics.

Typically offered in Spring only

CBS 680 MR Special Topics (1-6 credit hours)
Typically offered in Fall and Spring

CBS 681 MR Seminar (1-3 credit hours)
Typically offered in Fall and Spring

CBS 682 Seminar - Poultry Medicine (1-3 credit hours)
Typically offered in Fall, Spring, and Summer

CBS 683 MR Other Special Topics (1-6 credit hours)
Typically offered in Fall and Spring

CBS 684 Internship (1-3 credit hours)
Credit for internships in fields related to the comparative biomedical sciences.

Typically offered in Fall, Spring, and Summer

CBS 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CBS 686 Food Animal Health Teachings (1-3 credit hours)

CBS 693 Master’s Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CBS 695 Master’s Thesis Research (1-9 credit hours)
Thesis research

Prerequisite: Master’s student
Typically offered in Summer only

CBS 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master’s student
Typically offered in Summer only

CBS 699 Master’s Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master’s degree and are writing and defending their thesis.

Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

CBS 705/BIO 705 Fundamentals of Neuroscience (3 credit hours)
This is a fundamental course that will provide the student with an up-to-date coverage of molecular, cellular, physiological, and circuit-based aspects of Modern Neurosciences in the Comparative Biomedical Sciences Graduate Program. Being a graduate-level class, the instructors will assume that the students have acquired some background in basic biology and biochemistry. The most important goal of this course is to train PhD students in neuroscience function and disorders, preparing them for neuroscience research. Emphasis will be placed on the systems and skills needed to pursue experimental neuroscience activities. Important components of the learning process will be presentations from neuroscience experts, class discussions, exams and in class activities.

P: BIO 488 or permission of instructor
Typically offered in Fall only

CBS 711 Applications in Reproductive Physiology (2 credit hours)
Students with advanced interests in Theriogenology will meet weekly to discuss a wide range of current topics surrounding animal reproduction, including comparative physiology and endocrinology, reproductive management, reproductive pharmacologic/technologic advances in Theriogenology. Each student will be expected to present 2-3 topics with typed, referenced notes and an oral presentation. All students will be expected to actively participate in group discussions and briefly present a review of one topic-related article from the past 5 years during each lecture.

Typically offered in Fall only
### CBS 712 Reproductive Management and Disease in Domestic Animals (1 credit hours)
Students will meet every other week to review current literature and discuss a wide range of topics surrounding animal reproduction, focused on clinical causes of infertility and their treatments in domestic and non-domestic species. Students will explore 3-5 preassigned questions surrounding a particular topic and prepare an in-depth handout answering those questions prior to arrival. Each student will be expected to actively participate in group discussions.

**Typically offered in Fall and Spring**

### CBS 713 Zoonoses and Public Health (3 credit hours)
Enrollment to graduate veterinarians, MVPH, MPH, or other graduate students. Veterinary students will be considered for enrollment after consultation with the course coordinator.

Prerequisite: VPH 580 or equivalent, ST 511 or equivalent

### CBS 750 Techniques in Pharmacological Research (2 credit hours)
Theory and applications of modern scientific instrumentation to analysis of tissues, body fluids and drugs in pharmacological research. Discussion of appropriate aspects of the pharmacological use of spectroscopy, microscopy, chromatography, electrophoresis, radioisotope usage and centrifugation.

Prerequisite: BCH 452B or CH 315 or Equivalent and Graduate standing

**Typically offered in Spring only**

### CBS 754 Epidemiology II (3 credit hours)
Study design, data management, and statistical analysis including applications of logistic regression and survival analysis. Main focus on descriptive, analytical and experimental epidemiology pertinent to disease etiology and prevention.

Prerequisite: Graduate standing

**Typically offered in Fall and Spring**

### CBS 760 Molecular Technologies for Epidemiologic Investigation (3 credit hours)
The course is designed to help students refine their ability to select and interpret molecular diagnostic technologies for epidemiologic disease surveillance and investigation.

Prerequisite: Introductory Epidemiology

**Typically offered in Spring only**

### CBS 762 Principles of Pharmacology (3 credit hours)
The action of drugs in animals and man including basic principles of drug disposition, pharmacokinetics, drug resistance, and signal transduction. Modification of physiological processes by drugs influencing nervous, renal, cardiovascular, and endocrine systems and the antimicrobial and antineoplastics agents.

**Typically offered in Spring only**

### CBS 764/NTR 764/PHY 764 Advances in Gastrointestinal Pathophysiology (3 credit hours)
This course will focus on advanced gastrointestinal physiology and the pathophysiology of diseases of relevance to scientists involved in animal-related research. In particular, the course will cover the pathophysiology of ulceration, infectious diarrhea, ischemia, motility disorders, and inflammatory diseases of the gut. An in-depth review paper will be required based on recent literature regarding a specific gastrointestinal disease.

Prerequisite: PHY 503, PHY 504

**Typically offered in Fall only**

### CBS 770 Cell Biology (3 credit hours)
Advanced cell and organelle structure and function and recent advances in molecular biology. Emphasis on current literature and application of research procedures.

Prerequisite: BCH 451 and BIO 183 and (CH 223 or CH 227)

**Typically offered in Spring only**

### CBS 771/TOX 771 Cancer Biology (4 credit hours)
A comprehensive graduate course focusing on the molecular and cellular bases of cancer. Targets of oncogenic mutations will be discussed as well as their impact on cell proliferation, cell survival, and the invasion of normal tissues by tumorigenic cells. State-of-the-art technologies to detect oncogenic mutations and characterize transformed cells will be discussed as well as therapeutic strategies for the rational treatment of cancer.

Prerequisite: CBS 770

**Typically offered in Fall only**

### CBS 773 Advanced Developmental Biology (2 credit hours)
In-depth coverage of current concepts and new research technologies in developmental biology. Biochemical aspects of germ cell maturation and early development, molecular and genetic regulation of morphogenesis, cellular interaction for organogenesis, hormones and growth factors mediated cellular differentiation and growth, molecular basis of neoplasia, apoptosis and gene therapy.

**Typically offered in Fall and Spring**

### CBS 774 Epidemiology Of Infectious Diseases Of International Importance (3 credit hours)
Discussion of infectious diseases and epidemiological principles. Stress on selected enteric, zoonotic, nosocomial diseases of worldwide importance. Consideration of population dynamic techniques related to host-vector-agent.

**Typically offered in Fall only**

### CBS 780 Veterinary Production Epidemiology (2 credit hours)
Examination of tools, limits, advantages and disadvantages specific to veterinary epidemiology and its execution. Assessment of means of disease prevention and outbreak investigation; mathematical simulation and economics; plus monitoring and evaluation of disease control programs; use of a multiple-species orientation. Application of the above epidemiologic techniques and their roles in assisting producers, practitioners and regulators.

**Typically offered in Spring only**
CBS 783/IMM 783/MB 783  Advanced Immunology  (3 credit hours)
In depth study of the basic cellular and molecular mechanisms of immunity, including antigen processing and presentation, T cell development, initiation of the immune response, effector mechanisms, and immunological memory. The course is designed for advanced graduate students who wish to focus on the current concepts in immunology.

Prerequisite: MB (IMM) 751
Typically offered in Fall only

CBS 785  Advanced and Molecular Pharmacology  (2 credit hours)
A course for graduate students providing a comprehensive investigation of current topics in Pharmacology with an emphasis on molecular and cellular approaches in lecture and discussion formats. Faculty will introduce each subject area and students will read recent articles, present seminars, and write professional-grade papers.

Prerequisite: CBS 762

CBS 787  Pharmacokinetics  (3 credit hours)
Mathematical models to describe disposition of drugs and toxic chemicals in the animal body. Areas including classic compartmental and nonlinear models as well as physiological approaches. Discussion of application of these techniques to toxicologists.

Prerequisite: CBS 560, working knowledge of calculus
Typically offered in Fall only

CBS 795  Special Topics in Comparative Biomedical Sciences  (1-6 credit hours)
Special Topics in Comparative Biomedical Sciences

Prerequisite: Graduate Students, DVM or equivalent degree

CBS 800  CBS Seminar  (1 credit hours)
Presentation and discussions on ongoing research and current topics in biomedical sciences.

Typically offered in Fall only

CBS 803  Seminar in Surgical Pathology  (1 credit hours)
Description and interpretation of microscopic changes in tissues from diseased domestic and laboratory animals. Students attend and participate in a one-hour weekly seminar where microscopic lesions described, interpreted and discussed.

Prerequisite: Those holding the DVM or equivalent degree
Typically offered in Fall and Spring

CBS 804  Seminar in Necropsy Pathology  (1 credit hours)
Description and interpretation of gross changes in tissues from diseased domestic animals. Students attend daily (M-F) 15-to 30-minute review of necropsy lesions presented by a member of the graduate staff.

Prerequisite: Those holding the DVM or equivalent degree
Typically offered in Fall and Spring

CBS 805/BIO 805  Special Topics in Neuroscience  (1 credit hours)
Topics in neuroscience. This course will provide an opportunity for students to integrate and apply knowledge and skills gained from their graduate studies. Emphasis will be placed on primary literature, scientific practice, and on effective, professional communication and presentations. Topics and instructors will vary from semester to semester. Priority will initially be given to graduate students participating in the neuroscience concentration; other students with the necessary prerequisites will be admitted on a space available basis.

R: Grad Standing or Instructor Approval
Typically offered in Spring only

CBS 810  Special Topics  (1-6 credit hours)
Designed to present new or special subject matter within the scope of pathology, veterinary microbiology, morphology or pharmacology. The studies may include independent investigations, seminars and/or formal lectures.

Prerequisite: Senior standing or Graduate standing
Typically offered in Fall, Spring, and Summer

CBS 812  Special Topics Pathology  (1-6 credit hours)
Specific topics of study assigned in various laboratories involved in veterinary microbiology investigation. Students conduct in-dept studies of assigned problem areas.

Prerequisite: Those holding the DVM degree
Typically offered in Fall and Spring

CBS 813  Special Topics Laboratory Pharmacology  (1-6 credit hours)
Involvement in practical participation in the normal research activities of different laboratories working in pharmacological research. Students pursue a semi-independent project.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

CBS 816  Advanced Topics In Immunology  (1 credit hours)
Selected topics of current interest in immunology. A different topic will be covered each semester to focus on the most recent developments in the field.

Typically offered in Fall and Spring

CBS 817  Advanced Topics In Zoological Medicine I  (2 credit hours)
Selected topics of current interest in clinical zoological medicine focused on marine mammals, fish, reptiles, amphibians, waterfowl, rats, raptors and medical issues in free-ranging wildlife. Review of current clinical and basic science literature, student-lead discussion sessions and participation in faculty-lead discussions.

Prerequisite: Graduate standing or enrollment in DVM curriculum
Typically offered in Fall only
CBS 818 Advanced Topics in Zoological Medicine (2 credit hours)  
This course provides breadth and depth of knowledge in zoological medicine to prepare Zoological Medicine residents to pass American College of Zoological Medicine (ACZM) boards. Veterinary students are exposed to more in depth information related to zoological medicine than covered in their core curriculum. Each Fall (CBS 817) and Spring (CBS 818) semesters, different aspects of zoological medicine are covered. Topics rotate every 3 years so that all major groups of animals within the sub-groups, avian, aquatic, herptile, wildlife, and zoo are addressed.

Prerequisite: Graduate standing or enrollment in DVM curriculum  
Typically offered in Spring only

CBS 820 Special Problems (1-6 credit hours)  
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in CBS.

Typically offered in Fall and Spring

CBS 885 Doctoral Supervised Teaching (1-3 credit hours)  
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student  
Typically offered in Fall, Spring, and Summer

CBS 890 Doctoral Preliminary Examination (1-9 credit hours)  
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student  
Typically offered in Fall, Spring, and Summer

CBS 893 Doctoral Supervised Research (1-9 credit hours)  
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student  
Typically offered in Fall, Spring, and Summer

CBS 895 Doctoral Dissertation Research (1-9 credit hours)  
Dissertation research.

Prerequisite: Doctoral student  
Typically offered in Fall, Spring, and Summer

CBS 896 Summer Dissertation Research (1 credit hours)  
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student  
Typically offered in Summer only

CBS 899 Doctoral Dissertation Preparation (1-9 credit hours)  
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student  
Typically offered in Fall, Spring, and Summer

Comparative Literature (CL)

CL 495 Special Topics in Comparative Literature (3 credit hours)  
Detailed investigation of a topic in comparative literature. Topic and mode of study determined by faculty member(s) in consultation with Comparative Literature Committee and heads of departments of English and Foreign Languages.

Computer Science (CSC)

CSC 110 Computer Science Principles - The Beauty and Joy of Computing (3 credit hours)  
This course explores the principles of computer science while emphasizing the relevance of computing to students and to society. Students will learn about beautiful computing applications that have changed the world and how computing empowers discovery and innovation. Students will learn the joy of programming a computer using a friendly, graphical language, capable of creating apps, simulations, and games. Students who complete the course will be able to solve meaningful problems with computers, apply design processes to take an idea from concept to implementation, develop a computer program, and analyze computing artifacts from both design and computing perspectives. Students will complete a substantial team programming project related to their interests. 20% of seats will be restricted to Computer Science or CS-Intended students. Enrolling students must not have received credit for or a grade in CSC 116 or CSC 200.

Restriction: Cannot have taken CSC 111 or CSC 112 or CSC 113 or CSC 114 or CSC 116 or CSC 200  
GEP Interdisciplinary Perspectives  
Typically offered in Fall and Spring

CSC 111 Introduction to Computing: Python (3 credit hours)  
Computation problem solving through writing Python programs. Particular elements include: careful development of Python programs from specifications; documentation and style; appropriate use of control structures, data types and subprograms; abstractions and verification; engineering applications. Most seats reserved for Civil, Construction, and Environmental Engineering majors.

Co-requisite: E 115 or COS 100 and MA 121 or MA 131 or MA 141  
Typically offered in Fall and Spring

CSC 112 Introduction to Computing-FORTRAN (3 credit hours)  
Problem solving through writing FORTRAN programs. Particular elements include: careful development of FORTRAN programs from specifications; documentation and style; appropriate use of control structures, data types and subprograms; abstractions and verification; engineering applications.

Co-requisite: E 115 or COS 100 and MA 121 or MA 131 or MA 141  
Typically offered in Fall, Spring, and Summer

CSC 113 Introduction to Computing - MATLAB (3 credit hours)  
Problem solving through writing MATLAB programs. Particular elements include: careful development of MATLAB programs from specifications; documentation and style; appropriate use of control structures, data types and subprograms; abstractions and verification; engineering applications. Most seats reserved for Aerospace, Mechanical, and Biomedical Engineering majors.

Co-requisite: E 115 or COS 100 and MA 121 or MA 131 or MA 141  
Typically offered in Fall and Spring
CSC 116 Introduction to Computing - Java (3 credit hours)
An introductory course in computing in Java. Emphasis on algorithm
development and problem solving. Careful and methodical development
of Java applications from specifications; documentation and style;
appropriate use of control structures; classes and
Co-requisite: E 115 or COS 100 and MA 121 or MA 131 or MA 141
Typically offered in Fall, Spring, and Summer

CSC 200 Introduction to Computers and Their Uses (3 credit hours)
Survey of basic principles of computer hardware, communications,
operating systems, microcomputer issues, security, impact on society,
system development, and use in organizations. Hands-on use of
software, including operating system commands, wordprocessing,
spreadsheets, and database managers. Demonstration and application
of current end-user applications. May not be used by CSC major as a
restricted elective.

Typically offered in Fall, Spring, and Summer

CSC 216 Software Development Fundamentals (3 credit hours)
The second course in computing, intended for majors and minors.
Emphasis is on exploring encapsulation; polymorphism; composition;
inheritance; finite state machines; linear data structures (including array
lists, linked lists, stacks, queues, and the tradeoffs in implementation);
and recursion (including recursive linked lists) in the context of the
software development lifecycle including the processes and practices for
designing, implementing, and testing high quality software.
Prerequisite: CSC 116 with a grade of C or better; Corequisite: CSC 217
Typically offered in Fall, Spring, and Summer

CSC 217 Software Development Fundamentals Lab (1 credit hours)
Laboratory course to accompany CSC 216 lecture course. Application
of the software processes and practices to design, implement, and test
the development of software solutions requiring composition; inheritance;
finitate state machines; and linear data structures, including recursive
linked lists.
Prerequisite: CSC 116 with a C or better; Corequisites: CSC 216
Typically offered in Fall, Spring, and Summer

CSC 226 Discrete Mathematics for Computer Scientists (3 credit
hours)
Propositional logic and the predicate calculus. Logic gates and circuits.
Recursive definitions and algorithms. Solving recurrences. The
analysis of algorithms and asymptotic growth of functions. Elementary
combinatorics. Introduction to graph theory. Ordered sets, including
posets and equivalence relations. Introduction to formal languages and
automata. Most seats reserved for CSC and CPE major and Computer
Programming minors.

Typically offered in Fall, Spring, and Summer

CSC 230 C and Software Tools (3 credit hours)
Details of C programming as compared with Java; Lexical structure,
syntax, semantics, and pragmatics (idioms, common uses) of C; Stages
of compilation, linking and execution; Strings, arrays, structures, pointers,
and memory management; C libraries; Tools for design, maintenance, and
debugging of programs; Separate compilation, modular programming;
Integrated development environments.
Prerequisite: CSC 216 with a C or better.
Typically offered in Fall, Spring, and Summer

CSC 236 Computer Organization and Assembly Language for
Computer Scientists (3 credit hours)
Computer architecture topics required by professional software
developers, including binary and hexadecimal numbers, hardware
component organization, machine instruction sets, assembler language
programming, linking assembler language with high-level languages,
program testing, computer hardware design issues, computer software
design issues, and trends in current computer design.
Prerequisite: CSC 230 or ECE 209
Typically offered in Fall, Spring, and Summer

CSC 246 Concepts and Facilities of Operating Systems for
Computer Scientists (3 credit hours)
Fundamental concepts of computer operating systems for computer
scientists, including memory management, file systems, process
management, distributed systems, deadlocks, and basic security and
system accounting.
Prerequisite: CSC 230 or ECE 209; Corequisite CSC 236 or ECE 109
Typically offered in Fall, Spring, and Summer

CSC 251 Web Page Development (1 credit hours)
Syntax and semantics of HTML (HyperText Markup Language). Students
will learn necessary skills to develop web pages on their EOS/Unity
account. In addition to mechanics, design aspects and bandwidth
conservancy are covered. Several pages will be created including a final
project.
Prerequisite: E 115 or equivalent knowledge of EOS/Unity system
Typically offered in Spring only

CSC 255 String Processing Languages (1 credit hours)
Syntax and semantics of a string manipulation language, currently
SNOBOL 4. Application of the language to programming problems in
non-numeric areas. Discussion of other string processing languages such
as PERL.
Prerequisite: Programming knowledge
Typically offered in Fall only

CSC 281 Foundations of Interactive Game Design (3 credit hours)
Surveys history, technology, narrative, ethics, and design of interactive
computer games. Work in teams to develop novel game designs and
computer games. Introduction to the interplay of narrative, technology,
rule systems, play and culture in the creation of interactive games.
Programming experience not required. Enrollment restricted to students
with at least sophomore status.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

CSC 295 Special Topics in Computer Science (1-3 credit hours)
Special topics in CSC at the early undergraduate level.

CSC 302 Introduction to Numerical Methods (3 credit hours)
Numerical computations with digital computers; floating point arithmetic
and implications of round-off error. Algorithms and computer techniques
for the numerical solution of problems in: function evaluation; zeros of
functions; interpolation; numerical
Prerequisite: CSC 116 with a grade of C or higher and MA 305 or MA 405
Typically offered in Fall only
CSC 316 Data Structures and Algorithms (3 credit hours)
Abstract data types; abstract and implementation-level views of data types. Linear and branching data structures, including stacks, queues, trees, heaps, hash tables, graphs, and others at discretion of instructor. Best, worst, and average case asymptotic time and space complexity as a means of formal analysis of iterative and recursive algorithms.
Prerequisite: CSC 216 with a grade of C or better and (CSC 226 or MA 225) with a grade of C or better
Typically offered in Fall, Spring, and Summer

CSC 326 Software Engineering (4 credit hours)
Application of software engineering methods to develop complex products, including the following skills: quality assurance, project management, requirements analysis, specifications, design, development, testing, production, maintenance, security, privacy, configuration management, build systems, communication, and teaming.
Prerequisite: CSC 230 or ECE 209 and CSC 316 or ECE 309
Typically offered in Fall and Spring

CSC 333 Automata, Grammars, and Computability (3 credit hours)
Study of three classical formal models of computation--finite state machines, context-free grammars, and Turing machines--and the corresponding families of formal languages. Power and limitations of each model. Parsing. Non-determinism. The Halting Problem and undecidability. The classes P and NP, and NP-completeness.
Prerequisite: Grade of C or better in either MA 225 or CSC 226
Typically offered in Fall, Spring, and Summer

CSC 342 Applied Web-based Client-Server Computing (3 credit hours)
This course explores client-server computing on the World Wide Web. The course focuses on the architecture of web-based client-server applications and accepted industry practices. Students work in teams to develop web applications with dynamic content
Prerequisite: Grade of C or better in CSC 216

CSC 379 Ethics in Computing (1 credit hour)
Discussion of the concern for the way in which computers pose new ethical questions or pose new versions of standard moral problems and dilemmas. Study of ethical concepts to guide the computer professional. Computer professional codes of ethics. Use of
Requirement: Junior Standing
Typically offered in Fall and Spring

CSC 401 Data and Computer Communications Networks (3 credit hours)
This course provides an introduction to fundamental concepts in the design and implementation of computer networks, their protocols, and applications with a particular emphasis on the Internet's TCP/IP, OSPF/BGP, Ethernet, IEEE 802.11 protocol suite. Topics to be covered include: network architectures, packet/circuit switching, network applications, sockets, reliable data transport, flow control, congestion control, routing, link protocols, addressing, local area networks, wireless networks, mobility, management, network security, software defined networking and the design of network services. Credit is not allowed for both CSC 401 and ECE 407.
Prerequisite: ST 370 and CSC 246
Typically offered in Fall, Spring, and Summer

CSC 402 Networking Projects (3 credit hours)
Through a series of hands-on networking labs, students will gain experience in practical topics such as network configuration, troubleshooting, and static and dynamic routing. The course prepares students sufficiently for an industry certification.
Prerequisite: CSC 401
Typically offered in Spring only

CSC 405 Computer Security (3 credit hours)
Basic concepts and techniques in information security and management such as risks and vulnerabilities, applied cryptography, program security, malicious software, authentication, access control, operating systems security, multilevel security, trusted operating systems, database security, inference control, physical security, and system assurance and evaluation. Coverage of high-level concepts such as confidentiality, integrity, and availability applied to hardware, software, and data.
Prerequisite: CSC 246
Typically offered in Spring only

CSC 406/CSC 506/ECE 506/CSC 406 Architecture Of Parallel Computers (3 credit hours)
The need for parallel and massively parallel computers. Taxonomy of parallel computer architecture, and programming models for parallel architectures. Example parallel algorithms. Shared-memory vs. distributed-memory architectures. Correctness and performance issues. Cache coherence and memory consistency. Bus-based and scalable directory-based multiprocessors. Interconnection-network topologies and switch design. Brief overview of advanced topics such as multiprocessor prefetching and speculative parallel execution. Credit is not allowed for more than one course in this set: ECE 406, ECE 506, CSC 406.
Typically offered in Fall and Spring

CSC 411 Introduction to Artificial Intelligence (3 credit hours)
Overview and definitions of Artificial Intelligence (AI). Search, including depth-first and breadth-first techniques with backtracking. Knowledge representation with emphasis on logical methods, Horn databases, resolution, quantification, unification, skolemization and control issues; non-monotonic reasoning; frames; semantic nets. AI systems, including planning, learning, natural language and expert systems. An AI programming language may be taught at the instructor's discretion.
Prerequisite: CSC 316 or ECE 309
Typically offered in Spring only

CSC 412/CSC 512 Compiler Construction (3 credit hours)
The course will concentrate on the theory and practice of compiler-writing. Topics to be covered will include techniques for parsing, code generation, and optimization. Furthermore, the theoretical underpinnings of compilers such as LR parsing will be covered. Finally, the students will be exposed to compiler construction tools, and will obtain hands-on experience in building a compiler for a small programming language. Besides the listed prerequisite courses, other helpful courses include CSC 253, CSC 224, CSC 234, and MA 121.
Prerequisites: Graduate standing and CSC 316 and CSC 333 or equivalent classes.
Typically offered in Fall only
CSC 414/CSC 514/MA 414/MA 514  Foundations of Cryptography  (3 credit hours)
Cryptography is the study of mathematical techniques for securing digital information, systems and distributed computation against adversarial attacks. In this class you will learn the concepts and the algorithms behind the most used cryptographic protocols: you will learn how to formally define security properties and how to formally prove/disprove that a cryptographic protocol achieves a certain security property. You will also discover that cryptography has a much broader range of applications. It solves absolutely paradoxical problems such as proving knowledge of a secret without ever revealing the secret (zero-knowledge proof), or computing the output of a function without ever knowing the input of the function (secure computation). Finally, we will look closely at one of the recent popular application of cryptography: the blockchain technology. Additionally, graduate students will study some of the topics in greater depth.
Prerequisite: (CSC 226 AND CSC 333) OR MA 225
Typically offered in Fall only

CSC 415  Software Security  (3 credit hours)
Introduces students to the discipline of designing, developing, and testing secure and dependable software-based systems. Students will learn about risks and vulnerabilities, and effective software security techniques. Topics include common vulnerabilities, access control, information leakage, logging, usability, risk analysis, testing, design principles, security policies, and privacy. Project required.
Corequisite: CSC 326
Typically offered in Fall only

CSC 416/MA 416  Introduction to Combinatorics  (3 credit hours)
Basic principles of counting: addition and multiplication principles, generating functions, recursive methods, inclusion-exclusion, pigeonhole principle; basic concepts of graph theory: graphs, digraphs, connectedness, trees; additional topics from: Polya theory of counting, Ramsey theory; combinatorial optimization - matching and covering, minimum spanning trees, minimum distance, maximum flow; sieves; Mobius inversion; partitions; Gaussian numbers and q-analogues; bijections and involutions; partially ordered sets.
Prerequisite: Grade of C or better in either MA 225 or CSC 226
Typically offered in Spring only

CSC 417  Theory of Programming Languages  (3 credit hours)
Theory of programming languages with emphasis on programming language semantics and implementation issues. Formal models of syntax and semantics. Static versus dynamic scoping. Parameter passing mechanisms. Garbage collection. Programming in alternate paradigms such as applicative, functional, logic, and object-oriented programming languages.
Prerequisite: CSC 316 or ECE 309
Typically offered in Fall and Spring

CSC 422/CSC 522  Automated Learning and Data Analysis  (3 credit hours)
Introduction to the problems and techniques for automated discovery of knowledge in databases. Topics include representation, evaluation, and formalization of knowledge for discovery; classification, prediction, clustering, and association methods. Selected applications in commerce, security, and bioinformatics. Students cannot get credit for both CSC 422 and CSC 522.
Prerequisite: ST 370 and MA 305, and a grade of C- or better in either CSC 226 or LOG 201
Typically offered in Spring only

CSC 427/MA 427  Introduction to Numerical Analysis I  (3 credit hours)
Theory and practice of computational procedures including approximation of functions by interpolating polynomials, numerical differentiation and integration, and solution of ordinary differential equations including both initial value and boundary value problems. Computer applications and techniques.
Prerequisite: (MA 341 or MA 301) and (CSC 111 or CSC 112 or CSC 113 or CSC 114 or CSC 116 or MA 116 or PY 251 or ST 114 or ECE 209)
Typically offered in Fall only

CSC 428/MA 428  Introduction to Numerical Analysis II  (3 credit hours)
Computational procedures including direct and iterative solution of linear and nonlinear equations, matrices and eigenvalue calculations, function approximation by least squares, smoothing functions, and minimax approximations.
Prerequisite: (MA 305 or MA 405) and (CSC 111 or CSC 112 or CSC 113 or CSC 114 or CSC 116 or MA 116 or PY 251 or ST 114 or ECE 209)
Typically offered in Spring only

CSC 431  File Organization and Processing  (3 credit hours)
Hardware characteristics of storage devices. Basic file organizations including sequential, direct, and indexed sequential; hashing and collision resolution; perfect hashing; signatures; bloom filters; sorting and other bit level structures. Tree structures including binary search trees, B-trees, and tries. Dynamic hashing techniques. Structures including grid files. Applying file structures to practical problems.
Prerequisite: CSC 230 or ECE 209 and CSC 316 or ECE 309
Typically offered in Fall and Spring

CSC 433  Privacy in the Digital Age  (3 credit hours)
Privacy is a growing concern in our modern society. We interact and share our personal information with a wide variety of organizations, including financial and healthcare institutions, web service providers and social networks. Many times such personal information is inappropriately collected, used or shared, often without our awareness. This course introduces privacy in a broad sense, with the aim of providing students an overview of the challenging and emerging research topics in privacy. This course will expose students to many of the issues that privacy engineers, program managers, researchers and designers deal with in industry. ST 370 is recommended.
P: CSC 316
Typically offered in Spring only
CSC 450  Web Services  (3 credit hours)
Concepts, theories, and techniques for Web services. This course examines architectures for Web applications based on the classical publish, find, and bind triangle. It considers the description, discovery, and engagement of Web services. It emphasizes Web service composition. Key topics include semantics, transactions, processes, agents, quality of service, and compliance.
Prerequisite: CSC 316 or ECE 309
Typically offered in Fall only

CSC 454  Human-Computer Interaction  (3 credit hours)
A survey of concepts and techniques for user interface design and human computer interaction. Emphasizes user-centered design, interface development techniques, and usability evaluation.
Prerequisite: CSC 316 or ECE 309
Typically offered in Fall only

CSC 455  Social Computing and Decentralized Artificial Intelligence  (3 credit hours)
This course surveys the field of social computing, introducing its key concepts, paradigms, and techniques. Specific topics are selected from the following list: social media and social network analytics, sociological underpinnings, crowdsourcing and surveys, human computation, social mobilization, human decision making, voting theory, judgment aggregation, prediction markets, economic mechanisms, incentives, organizational modeling, argumentation, contracts, norms, mobility and social context, sociotechnical systems, and software engineering with and for social computing. This course incorporates ideas from diverse disciplines (including sociology, psychology, law, economics, political science, logic, statistics, philosophy, business) to provide essential background for future computer science careers in industry and research.
Prerequisite: CSC 226 and CSC 316
Typically offered in Fall only

CSC 456  Computer Architecture and Multiprocessors  (3 credit hours)
Major components of digital computers and the organization of these components into systems. Begins with single processor systems and extends to parallel systems for multiprocessing. Topics include computer organization, instruction set design, cache memory, pipelined processors, and multiprocessors. Recent developments in PC and desktop architectures are also studied.
Prerequisite: CSC 236 and CSC 316
Typically offered in Fall only

CSC 461  Computer Graphics  (3 credit hours)
Principles of computer graphics with emphasis on two-dimensional and aspects of three-dimensional raster graphics. Topics include: graphics hardware devices, lines and polygons, clipping lines and polygons to windows, graphical user interface, vectors, projections, transformations, polygon fill. Programming projects in C or C++.
Prerequisite: MA 305 or MA 405 and CSC 230 or ECE 209 and CSC 316 or ECE 309
Typically offered in Fall only

CSC 462  Advanced Computer Graphics Projects  (3 credit hours)
Principles of computer graphics with emphasis on three-dimensional graphics. Topics include: 3-D projections and transformations, curves and surfaces, color and texture, animation, visualization, and global illumination techniques. Programming project required.
Prerequisite: CSC 461
Typically offered in Spring only

CSC 467  Multimedia Technology  (3 credit hours)
Methods of creating, recording, compressing, parsing, editing and playing back on a computer the following media: sound, music, voice, graphics, images, video, and motion. Introduction to basic principles: signal processing, information theory, real-time scheduling. Also includes discussion of standards, programming tools and languages, storage and I/O devices, networking support, legal issues, user interfaces, and applications. Includes significant hands-on experience.
Prerequisite: CSC 246
Typically offered in Spring only
CSC 472 Cybersecurity Projects (3 credit hours)
Application of cybersecurity principles and basic computer science to solve a cybersecurity problem. Project with comprehensive written and oral project report is required. Enrollment is open to CSC majors only.
Prerequisite: CSC 471 and Senior Status
Typically offered in Spring only

CSC 474 Network Security (3 credit hours)
Basic concepts and techniques in information security and management such as risks and vulnerabilities, applied cryptography, authentication, access control, multilevel security, multilateral security, network attacks and defense, intrusion detection, physical security, copyright protection, privacy mechanisms, security management, system assurance and evaluation, and information warfare. Coverage of high-level concepts such as confidentiality, integrity, and availability applied to hardware, software, and data. Credit not allowed for both CSC 474 and CSC 574.
Prerequisite: CSC 230 or ECE 209
Typically offered in Fall only

CSC 481 Game Engine Foundations (3 credit hours)
An introduction to game engines, the technologies underlying computer and console game development. This course will cover engine components, architectures, and designs. Topics include asset management, resource management, event management, memory management, timelines, multithreading, network architectures, and game object models. A sequence of programming assignments will lead students through the implementation of their own game engine, which they will use to design their own game.
Prerequisite: CSC 316 or ECE 309
Typically offered in Fall only

CSC 482 Advanced Computer Game Projects (3 credit hours)
Principles of computer game development with emphasis on 3D first-person game engines. Topics include: advanced character behavior control, procedural content generation, large scale multi-player game design and infrastructure, serious games for education, training and other applications, the game production pipeline and project built on top of a commercial game engine. Consideration of the game production pipeline, including project pitches, requirements and design detail. Programming project with written and oral reporting is required. Enrollment open to CSC majors only.
Prerequisite: CSC 481
Typically offered in Spring only

CSC 484/CSC 584 Building Game AI (3 credit hours)
In this course we will examine Artificial Intelligence (AI) techniques that are used in the design of computer games. We will look at techniques for game playing as well as the design of AI opponents tasked with creating "good experiences" for players. The course will begin with a discussion of general AI, common algorithms, data structures, and representations. From there, we will cover topics in character movement, pathfinding, decision making, strategy, tactics, and learning. In a sequence of programming assignments students will create increasingly sophisticated AI implementations. Students will also critically review the projects conducted by graduate students enrolled in CSC584. CSC majors only. Students cannot get credit for both CSC 484 and CSC 584.
Prerequisite: CSC 316
Typically offered in Spring only

CSC 492 Senior Design Project (3 credit hours)
Application of software engineering principles and basic computer science to the total development of a software system. Consideration of the software system design process, including requirements and design detail. Development and evaluation of a prototype accomplished through design team activity. Comprehensive written and oral project report is required. Open to CSC majors. Restricted to students with 6 hours of Computer Science Restricted Elective.
Prerequisite: CSC 326
Typically offered in Fall and Spring

CSC 495 Special Topics in Computer Science (1-6 credit hours)
Used for the following types of study: readings in the literature of computer science, introductory research projects, major computer programming projects, seminars, or new course development. Work may be done in any CSC area such as software, hardware utilization, programming languages, numerical methods or telecommunications. Departmental Approval Required.
Typically offered in Fall, Spring, and Summer

CSC 499 Independent Research in Computer Science (1-6 credit hours)
Independent investigation of a research problem under faculty supervision. Departmental Approval Required. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the
Typically offered in Fall, Spring, and Summer

CSC 501 Operating Systems Principles (3 credit hours)
Fundamental issues related to the design of operating systems. Process scheduling and coordination, deadlock, memory management and elements of distributed systems.
Prerequisite: CSC 246, CSC 316 and MA 421
Typically offered in Fall and Spring

CSC 503 Computational Applied Logic (3 credit hours)
Introduction to the conceptual and formal apparatus of mathematical logic, to mathematical concepts underlying the process of logical formalization, and to the applications of various logics across a broad spectrum of problems in computer science and artificial intelligence.
Prerequisite: CSC 333 of LOG 335 or LOG 435
Typically offered in Fall only

CSC 505 Design and Analysis Of Algorithms (3 credit hours)
Algorithm design techniques: use of data structures, divide and conquer, dynamic programming, greedy techniques, local and global search. Complexity and analysis of algorithms: asymptotic analysis, worst case and average case, recurrences, lower bounds, NP-completeness. Algorithms for classical problems including sorting, searching and graph problems (connectivity, shortest paths, minimum spanning trees).
Prerequisite: CSC 316 and CSC 226
Typically offered in Fall, Spring, and Summer
CSC 506/ECE 506/ECE 406/CSC 406  Architecture Of Parallel Computers  (3 credit hours)  
The need for parallel and massively parallel computers. Taxonomy of parallel computer architecture, and programming models for parallel architectures. Example parallel algorithms. Shared-memory vs. distributed-memory architectures. Correctness and performance issues. Cache coherence and memory consistency. Bus-based and scalable directory-based multiprocessors. Interconnection-network topologies and switch design. Brief overview of advanced topics such as multiprocessor prefetching and speculative parallel execution. Credit is not allowed for more than one course in this set: ECE 406, ECE 506, CSC 406.  
Typically offered in Fall and Spring  

CSC 510  Software Engineering  (3 credit hours)  
An introduction to software life cycle models; size estimation; cost and schedule estimation; project management; risk management; formal technical reviews; analysis, design, coding and testing methods; configuration management and change control; and software reliability estimation. Emphasis on large development projects. An individual project required following good software engineering practices throughout the semester.  
Prerequisite: CSC 316 and CSC 226  
Typically offered in Fall and Spring  

CSC 512/CSC 412  Compiler Construction  (3 credit hours)  
The course will concentrate on the theory and practice of compiler-writing. Topics to be covered will include techniques for parsing, code generation, and optimization. Furthermore, the theoretical underpinnings of compilers such as LR parsing will be covered. Finally, the students will be exposed to compiler construction tools, and will obtain hands-on experience in building a compiler for a small programming language. Besides the listed prerequisite courses, other helpful courses include CSC 253, CSC 224, CSC 234, and MA 121.  
Prerequisites: Graduate standing and CSC 316 and CSC 333 or equivalent classes.  
Typically offered in Fall only  

CSC 513  Electronic Commerce Technology  (3 credit hours)  
Exploration of technological issues and challenges underlying electronic commerce. Distributed systems; network infrastructures; security, trust, and payment solutions; transaction and database systems; and presentation issues. Project required. No Audits.  
Prerequisite: CSC 501  
Typically offered in Spring only  

CSC 514/MA 414/MA 514/CSC 414  Foundations of Cryptography  (3 credit hours)  
Cryptography is the study of mathematical techniques for securing digital information, systems and distributed computation against adversarial attacks. In this class you will learn the concepts and the algorithms behind the most used cryptographic protocols: you will learn how to formally define security properties and how to formally prove/disprove that a cryptographic protocol achieves a certain security property. You will also discover that cryptography has a much broader range of applications. It solves absolutely paradoxical problems such as proving knowledge of a secret without ever revealing the secret (zero-knowledge proof), or computing the output of a function without ever knowing the input of the function (secure computation). Finally, we will look closely at one of the recent popular application of cryptography: the blockchain technology. Additionally, graduate students will study some of the topics in greater depth.  
Prerequisite: (CSC 226 AND CSC 333) OR MA 225  
Typically offered in Fall only  

CSC 515  Software Security  (3 credit hours)  
Introduces students to the discipline of designing, developing, and testing secure and dependable software-based systems. Students will learn about risks and vulnerabilities, and effective software security techniques. Topics include common vulnerabilities, access control, information leakage, logging, usability, risk analysis, testing, design principles, security policies, and privacy. Project required.  
Prerequisite: CSC 510  
Typically offered in Fall only  

CSC 517/ECE 517  Object-Oriented Design and Development  (3 credit hours)  
The design of object-oriented systems, using principles such as the GRASP principles, and methodologies such as CRC cards and the Unified Modeling Language (UML). Requirements analysis. Design patterns Agile Methods. Static vs. dynamic typing. Metaprogramming. Open-source development practices and tools. Test-first development. Project required, involving contributions to an open-source software project.  
Prerequisite: CSC 326 or ECE 309  
Typically offered in Fall and Spring  

CSC 519  DevOps: Modern Software Engineering Practices  (3 credit hours)  
Modern software development organizations require entire teams of DevOps to automate and maintain software engineering processes and infrastructure vital to the organization. In this course, you will gain practical exposure to the skills, tools, and knowledge needed in automating software engineering processes and infrastructure. Students will have the chance to build new or extend existing software engineering tools and design a DevOps pipeline.  
Prerequisite: CSC 510 or (graduate or senior standing with at least a 3.0 GPA) and good knowledge of at least one high level programming language  
Typically offered in Fall and Spring
CSC 520 Artificial Intelligence I (3 credit hours)
Introduction to and overview of artificial intelligence. Study of AI programming language such as LISP or PROLOG. Elements of AI problem-solving technique. State spaces and search techniques. Logic, theorem proving and associative databases. Introduction to knowledge representation, expert systems and selected topics including natural language processing, vision and robotics.
Prerequisite: CSC 316 and either CSC 226 or LOG 201 or LOG 335 or background in symbolic logic
Typically offered in Fall and Spring

CSC 522/CSC 422 Automated Learning and Data Analysis (3 credit hours)
Introduction to the problems and techniques for automated discovery of knowledge in databases. Topics include representation, evaluation, and formalization of knowledge for discovery; classification, prediction, clustering, and association methods. Selected applications in commerce, security, and bioinformatics. Students cannot get credit for both CSC 422 and CSC 522.
Prerequisite: ST 370 and MA 305, and a grade of C- or better in either CSC 226 or LOG 201
Typically offered in Fall and Spring

CSC 530 Computational Methods for Molecular Biology (3 credit hours)
Computer algorithms supporting genomic research: DNA sequence comparison and assembly, hybridization mapping, phylogenetic reconstruction, genome rearrangement, protein folding and threading.
Prerequisite: CSC 316, Corequisite: CSC 505
Typically offered in Fall only

CSC 533 Privacy in the Digital Age (3 credit hours)
Privacy is a growing concern in our modern society. We interact and share our personal information with a wide variety of organizations, including financial and healthcare institutions, web service providers and social networks. Many times such personal information is inappropriately collected, used or shared, often without our awareness. This course introduces privacy in a broad sense, with the aim of providing students an overview of the challenging and emerging research topics in privacy. This course will expose students to many of the issues that privacy engineers, program managers, researchers and designers deal with in industry. ST 370 is recommended but not mandatory.
Prerequisite: CSC 316
Typically offered in Fall only

CSC 540 Database Management concepts and Systems (3 credit hours)
Advanced database concepts. Logical organization of databases: the entity-relationship model; the relational data model and its languages. Functional dependencies and normal forms. Design, implementation, and optimization of query languages; security and integrity, concurrency control, transaction processing, and distributed database systems.
Prerequisite: CSC 316
Typically offered in Fall and Spring

CSC 541 Advanced Data Structures (3 credit hours)
Complex and specialized data structures relevant to design and development of effective and efficient software. Hardware characteristics of storage media. Primary file organizations. Hashing functions and collision resolution techniques. Low level and bit level structures including signatures, superimposed coding, disjoint coding and Bloom filters. Tree and related structures including AVL trees, B*trees, tries and dynamic hashing techniques.
Prerequisite: CSC 316
Typically offered in Spring only

CSC 546/ISE 546 Management Decision and Control Systems (3 credit hours)
Planning, design, and development and implementation of comprehensive computer-based information systems to support management decisions. Formal information systems principles; information requirements analysis; knowledge acquisition techniques; information modeling. Information resource management for quality operational control and decision support; system evaluation, process improvement and cost effectiveness.
Prerequisite: CSC 423 or BUS 541
Typically offered in Fall only

CSC 547/ECE 547 Cloud Computing Technology (3 credit hours)
Study of cloud computing principles, architectures, and actual implementations. Students will learn how to critically evaluate cloud solutions, how to construct and secure a private cloud computing environment based on open source solutions, and how to federate it with external clouds. Performance, security, cost, usability, and utility of cloud computing solutions will be studied both theoretically and in hands-on exercises. Hardware-, infrastructure-, platform-, software-, security-, - "as-a-service".
Prerequisites: CSC 501 and either ECE/CSC 570 or ECE/CSC 573
Typically offered in Spring only

CSC 548 Parallel Systems (3 credit hours)
Basic concepts of parallel computation; parallel programming models and algorithm design; load balancing and performance optimization; parallel I/O and high-end storage systems; high performance parallel applications.
Prerequisite: CSC 246 or CSC 451 or CSC 501
Typically offered in Fall only

CSC 554 Human-Computer Interaction (3 credit hours)
Prerequisite: CSC 316
Typically offered in Spring only
CSC 555 Social Computing and Decentralized Artificial Intelligence (3 credit hours)
This course surveys the field of social computing, introducing its key concepts, paradigms, and techniques. Specific topics are selected from the following list: social media and social network analytics, sociological underpinnings, crowdsourcing and surveys, human computation, social mobilization, human decision making, voting theory, judgment aggregation, prediction markets, economic mechanisms, incentives, organizational modeling, argumentation, contracts, norms, mobility and social context, sociotechnical systems, and software engineering with and for social computing. This course incorporates ideas from diverse disciplines (including sociology, psychology, law, economics, political science, logic, statistics, philosophy, business) to provide essential background for future computer science careers in industry and research.

Typically offered in Fall only

CSC 561 Principles of Computer Graphics (3 credit hours)
Fundamentals of the OpenGL API. 2D and 3D transformations, perspective and orthographic projection, and the mathematical foundations that underlie these concepts. Geometric primitives, clipping, depth buffering, scan conversion, and rasterization. Lighting, shadows, and texture mapping. Curves and surfaces.

Prerequisite: CSC Majors
Typically offered in Fall only

CSC 562 Introduction to Game Engine Design (3 credit hours)
This course offers an advanced discussion of topics in computer graphics, with an emphasis on rendering techniques and GPU shader programming used in computer game engine design. Students are required to implement a medium-size game program that includes modeling and rendering, 2D physics, and animation of dynamic objects. Students will learn about GPU basics, mathematics of transformations, visual appearance properties, texturing, global illumination, and toon shading in computer games.

Prerequisites: CSC 561 or CSC 461 or equivalent course from a previous university
Typically offered in Spring only

CSC 563 Visual Interfaces for Mobile Devices (3 credit hours)
The conception and creation of effective visual interfaces for mobile devices, including ideation and prototyping for useful mobile applications, the industry and architecture of mobile devices, mobile usage context, computer graphics and interfaces for mobiles, and mobile programming.

Prerequisite: CSC 554 or CSC 561
Typically offered in Spring only

CSC 565/MA 565/OR 565 Graph Theory (3 credit hours)

Prerequisite: CSC 226 or MA 351.
Typically offered in Spring only

CSC 568 Enterprise Storage Architecture (3 credit hours)
An introduction to storage systems architecture in an enterprise. Begins with a review of the individual components of a system (e.g., hard disk drives, network interfaces), and shows how to aggregate those into storage systems. Tradeoffs involving factors such as cost, complexity, availability, power and performance. Discussion of information management strategies, including data migration. Guest lectures by representatives from local industry. Students work in teams on a semester-long project.

Prerequisite: CSC 246 and CSC 401 and CSC 316
Typically offered in Spring only

CSC 570/ECE 570 Computer Networks (3 credit hours)
General introduction to computer networks. Discussion of protocol principles, local area and wide area networking, OSI stack, TCP/IP and quality of service principles. Detailed discussion of topics in medium access control, error control coding, and flow control mechanisms. Introduction to networking simulation, security, wireless and optical networking.

Prerequisite: ECE 206 or CSC 312, ST 371, CSC 258 and Senior standing or Graduate standing
Typically offered in Fall and Spring

CSC 573/ECE 573 Internet Protocols (3 credit hours)
Principles and issues underlying provision of wide area connectivity through interconnection of autonomous networks. Internet architecture and protocols today and likely evolution in future. Case studies of particular protocols to demonstrate how fund

Prerequisite: CSC/ECE 570
Typically offered in Fall, Spring, and Summer

CSC 574/ECE 574 Computer and Network Security (3 credit hours)
Security policies, models, and mechanisms for secrecy, integrity, and availability. Basic cryptography and its applications; operating system models and mechanisms for mandatory and discretionary controls; introduction to database security; security in distributed systems; network security (firewalls, IPsec, and SSL); and control and prevention of viruses and other rogue programs.

Prerequisite: (CSC 316) and (CSC 401 or CSC/ECE 570)
Typically offered in Fall and Spring

CSC 575/ECE 575 Introduction to Wireless Networking (3 credit hours)
Introduction to cellular communications, wireless local area networks, ad-hoc and IP infrastructures. Topics include: cellular networks, mobility management, connection admission control algorithms, mobility models, wireless IP networks, ad-hoc routing, sensor networks, quality of service, and wireless security.

Prerequisite: ECE/CSC 570
Typically offered in Spring and Summer
CSC 576/ECE 576 Networking Services: QoS, Signaling, Processes (3 credit hours) Topics related to networking services, signaling for setting up networking services, such as SIP and IMS, networking architectures for providing QoS for networking services, such as MPLS, DiffServ and RAC, signaling protocols for setting up QoS connections in the transport stratum, such as LDP and RSVP-TE, video-based communications, and capacity planning models for dimensioning services.

Prerequisite: CSC/ECE 570
Typically offered in Fall and Spring

CSC 577/ECE 577 Switched Network Management (3 credit hours) Topics related to design and management of campus enterprise networks, including VLAN design; virtualization and automation methodologies for management; laboratory use of open space source and commercial tools for managing such networks.

Typically offered in Fall only

CSC 579/ECE 579/OR 579 Introduction to Computer Performance Modeling (3 credit hours) Workload characterization, collection and analysis of performance data, instrumentation, tuning, analytic models including queuing network models and operational analysis, economic considerations.

Prerequisite: CSC 312 or ECE 206 and MA 421
Typically offered in Fall and Spring

CSC 580/MA 580 Numerical Analysis I (3 credit hours) Algorithm behavior and applicability. Effect of roundoff errors, systems of linear equations and direct methods, least squares via Givens and Householder transformations, stationary and Krylov iterative methods, the conjugate gradient and GMRES methods, convergence of method.

Prerequisite: MA 405; MA 425 or MA 511; high-level computer language
Typically offered in Fall only

CSC 582 Computer Models of Interactive Narrative (3 credit hours) A theoretical and practical study of the computational models supporting the creation of interactive narrative systems. Topics include basic introductions to cognitive, linguistic and film theoretic models of narrative; representations and reasoning techniques from artificial intelligence related to the creation of storylines, dialog, camera control and other features of narrative in text-based and/or 3D virtual worlds; mechanisms for controlling character behavior in multi-agent multi-user stories; and applications of these techniques ranging from interactive entertainment to educational software to training simulations.

Typically offered in Fall only

CSC 583/MA 583 Introduction to Parallel Computing (3 credit hours) Introduction to basic parallel architectures, algorithms and programming paradigms; message passing collectives and communicators; parallel matrix products, domain decomposition with direct and iterative methods for linear systems; analysis of efficiency, complexity and errors; applications such as 2D heat and mass transfer.

Prerequisite: CSC 302 or MA 402 or MA/CSC 428 or MA/CSC 580
Typically offered in Spring only

CSC 584/CSC 484 Building Game AI (3 credit hours) In this course we will examine Artificial Intelligence (AI) techniques that are used in the design of computer games. We will look at techniques for game playing as well as the design of AI opponents tasked with creating “good experiences” for players. The course will begin with a discussion of general AI, common algorithms, data structures, and representations. From there, we will cover topics in character movement, pathfinding, decision making, strategy, tactics, and learning. In a sequence of programming assignments students will create increasingly sophisticated AI implementations. Students will also critically review the projects conducted by graduate students enrolled in CSC 584. CSC majors only. Students cannot get credit for both CSC 484 and CSC 584.

Prerequisite: CSC 316
Typically offered in Spring only

CSC 591 Special Topics In Computer Science (1-6 credit hours) Topics of current interest in computer science not covered in existing courses.

Prerequisite: B average in technical subjects
Typically offered in Fall and Spring

CSC 600 Computer Science Graduate Orientation (1 credit hour) Introduction for new graduate students to (a) information about graduate program, department, and university resources, and (b) research projects conducted by CSC faculty.

Typically offered in Fall and Spring

CSC 630 Master's Independent Study (1-3 credit hours) Individual investigation of topics under the direction of member(s) of the graduate faculty.

Typically offered in Fall, Spring, and Summer

CSC 685 Master's Supervised Teaching (1-3 credit hours) Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CSC 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hour) For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CSC 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours) For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer
CSC 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CSC 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CSC 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CSC 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

CSC 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CSC 705 Operating Systems Security (3 credit hours)
Fundamentals and advanced topics in operating system (OS) security. Study OS level mechanisms and policies in investigating and defending against real-world attacks on computer systems, such as self-propagating worms, stealthy rootkits and large-scale botnets. OS security techniques such as authentication, system call monitoring, as well as memory protection. Introduce recent advanced techniques such as system-level randomization and hardware virtualization.

Prerequisite: CSC 501
Typically offered in Spring only

CSC 707 Automata, Languages and Computability Theory (3 credit hours)
Formal models of language and computation; finite automata and regular languages, pushdown automata and context-free languages, Turing machines. Relative power of models, Chomsky hierarchy. Inherent complexity of problems: undecidability, computational complexity, intractable problems.

Prerequisite: CSC 226 required, CSC 333 recommended
Typically offered in Fall only

CSC 710 Software Engineering as a Human Activity (3 credit hours)
This course addresses the human aspect of software engineering, by studying the people who practice it. Students will explore software engineering as traditionally defined, and also consider techniques that transform how we understand software engineering, such as methods from psychology and sociology. Students will study the usability of software engineering tools, the psychology of programming, performance of software developers, experimental methods in observing software engineers, distributed development and coordination, and cultural differences between software developers.

Prerequisite: CSC 510
Typically offered in Spring only

CSC 711/GIS 711 Geospatial Data Management (3 credit hours)
Data management principles and technologies for efficient implementation of geospatial applications. This course introduces students to: spatial and temporal data types, data models, geometry models, spatial predicates, spatial access methods, and spatial query processing. In addition, students will be exposed to modern data management systems for geospatial application development and data integration principles. Prior GIS programming knowledge and knowledge of database management systems and SQL is preferred.

Typically offered in Fall only

CSC 712 Software Testing and Reliability (3 credit hours)
An advanced introduction to software testing and reliability. The course is a balanced mixture of theory, practice, and application. Methods, techniques, and tools for testing software and producing reliable and secure software are used and analyzed. Software reliability growth models and techniques for improving and predicting software reliability are examined, and their practical use is demonstrated. Good knowledge of C++ or Java. Knowledge of the basics of statistics, calculus, and linear algebra.

Prerequisite: CSC 510
Typically offered in Fall only

CSC 714 Real Time Computer Systems (3 credit hours)
Design and implementation of computer systems required to provide specific response times. Structure of a real-time kernel, fixed and dynamic priority scheduling algorithms, rate monotonic scheduling theory, priority inheritance protocols, real-time benchmarks, case study of a real-time kernel.

Prerequisite: CSC 451 or CSC 501
Typically offered in Spring only

CSC 720 Artificial Intelligence II (3 credit hours)
A second course in artificial intelligence emphasizing advanced concepts of AI including logic programming, automatic programming, natural language understanding, visual perception by machine, learning and inference, intelligent computer-aided instruction, knowledge representation, robotics and other topics to be chosen by instructor. Students asked to write programs in AI programming language such as LISP and PROLOG.

Prerequisite: CSC 520
Typically offered in Spring only
CSC 722 Advanced Topics in Machine Learning (3 credit hours)
A broad range of advanced topics in machine learning, the building of computer-based systems that can adapt to their environment and learn from their own experience. Theory of learnability, technical details of various learning methods, combination of multiple methods, evaluation of methods, and related topics (at the discretion of the instructor).
Prerequisite: CSC 520
Typically offered in Fall only

CSC 724 Advanced Distributed Systems (3 credit hours)
Principles in the design and implementation of modern distributed systems; recent techniques used by real-world distributed systems such as peer-to-peer file sharing, enterprise data center, and internet search engines; state-of-the-art architectures, algorithms, and performance evaluation methodologies in distributed systems.
Prerequisite: CSC 501 or equivalent. Programming in C++ or Java in Unix environments
Typically offered in Spring only

CSC 742 Database Management Systems (3 credit hours)
Prerequisite: CSC 431 or 541
Typically offered in Spring only

CSC 743 Secure Data Management (3 credit hours)
Advanced topics in secure data management with techniques in traditional database management systems as well as in recent advances in emerging areas. Emphasis on new security issues and challenges imposed by the Internet and the Web on cross-organization data sharing and management. Example topics include XML, data management in P2P, trust management, data authorship, and the integration of security and privacy policies with information systems.
Prerequisite: CSC/ECE 574 and (CSC 440 or CSC 540). Background in databases and basic security concepts required.
Typically offered in Fall only

CSC 750 Service-Oriented Computing (3 credit hours)
Concepts, theories, and techniques for computing with services. This course examines architectures for Web applications based on the classical publish, find, and bind triangle, but formulates it at a higher level. It considers sophisticated approaches for the description, discovery, and engagement of services, especially over the Web and the Grid. This course emphasizes service composition. Key topics include semantics, transactions, processes, agents, quality of service, compliance, and trust.
Prerequisite: CSC 540: Database Management Concepts and Systems
Typically offered in Fall only

CSC 761 Advanced Topics in Computer Graphics (3 credit hours)
Understanding and discussing current advances and research topics in computer graphics. Possible topics include nonphotorealistic rendering, modeling natural phenomena, illumination and rendering techniques, model simplification, animation, visualization, graphics hardware. Learning to critique research papers from important venues in the computer graphics field. Learning to read, interpret, and present computer graphics research papers in a conference-type environment.
Prerequisite: Graduate standing in Computer Science
Typically offered in Fall only

CSC 762/OR 762/ISE 762 Computer Simulation Techniques (3 credit hours)
Basic discrete event simulation methodology: random number generators, simulation designs, validation, analysis of simulation output. Applications to various areas of scientific modeling. Simulation language such as SLAM and GPSS. Computer assignments and projects.
Prerequisite: ST 512 and a scientific programming language
Typically offered in Fall only

CSC 766 Code Optimization for Scalar and Parallel Programs (3 credit hours)
Advanced research issues in code optimization for scalar and parallel programs; program analysis, scalar and parallel optimizations as well as various related advanced topics.
Prerequisite: CSC 512, or CSC 548, or CSC 501
Typically offered in Spring only

CSC 772 Survivable Networks (3 credit hours)
Principles of network and service continuity and related metrics; the theory of network availability, survivability, and restoration; a comprehensive coverage of network architectures, protocols, algorithms, and related technology for survivability; advanced topics in network survivability; hands-on experience in the implementation of protocols and software for survivable systems and the operation of survivable networks.
Typically offered in Spring only

CSC 773/ECE 773 Advanced Topics in Internet Protocols (3 credit hours)
Cutting-edge concepts and technologies to support internetworking in general and to optimize the performance of the TCP/IP protocol suite in particular. Challenges facing and likely evolution for next generation internetworking technologies. This course investigates topics that include, but may not be limited to: Internet traffic measurement, characterization and modeling, traffic engineering, network-aware applications, quality of service, peer-to-peer systems, content-distribution networks, sensor networks, reliable multicast, and congestion control.
Prerequisite: CSC/ECE 573
Typically offered in Spring only

CSC 774/ECE 774 Advanced Network Security (3 credit hours)
A study of network security policies, models, and mechanisms. Topics include: network security models; review of cryptographic techniques; internet key management protocols; electronic payments protocols and systems; intrusion detection and correlation; broadcast authentication; group key management; security in mobile ad-hoc networks; security in sensor networks.
Prerequisite: CSC/ECE 570, CSC/ECE 574
Typically offered in Spring only
CSC 775/ECE 775 Advanced Topics in Wireless Networking (3 credit hours)
Reviews the current state of research in wireless networks, network architectures, and applications of wireless technologies; students will design, organize, and implement or simulate systems in a full-semester research project. For students with background in networking and communications who wish to explore research and development topics.
Prerequisite: ECE/CSC 575
Typically offered in Fall only

CSC 776/ECE 776 Design and Performance Evaluation of Network Systems and Services (3 credit hours)
Introduction to the design and performance evaluation of network services. Topics include top-down network design based on requirements, end-to-end services and network system architecture, service level agreements, quantitative performance evaluation techniques. Provides quantitative skills on network service traffic and workload modeling, as well as, service applications such as triple play, internet (IPTV), Peer-to-peer (P2P), voice over IP (VoIP), storage, network management, and access services.
Prerequisite: CSC(ECE) 570 and CSC(ECE) 579
Typically offered in Spring only

CSC 777/ECE 777 Telecommunications Network Design (3 credit hours)
Analytic modeling and topological design of telecommunications networks, including centralized polling networks, packet switched networks, T1 networks, concentrator location problems, routing strategies, teletraffic engineering and network reliability.
Prerequisite: CSC(ECE) 570
Typically offered in Spring only

CSC 780/MA 780 Numerical Analysis II (3 credit hours)
Approximation and interpolation, Fast Fourier Transform, numerical differentiation and integration, numerical solution of initial value problems for ordinary differential equations.
Prerequisite: MA 580
Typically offered in Spring only

CSC 791 Advanced Topics in Computer Science (1-6 credit hours)
Advanced topics of current interest in computer science not covered by existing courses.
Typically offered in Fall and Spring

CSC 801 Seminar in Computer Science (1-3 credit hours)
Faculty and graduate student research presentations and discussions centered around current research problems in Computer Science and advanced theories in these areas. Students are expected to make presentations of published works and, depending on the course credit received and their academic degree progress, present their own research results. Critical discussions of the various research approaches and results and their relationships based on the presentations and additional readings and research. Departmental Approval Required.
Prerequisite: Graduate standing
Typically offered in Fall and Spring

CSC 830 Doctoral Independent Study (1-3 credit hours)
Individual investigation of advanced topics under the direction of member(s) of the graduate faculty.
Typically offered in Fall, Spring, and Summer

CSC 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CSC 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CSC 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CSC 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research
Prerequisite: Doctoral student
Typically offered in Summer only

CSC 896 Doctoral Dissertation Preparation (1-9 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Summer only

CSC 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Cooperative Education (COP)

COP 100 Co-Op Work 1st Alt (0 credit hours)
Typically offered in Fall, Spring, and Summer

COP 101 Co-Op Work 1st Par (0 credit hours)
Typically offered in Fall, Spring, and Summer

COP 200 Co-Op Work 2nd Alt (0 credit hours)
Typically offered in Fall, Spring, and Summer

COP 201 Co-Op Work 2nd Par (0 credit hours)
Typically offered in Fall, Spring, and Summer

COP 300 Co-Op Work 3rd Alt (0 credit hours)
Typically offered in Fall, Spring, and Summer

COP 301 Co-Op Work 3rd Par (0 credit hours)
Typically offered in Fall, Spring, and Summer

COP 400 Co-Op Work 4th Alt (0 credit hours)
Typically offered in Fall, Spring, and Summer

COP 401 Co-Op Work 4th Par (0 credit hours)
Typically offered in Fall, Spring, and Summer
### Counselor Education (ECD)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
<th>Schedule</th>
<th>Prerequisites</th>
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<td>COP 500</td>
<td>Co-Op Work Graduate Alt</td>
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<td>Co-Op Work Graduate PAR</td>
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#### ECD 220 College Student Development and Peer Counseling (2 credits)
Developmental issues of young adulthood with opportunity for the acquisition of paraprofessional counseling skills and crisis intervention skills. Major consideration is given to self-awareness and values clarification through utilization of personal and group activities. Typically offered in Spring only.

#### ECD 221 Career Planning and Personal Development (3 credits)
Knowledge, attitudes, self-understanding, and skills needed to enhance career planning and foster personal development. Study of self-understanding, self-talk, goal setting, the environment, and decision making as ways to adapt more effectively to the challenges of life. Typically offered in Fall and Spring.

#### ECD 222 Sexual Violence Prevention for Peer Educators (3 credits)
This course trains students to educate their peers about sexual and relationship violence and stalking. Students will explore how this violence impacts people of varying cultures including people of color and the gay, lesbian, bisexual, and transgender community. They are taught to be social activists and learn skills to be confident and active bystanders as well as knowledgeable and effective facilitators. Topics include learning about the objectification of women and men in the media, masculinity and patriarchy, pornography, and how these all contribute to a rape culture. Upon successful completion, students will be ready to be a Movement peer educator. Student must complete application and interview process and have been approved by the instructor prior to registration in the course. Typically offered in Fall only.

#### ECD 224 Student Development and Peer Mentoring (2 credits)
For new student peer mentors of primarily African American freshmen. Relevant student development, psychology and counseling research and theory as well as shared professional experiences are presented. Class discussion, group activities, role playing, relevant readings and video are employed. Reaction papers and project are required. Prerequisite: Selection as a Peer Mentor. Typically offered in Fall only.

#### ECD 225 Foundations of Cultural Competence (3 credits)
This course engages students in the process to work effectively with diverse populations to develop cross-cultural competencies and identify culturally-appropriate strategies in the workplace and life. This course introduces multicultural and international diversity concepts while having students participate in reflective and experiential activities. Students gain an overview of historical and psychological conceptual frameworks and models for understanding cultural differences and similarities within, among, and between groups of people domestically and internationally. Sophomore standing or above. Typically offered in Fall only.

#### ECD 296 Special Topics in Education: Counselor Education (1-3 credits)
Individual or group study of special topics in professional education. The topic and mode of study are determined by the faculty member after discussion with the students. Typically offered in Fall, Spring, and Summer.

#### ECD 300 Caldwell Fellows Honors Seminar: Foundations in Self-Development (3 credits)
Students are selected as Caldwell Fellows on the basis of their potential for effective leadership. The Caldwell seminar is the foundational experience for all Fellows, grounding them the essential grounding of leadership - self-understanding. The course employs theory and practice for psychosocial development, grounding in the servant-leader philosophy of leadership, and practice in engaged social issues leadership through service-learning and reflection. Prerequisite: Caldwell Fellows Only. GEP U.S. Diversity. Typically offered in Fall only.

#### ECD 510 Orientation to Professional Counseling, Identity, and Ethics (3 credits)
This course examines (1) the purpose of counseling, (2) the historical context for counseling, (3) the basic principles of major counseling theories, and (4) the practice of counseling in various professional settings. Prerequisite: 6 credits in ED or PSY. Typically offered in Spring and Summer.

#### ECD 524 Career Counseling and Development (3 credits)
Knowledge and skills needed to: (a) provide professional career counseling to individuals and (b) design, implement and evaluate career development programs for particular groups. Theories of career development and decision making; career guidance programs in educational, agency and industrial setting; career information sources and delivery systems; and assessment in career counseling. Prerequisite: 6 credits in ED or PSY. Typically offered in Fall, Spring, and Summer.

#### ECD 525 Multicultural Counseling (3 credits)
Theory and practice of counseling culturally diverse clients. Client populations include African Americans, Asian-Americans, American Indians and Hispanics. Cultural assumptions, cultural values, counselor credibility, prejudice and racism in context of counseling. Prerequisite: Six hrs. in ED or PSY, Corequisite: ECD 530. Typically offered in Fall, Spring, and Summer.

#### ECD 530 Theories and Tech of Counseling (4 credits)
Theory, philosophy, roles, professional ethics, and techniques of counseling. Eleven major counseling approaches including behavioral, psychoanalytic, client-centered, existential, family and post-modern approaches, and related counseling strategies are discussed. Students have opportunities to practice related strategies through role-plays. Prerequisite: 6 credits in ED or PSY. Typically offered in Fall and Spring.

**GEP Global Knowledge, GEP Humanities, GEP U.S. Diversity**

Typically offered in Fall and Spring.
ECD 533  Int Sch Counseling  (4 credit hours)
An examination of the conceptual framework for the role and functions of school counselors, prevention and treatment strategies, program development and evaluation. Focus is on the school-college-community collaboration model, preparing counselors who can work effectively across different counseling settings by collaborating with other counselors and mental health professionals. Graduate standing required.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ECD 534  Guidance and Counseling In Elementary and Middle Schools  (4 credit hours)
Examination of (1) theoretical framework for roles and functions of elementary and middle school counselors, (2) primary and secondary prevention strategies and (3) evaluation and administration procedures to develop and implement model programs forelementary and middle schools.

Prerequisite: Graduate standing
Typically offered in Fall only

ECD 535  Introduction to College Counseling and Student Development  (4 credit hours)
College Counseling and student development theory, research and practice as well as overview of profession. Discussion of counselor roles, professional ethics, history, identity, and development. Instruction in and design of structured group work in laboratory.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Spring

ECD 536  Introduction to Clinical Mental Health Counseling  (4 credit hours)
Issues, functions and scope of work being done in various clinical mental health programs; overview of helping approaches with selected client populations; related professional concerns. Instruction in and design of structured group work in laboratory.

Prerequisite: Graduate Standing
Typically offered in Fall and Spring

ECD 539  Group Counseling  (3 credit hours)
Theory and practice of group counseling. Theoretical positions include client-centered, behavioral and rational-emotive. Aspects of group process include group leadership, group membership, establishing and maintaining a group.

Prerequisite: ECD 530 and one of the following: ECD 510, 534, 535 or 536
Typically offered in Fall, Spring, and Summer

ECD 540/WGS 540  Gender Issues In Counseling  (3 credit hours)
Exploration of gender as primary identity and social construct. Emphasis on gender dynamics in counseling, client empowerment and preventive approaches.

Prerequisite: Graduate standing or Six hrs. in ED or PSY
Typically offered in Summer only

ECD 541  Substance Abuse and Counseling  (3 credit hours)
This course explores counseling as it relates to working with clients with substance abuse disorders. Ethical and legal issues, theoretical models, assessment and diagnosis, treatment planning, techniques and individual/family/group interventions with diverse populations will be discussed throughout class sessions. This course is distinctively geared towards students who are training to be counselors. Substance abuse issues that clients might present within counseling are addressed by way of assigned readings, class discussions, video segments, case studies, internet resources and assignments.

Prerequisite: 6 hours of Graduate Coursework
Typically offered in Fall and Summer

ECD 542  Research in Counseling  (3 credit hours)
This introductory graduate level course in research in counseling is intended to provide students with an overview of the fundamentals of research methods and program evaluations in the field. Students will be able to identify various research approaches.

Prerequisite: 6 hours of ECD Graduate Courses
Typically offered in Fall and Summer

ECD 543  Introduction to College Counseling  (3 credit hours)
A course designed for investigation of college counseling services and strategies. Assessment and research in student development, and professionals design and implement a developmental intervention based on Knefelkamp and Wells’ Practice-to-Theory-to-Practice model.

Prerequisite: ECD 535 or Doctoral student
Typically offered in Spring only

ECD 544  Counseling Couples and Families  (3 credit hours)
This elective course explores counseling as it relates to working with couples and families. Theoretical models, techniques and interventions will be discussed throughout class sessions. This course is distinctively geared towards students who are training to be counselors. Family and couples issues that clients might present within counseling are addressed by way of class discussions, assigned readings, video segments, case studies, role plays and Internet resources.

Prerequisite: 6 hours of ECD Graduate Courses
Typically offered in Spring and Summer

ECD 546  Crisis Interventions in Counseling  (3 credit hours)
An overview of crisis intervention and theoretical models. Crisis situations are described across developmental age-span across a variety of service delivery settings. Students will develop conceptual competency for professional counselors to engage in.

Prerequisite: 6 hours of ECD Graduate Courses
Typically offered in Fall and Summer
ECD 547 Counseling Children and Adolescents (7 credit hours)
Counseling children and adolescents can be very different from working with adults. This course will explore some key developmental considerations, as well as creative approaches to working with this population (ages 0-18). Some topics that will be covered include early interventions, developmental milestones, working with parents, transitions, behavioral changes, peer relationships, sexuality, crisis counseling, ethics, advocacy, and collaborating with other professionals. In addition, common diagnoses and disorders corresponding with each stage of development will also be explored, as well as evidence-based interventions for working with each developmental stage (e.g., bibliotherapy, play therapy, music and art as adjunctive tools, behavior interventions, etc.).

Prerequisite: 6 hours of ECD Graduate Courses
Typically offered in Summer only

ECD 560 Research and Assessment in Counseling (3 credit hours)
Research and assessment issues in counseling. Emphasis on writing research proposals in counseling and critiquing articles in counseling research. Exploration of meaning and importance of assessment in counseling. Examination of research designs in counseling.

Prerequisite: Graduate standing
Typically offered in Spring and Summer

ECD 561 Strategies for Clinical Assessment in Counseling (3 credit hours)
Exploration of meaning and importance of assessment in the counseling process. The utilization of counseling assessments based on legal and ethical guidelines and cultural considerations. Identify, interpret, and explain assessments in clinical, college, and school counseling settings.

R: Graduate Students Only
Typically offered in Spring and Summer

ECD 562 Techniques in Counseling (4 credit hours)
In this course students work towards mastery of counseling skills, review relevant theories, and prepare for Practicum. Students will practice counseling skills in class and spend their out of class lab hours practicing skills in partnering schools. Students will do some limited video taping of counseling sessions and receive feedback on tapes from Counselor Education doctoral students taking their supervision theory class.

Prerequisite: ECD 530
Typically offered in Fall only

ECD 575/EDP 575 Multicultural Lifespan Development (3 credit hours)
This course surveys theories, principles, and issues of psychological development throughout the lifespan. Emphasis will be placed on understanding current developmental research and its application to the enhancement of development from birth to late adulthood. Implications for helping professionals working in multicultural contexts will be provided.

Prerequisite: Six Hours of Graduate Study
Typically offered in Fall, Spring, and Summer

ECD 590 Special Problems in Guidance (1-6 credit hours)
For individual or group studies of one or more of major problems in guidance and personnel work. Problems selected to meet interests of individuals. Workshop procedure used whereby special projects, reports and research developed by individuals and by groups.

Prerequisite: Six hrs. grad. work in dept.
Typically offered in Fall and Spring

ECD 620 Special Problems in Guidance (1-6 credit hours)
For individual or group studies of one or more of major problems in guidance and personnel work. Problems selected to meet interests of individuals. Workshop procedure used whereby special projects, reports and research developed by individuals and by groups.

Prerequisite: Six hrs. grad. work in dept.
Typically offered in Fall, Spring, and Summer

ECD 641 Introductory Practicum in Counseling (1 credit hours)
Student participation in introductory supervised individual and group counseling experiences in laboratory setting.

Prerequisite: ECD 530, 525
Typically offered in Spring only

ECD 642 Practicum in Counseling (3 credit hours)
Student participation in individual and group counseling and consultation experiences under supervision in a school, college or agency setting.
Prerequisite: 1. Completion of all ECD, PSY, and STAT courses with exception of ECD 539 Group Counseling that may be taken concurrently. [Other classes that could be taken concurrently PSY 535, 582, 584, 475, 476] 2. Consent of concentration coordin

Prerequisite: ECD 641
Typically offered in Spring only

ECD 651 Internship in School Counseling (6-12 credit hours)
A 600-hour internship for school counselors in training in a school setting under the supervision of qualified professionals. Students perform a variety of activities expected of school counselors. Weekly meetings with faculty and on-site supervisors.

Prerequisite: ECD 642
Typically offered in Fall and Spring

ECD 652 Internship in College Counseling and Student Development (6-12 credit hours)
A 600-hour internship. Professional experience in student affairs department with on-site supervision from qualified professional. Expectations including employment of broad repertoire of skills in roles of counselor, student development educator and administrator. Weekly student meetings with faculty and on-site supervisors.

Prerequisite: ECD 642
Typically offered in Fall and Spring

ECD 653 Internship in Clinical Mental Health Counseling (6-12 credit hours)
A 600-hour internship for community agency counselors in agency counseling setting under supervision of qualified professional. Employment of broad repertoire of primary and secondary prevention approaches to individual and group techniques, workshop leadership skills, consultation techniques and advocacy methods. Weekly meetings with faculty and on-site supervisors.

Prerequisite: ECD 642
Typically offered in Fall and Spring
ECD 692 Research Projects in Counselor Education (1-3 credit hours)
Project or problem in research in education for graduate students, supervised by members of graduate faculty. Research chosen on basis of individual students’ interests and not to be part of thesis or dissertation research.
Prerequisite: ELC 532
Typically offered in Fall, Spring, and Summer

ECD 693 Master’s Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master’s student
Typically offered in Fall and Spring

ECD 695 Master’s Thesis Research (1-9 credit hours)
Thesis research.
Prerequisite: Master’s student
Typically offered in Summer only

ECD 699/ECI 699/ELP 699/EMS 699/EOE 699/EAC 699 Master’s Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master’s degree and are writing and defending their theses.
Prerequisite: Master’s student
Typically offered in Fall and Spring

ECD 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master’s student
Typically offered in Summer only

ECD 733 Cognitive-Behavioral Theory, Research, and Practice (3 credit hours)
Behavioral and cognitive behavioral change methods and research supporting their efficacy in counselor education. Major focus on synthesis of cognitive-developmental and cognitive-behavioral methods.
Prerequisite: ECD 737, Corequisite: ST 700
Typically offered in Spring only

ECD 735 Counseling Supervision: Theory and Research (3 credit hours)
Examination of conceptual and methodological issues relating to supervision and evaluation of novice counselors. Special emphasis on developmental supervision approaches.
Prerequisite: Doctoral student
Typically offered in Fall only

ECD 736 Advanced Assessment in Counseling (3 credit hours)
Doctoral students will have learning experiences beyond the entry-level master’s degree models and methods of assessment. Content focuses on advanced applications of assessment principles in clinical counseling and supervision practice, program evaluation, and outcome and action research studies. Students will demonstrate mastery of foundations of tests and measurement, present advanced assessment content modules during class sessions, and present documented and oral reports on personal quests for advanced knowledge in chosen assessment domains.
Prerequisite: PSY 535 or equivalent
Typically offered in Fall only

ECD 737 Cognitive Developmental Theory, Research and Practice (3 credit hours)
Prerequisite: Doctoral student : PSY 535, ST 507, Corequisite: ST 508
Typically offered in Fall only

ECD 738 Research in Counselor Education (3 credit hours)
Instruction in required skills and knowledge to conduct research in counselor education, including narrative and quantitative integration of research, experimental and quasi-experimental designs, analogue and process research, single subject and descriptive designs, and qualitative research. Preparation of narrative and meta-analytic research review and research proposal with oral presentation.
Prerequisite: Doctoral student : ST 507; PSY 535, Corequisite: ST 508
Typically offered in Spring only

ECD 740 Advanced Psycho-Social Identity Development: Race, Gender, and Culture (3 credit hours)
Meanings and intersections of gender, race and culture. Advanced theories and research related to counseling practice. Sexuality, disability and class and implications for counseling. Case study, personal narratives and video segments expand on course readings.
Prerequisite: ECD 540; ECD 525 ; Post-master’s degree students
Typically offered in Fall and Spring
ECD 790 Special Problems in Guidance (1-6 credit hours)
For individual or group studies of one or more of major problems in guidance and personnel work. Problems selected to meet interests of individuals. Workshop procedure used whereby special projects, reports and research developed by individuals and by groups.
Prerequisite: Six hrs. grad. work in dept.
Typically offered in Fall, Spring, and Summer

ECD 820 Special Problems in Guidance (1-6 credit hours)
For individual or group studies of one or more of major problems in guidance and personnel work. Problems selected to meet interests of individuals. Workshop procedure used whereby special projects, reports and research developed by individuals and by groups.
Prerequisite: Six hrs. grad. work in dept.
Typically offered in Fall, Spring, and Summer

ECD 843 Advanced Counseling Practicum (4 credit hours)
Participation of doctoral-level students with previous counseling experience in advanced, supervised counseling experience.
Prerequisite: Doctoral student, ECD 642
Typically offered in Fall, Spring, and Summer

ECD 847 Internship in Supervision (4 credit hours)
A supervised internship for doctoral students in assisting with the supervision of first-year students in laboratory and practicum experiences in individual and group counseling and consultation. This is a doctoral-level in-depth internship in the group and individual supervision designed to examine conceptual and methodological issues related to the supervision and evaluation of novice counselors. It is the second part of a two-course sequence devoted to the supervision of counseling. This course has two components: (1) doctoral group supervision sessions, and (2) doctoral individual supervision sessions.
Prerequisite: ECD 735
Typically offered in Spring only

ECD 850 Doctoral Internship (1-9 credit hours)
Utilizing participant-observer role, participation required in selected educational situations with emphasis upon development of observational skills, ability to record relevant observations by means of written journals, skills in analyzing experiences identifying critical incidents and projection of events and consequences. Student required to develop possible alternative courses of action in various situations, select one of the alternatives and evaluate consequences.
Prerequisite: Nine hrs. in grad. level courses
Typically offered in Fall, Spring, and Summer

ECD 860 Professional Issues in Counseling (1-3 credit hours)
Consideration of contemporary issues, trends and recent research in field of counseling.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

ECD 886 Internship in Teaching in Counselor Education (4 credit hours)
Using the participant-observer role, this course requires participation in selected educational situations with emphasis upon development of observational skills, ability to record relevant observations by means of written journals, skills in analyzing counseling and teaching experiences, identifying critical incidents in counseling and teaching, and predicting consequences of counseling and teaching interventions.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ECD 892 Doctoral Research Projects (1-3 credit hours)
Project or problem in research in education for graduate students, supervised by members of graduate faculty. Research chosen on basis of individual students’ interests and not to be part of thesis or dissertation research.
Typically offered in Fall, Spring, and Summer

ECD 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ECD 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ECD 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Summer only

ECD 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Crop Science (CS)

CS 101 Field Crop and Turfgrass Management Orientation (1 credit hours)
Introduction to NCSU and the Agricultural Institute with an emphasis on areas related to Field Crops Technology and Turfgrass Management. Students will explore university, college, and departmental resources, academic policies and procedures, career opportunities, and current trends and issues in our related disciplines. Students cannot receive credit for both CS 10 and AGI 10. FCT or TGM only.
Requisite: Agricultural Institute Only
Typically offered in Fall only
CS 111 Field Crop Production (4 credit hours)
Management of field crops, including growth and development, establishment, pest management, environmental considerations, rotations of crops and chemicals, harvesting, storage and marketing. SPEARS
Requisite: Agricultural Institute Only
Typically offered in Fall and Spring

CS 116 Agronomic Crops - Cotton, Peanuts, and Tobacco (3 credit hours)
Fundamental agronomic practices associated with the production of cotton, peanuts, and tobacco. Discussions will include crop growth and development stages, how to choose the best varieties and hybrids, planting strategies, fertility and pest management programs, harvest and storage options, and the use of technologies associated with the production and maintenance of a quality commodity.
Restriction: AGI Only
Typically offered in Fall only

CS 118 Agronomic Crops - Corn, Small Grains and Soybeans (3 credit hours)
Fundamental agronomic practices associated with the production of corn, small grains and soybean. Discussions will include crop growth and development stages, how to choose the best varieties and hybrids, planting strategies, fertility and pest management programs, harvest and storage options, and the use of technologies associated with the production and maintenance of a quality commodity.
Restriction: AGI Only
Typically offered in Fall and Spring

CS 121 Turfgrasses and Their Uses (3 credit hours)
An introduction to turfgrass species and their uses. Emphasis on: size and scope of the turfgrass industry, basic concepts of grass growth and development, characteristics of cool- and warm-season turfgrasses and their use for golf courses, lawns, athletic fields, and other applications. Techniques for successful establishment and maintenance of turfgrass areas.
Requisite: Agricultural Institute Only
Typically offered in Fall only

CS 122 Principles of Turfgrass Management (3 credit hours)
An examination of cultural practices essential for management of high quality turfgrass areas. Topics include: function of plant nutrients, fertilizer characteristics and application techniques, irrigation programming, construction of high use turfgrass areas, calibration of spreaders and sprayers, aerification, pesticide fate and developing effective management systems. ERICKSON
Requisite: Agricultural Institute Only
Typically offered in Spring only

CS 125 Weed Control in Field Crops (3 credit hours)
Principles involved in development of weed control programs and practical application of weed management techniques for major North Carolina cropping systems. Emphasis on proper use of herbicides. Laboratory includes weed identification and herbicide application methods.
Requisite: Agricultural Institute Only
Typically offered in Fall only

CS 135 Turfgrass and Ornamental Weed Control (3 credit hours)
General principles in development of turfgrass and ornamental weed prevention and management programs. Different weeds and their life cycles and management techniques and factors affecting herbicide performance. Laboratory includes weed identification and herbicide application methods.
Requisite: Agricultural Institute Only
Typically offered in Fall only

CS 144/PP 154 Turf Weed and Disease Management (3 credit hours)
General principles in turfgrass weed and disease development and management programs. Different weeds, their life cycles, management techniques, and factors affecting herbicide application performance will be covered. Students will learn the causes, development, identification and management of turfgrass diseases. Laboratory includes weed identification and herbicide application methods. Certain laboratory exercises will require personal transportation to Lake Wheeler Road Turf Field Lab unless otherwise specified by the lab instructors. The course is restricted to AGI students only.
Requisite: Agricultural Institute Only
Typically offered in Fall only

CS 155 Advanced Turf Management (3 credit hours)
Turfgrass management covering mineral nutrition, water relations, environmental stress responses and management regimes for low maintenance turf, golf courses, athletic fields and other turf settings.
Requisite: Agricultural Institute Only; Prerequisite: CS 121 and CS 122
Typically offered in Fall only

CS 156 Flue-Cured Tobacco Production (1 credit hour)
Flue-cured tobacco production, with emphasis on crop management practices, variety selection, transplant production, integrated pest management, fertilization, harvesting and curing, competitiveness in the world market, product needs of the tobacco manufacturing industry, and the role of climate and soil on yield and quality. FISHER
Requisite: Agricultural Institute Only
Typically offered in Spring only

CS 158 Peanut Production (1 credit hour)
Principles of modern peanut production. Emphasis on the history and dispersal of peanuts, supply management programs, physiology of peanut growth and development, weed, disease, and insect management, fertility practices, recommended cultural practices including IPM, methods of maturity determination, recommended harvesting, curing, and handling practices. JORDAN
Requisite: Agricultural Institute Only
Typically offered in Fall only
CS 164 Soybean Production (1 credit hours)
Introduction to the production of soybeans in North Carolina and the southeastern United States. Growth and development, tillage, fertility, varieties, seed quality, planting decision, pest management, harvesting, production economics, marketing, environmental quality, and social responsibility. DUNPHY

Requisite: Agricultural Institute Only
Typically offered in Fall only

CS 165 Cotton Production (1 credit hours)
Cotton production, marketing, and improvement. Emphasis on current information regarding varieties, fertilization, disease, insect and weed control, cultural practices, equipment, harvesting and marketing. EDMISTEN

Requisite: Agricultural Institute Only
Typically offered in Fall only

CS 166 Corn Production (1 credit hours)
Growth, management, and markets for corn in North Carolina.

Requisite: Agricultural Institute Only
Typically offered in Spring only

CS 167 Wheat Production (1 credit hours)
Practical approach to growing wheat and other small grain crops. Topics will include growth, management, and markets for small grains in North Carolina.

Requisite: Agricultural Institute Only
Typically offered in Spring only

CS 190 Turf Seminar (1 credit hours)
Discussions of the operations, opportunities, and problems existing in various phases of the turf industry by leaders in the various facets of the industry.

Requisite: Agricultural Institute Only
Typically offered in Spring only

CS 191 Field Crops Seminar (2 credit hours)
Guest speakers, students presentations, and outside assignments will address professionalism; professional development; and current challenges, issues, and opportunities facing profitable and sustainable agronomic crop production. A grade of C or better is required. FCT Only.

Requisite: Agricultural Institute Only
Typically offered in Spring only

CS 200 Introduction to Turfgrass Management (4 credit hours)
Turfgrass selection, establishment, maintenance, and pest management in lawns, golf courses, athletic fields, and roadside care; Emphasis on understanding the impact of the environment on management practices and turfgrass performance. Field trips in laboratory.

Prerequisite: BIO 181(preferred) or ZO 160(alternate) BO 200, or CS 213
Typically offered in Fall only

CS 210 Lawns and Sports Turf (3 credit hours)
Utilization of turfgrasses for lawns and recreational areas. Emphasis on: the cultural and environmental benefits of grassed areas, concepts of grass growth and development, selecting adapted grasses for proper use, techniques for successful establishment and management of cool- and warm-season turfgrasses, fertilization, irrigation, aeration, and pest management. The history and benefit of natural and artificial sports fields will also be discussed. Credit will not be awarded for both CS 200 and CS 210.

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

CS 211 Plant Genetics (3 credit hours)
Fundaments of plant genetics. Genetic basis for plant improvement. Genetic analysis of Mendelian traits, molecular structure and organization of genetic material, crop biotechnology, distribution and behavior of genes in populations.

Prerequisite: BIO 183 or ZO 160
Typically offered in Spring only

CS 213 Crop Science (3 credit hours)
Our basic premise is that to produce field crops successfully we must know how our crops grow and develop and what they require from the production environment - including the farmer - for satisfactory management of the relevant environment, and finally to successful yield and quality of commercially important product. Especially important is to understand the various ways in which producers must respond to ever-changing circumstances on the farm, at the bank (credit), and in the marketplace. A solid understanding of the impact of cropping history on the soil and entire ecosystem to be used for the next crop also is vitally important.

Prerequisite: BIO 181 or BIO 183 or PB 200 or PB 250
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

CS 214 Crop Science Laboratory (1 credit hours)
The laboratory's intent is to provide students enrolled in the CS 213 lecture course opportunity to apply under field and controlled environmental conditions the crop production principles introduced in the lecture course. Using a hands-on approach targeting a variety of crop management approaches, students will examine the growth and development characteristics that relate most directly to final yield and quality of the marketed product. Students will employ a spectrum of treatment combinations aimed at strengthening understanding of the interaction of genotype, environment, and management, with the goal of identifying influential factors of crop yield and quality.

"Co-requisite: CS 213"
Typically offered in Fall and Spring
CS 216 Southern Row Crop Production - Cotton, Peanuts, and Tobacco (3 credit hours)
Crop production systems comprised of cotton, peanuts, and tobacco are unique to the southern United States, and management practices tailored to a successful harvest are vastly different than those employed in the production of grain crops. CS 216 will introduce students to these production standards and provide a basic foundation for the principles of cotton, peanut, and tobacco management. At the conclusion of the course students will be able to describe growth/development patterns, tillage systems, scouting techniques, proper seed/variety selection and planting populations, provide recommendations for pest management, employ Integrated Pest Management strategies, describe harvesting practices, and give marketing approaches for each crop.

Typically offered in Fall and Spring

CS 218 Southern Row Crop Production - Corn, Small Grains and Soybeans (3 credit hours)
Fundamental agronomic practices associated with the production of corn, small grains and soybean. Discussions will include crop growth and development stages, how to choose the best varieties and hybrids, planting strategies, fertility and pest management programs, harvest and storage options, and the use of technologies associated with the production and maintenance of quality commodity.

Typically offered in Fall and Spring

CS 224 Seeds, Biotechnology and Societies (3 credit hours)
An exploration of seeds, how seeds are the delivery system for crop biotechnology and how a specific culture’s perception of science and agriculture influence the acceptance or rejections of modern genetic technologies. Topics include seed germination, survival and preservation; seed industry influence on societies and how societies are influencing the seed industry; seed production - commercially and at home; how our diverse genetic resources are preserved; how biotechnology is applied to agriculture and delivered through seeds; the impact biotech is having on the seed industry and subsequently on us and global agriculture; concerns and potential benefits of biotechnology application to crops.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

CS 230 Introduction to Agroecology (3 credit hours)
This course will examine the biological and physical attributes of farming systems and their associated ecological and social impacts in temperate and tropical regions. It will address the ecological consequences of indigenous food and fiber production systems, conventional agricultural systems and *alternative* systems that incorporate biological pest control and natural nutrient inputs. Students will examine several case studies that integrate their understanding of concepts.

Prerequisite: BIO 105 or BIO 181 or BIO/ZO 160 or BO 200 or BO 250 or HS 201 or CS 213
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

CS 312 Grassland Management for Natural Resources Conservation (3 credit hours)
Basic principles and practices of production and utilization of pasture and forage crops; impact on developing sustainable systems for livestock feed, soil and water conservation; use of computers to assist in whole farm planning and information retrieval.

Prerequisite: BIO 181(preferred) or ZO 160(alternate) CS 213, SSC 200
Typically offered in Spring only

CS 400 Turf Cultural Systems (3 credit hours)
Topics include: golf course design considerations, fertilizer characteristics and application techniques, irrigation programming, construction of high use turfgrass areas, calibration of spreaders and sprayers, aerification, pesticide fate and development of effective management systems.

Prerequisite: C- or better in CS 200
Typically offered in Spring only

CS 410/HS 410 Community Food Systems (3 credit hours)
This course explores the economic, socio-cultural, policy and health perspectives of community food systems using a multidisciplinary and systems-level framework. Students will use a systems framework to critically examine local and global food challenges related to food insecurity, food justice and food sovereignty, food waste and sustainable approaches to addressing food challenges. Novel aspects of this course include student experiential learning opportunities that include service learning with community partners addressing local food challenges, team building through group work and in-class discussion and development of personal food ethic provocative proposition.

Prerequisite:Junior or senior standing
Typically offered in Fall only

CS 411 Crop Ecology (3 credit hours)
Ecology and production of major agronomic crops of economic importance. Impact of key environmental stress factors on production processes and management strategies. Environmental issues pertaining to sustainable cropping systems. Manipulation of cano

Prerequisite: PB 321 or PB 421
Typically offered in Fall only

CS 413 Plant Breeding (2 credit hours)
Discussion of reproductive systems of higher plants; the genetic basis for plant improvement and the selection, evaluation, and utilization of crop varieties.

Prerequisite: CS 211 or GN 311
Typically offered in Spring only

CS 414 Weed Science (4 credit hours)
History, current status and fundamentals of weed biology and cultural, biological, and chemical weed control; properties and uses of herbicides; weed identification; proper use of herbicide application equipment; current weed management practices incrops and non-cropland situations.

Typically offered in Fall only

CS 415 Integrated Pest Management (3 credit hours)
History, principles, and application of techniques for managing plant pests. Theory and practice of integrating pest control tactics to manage pests within economic, environmental, and sociological constraints. Topics include pest monitoring methodology, economic aesthetic thresholds, biological control, efficient pesticide use, biotechnology, and global positioning systems.

Prerequisite: BIO 181(preferred) or ZO 160(alternate) or BO 200 or BO 250
Typically offered in Spring only
CS 418/CS 518 Introduction to Regulatory Science in Agriculture (3 credit hours)
This course covers laws, regulations and agencies involved in the registration of conventional, biotechnology and biological crops, crop protectants and growth regulators. US and International laws and regulations will be discussed from technical proof of concept through commercial release.

Typically offered in Fall only

CS 424/CS 524 Seed Physiology (3 credit hours)
This course will explore the physiological processes associated with seed formation, development, maturation, germination, and deterioration of agronomic and horticultural species. We will also study the physiological aspects of seed dormancy, how dormancy is manifested and overcome in cultivated and noncultivated systems and dormancy’s impact on weed seedbank ecology.

Prerequisite: PB 321 or PB 421 or FOR 303
Typically offered in Fall only

CS 428/CS 528 Advanced Regulatory Science in Agriculture (3 credit hours)
This course goes into additional depth and provides hands-on exercises concerning agriculture regulatory topics covered in CS 418/518. The course will introduce laws, regulations and agencies involved in the fertilizer, animal and waste management as well as the role of public policy in the regulatory process. CS 418/518 is a prerequisite for this class.

Prerequisite: CS 418
Typically offered in Spring only

CS 430 Advanced Agroecology (4 credit hours)
This course applies agroecological principles introduced in CS 230 and critical thinking to evaluate various agroecosystems. Students will examine food, fiber, and other commodity production systems for security, productivity, and sustainability and address the simultaneous need to protect natural environments and the biodiversity on which agroecosystems depend. Topics include discussion of national and international government policies, research programs, and education programs that influence the future application of agroecosystem principles.

P: CS 230
Typically offered in Spring only

CS 465/CS 565 Turf Management Systems and Environmental Quality (3 credit hours)
Integration of turfgrass management systems and the use of BMPs and IPM to protect environmental quality. Examination of water quality issues relative to turf. Application of Best Management Practice and Integrated Pest Management strategies. Credit c

Prerequisite: CS 400 and Senior standing
Typically offered in Fall only

CS 470/ENT 470/PP 470 Advanced Turfgrass Pest Management (2 credit hours)
Characteristics and ecology of turfgrass weed, insect, and disease pests; identification and diagnosis of turfgrass pests, strategies for managing pests including cultural, mechanical, biological, and chemical methods; development of integrated pest management programs, characteristics and modes of action for herbicides, insecticides, fungicides, and plant growth regulators; behavior and fate of pesticides in soil; and the development and management of pesticide resistant pest populations.

Prerequisite: C- or better in CS 200
Typically offered in Spring only

CS 480/HS 480 Sustainable Food Production (capstone) (1 credit hours)
This course introduces students to the process of developing a project for presentation in the area of sustainable food production and food systems. Students are to synthesize and integrate knowledge acquired in previous course work and other learning experiences.

Prerequisites: Senior standing and CS 430
Typically offered in Fall only

CS 502/HS 502/PP 502 Plant Disease: Methods & Diagnosis (2 credit hours)
Introduction to the basic principles of disease causality in plants and the methodology for the study and diagnosis of plant diseases caused by fungi. Identification of plant-pathogenic fungi. Research project, disease profiles and field trips are required.

Prerequisite: PP 315
Typically offered in Fall only

CS 518/CS 418 Introduction to Regulatory Science in Agriculture (3 credit hours)
This course covers laws, regulations and agencies involved in the registration of conventional, biotechnology and biological crops, crop protectants and growth regulators. US and International laws and regulations will be discussed from technical proof of concept through commercial release.

Typically offered in Fall only

CS 524/CS 424 Seed Physiology (3 credit hours)
This course will explore the physiological processes associated with seed formation, development, maturation, germination, and deterioration of agronomic and horticultural species. We will also study the physiological aspects of seed dormancy, how dormancy is manifested and overcome in cultivated and noncultivated systems and dormancy’s impact on weed seedbank ecology.

Prerequisite: PB 321 or PB 421 or FOR 303
Typically offered in Fall only

CS 528/CS 428 Advanced Regulatory Science in Agriculture (3 credit hours)
This course goes into additional depth and provides hands-on exercises concerning agriculture regulatory topics covered in CS 418/518. The course will introduce laws, regulations and agencies involved in the fertilizer, animal and waste management as well as the role of public policy in the regulatory process. CS 418/518 is a prerequisite for this class.

Prerequisite: CS 418
Typically offered in Spring only
CS 541/HS 541 Plant Breeding Methods (3 credit hours)
Overview of plant breeding methods for advanced undergraduate and beginning graduate students. Covers principles and concepts of inheritance, germplasm resources, pollen control, measurement of genetic variances, and heterosis. Special topics include heritability, genotype-environment interaction, disease resistance, and polyploidy. In-depth coverage on methods for breeding cross-pollinated and self-pollinated crops. Prepares students for advanced plant breeding courses.
Prerequisite: ST 511, Corequisite: ST 512
Typically offered in Fall only

CS 565/CS 465 Turf Management Systems and Environmental Quality (3 credit hours)
Integration of turfgrass management systems and the use of BMPs and IPM to protect environmental quality. Examination of water quality issues relative to turf. Application of Best Management Practice and Integrated Pest Management strategies. Credit c
Prerequisite: CS 400 and Senior standing
Typically offered in Fall only

CS 590 Special Topics (1-6 credit hours)
The study of special problems and selected topics of current interest in crop science and related fields.

CS 591 Special Problems (1-6 credit hours)
Special problems in various phases of crop science. Problems may be selected or will be assigned. Emphasis on review of recent and current research. Credits Arranged.

CS 601 Seminar (1 credit hour)
Review and discussion of scientific articles, progress reports in research and special problems of interest to agronomists. Maximum of two credits allowed toward master's degree; however, additional credits toward doctorate allowed.
Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

CS 620 Special Problems (1-6 credit hours)
Special problems in various phases of crop science. Problems may be selected or will be assigned. Emphasis on review of recent and current research. Credits Arranged.
Typically offered in Fall, Spring, and Summer

CS 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall and Spring

CS 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.
Prerequisite: Master's student
Typically offered in Spring only

CS 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.
Prerequisite: Master's student
Typically offered in Spring only

CS 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.
Prerequisite: Master's student
Typically offered in Spring only

CS 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CS 695 Master's Thesis Research (1-9 credit hours)
Thesis research.
Prerequisite: Master's student
Typically offered in Summer only

CS 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CS 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CS 714 Crop Physiology: Plant Response to Environment (3 credit hours)
Examines interactions between plants and the environment. Light environment, plant canopy development, photosynthesis, source-sink relations, growth analysis, growth regulation, water relations, and environmental stresses are addressed.
Prerequisite: (PB 321 or PB 421) and CH 223 or CH 227
Typically offered in Fall only

CS 716/HS 716 Weed Biology (3 credit hours)
This course analyzes the interactions between human disturbance and dynamics of weed populations and communities. Emphasis is given to factors that drive weed control actions and the ecological and evolutionary processes by which weeds survive and adapt.
Prerequisite: CS 414
Typically offered in Spring only
CS 717/HS 717  **Weed Management Systems** (1 credit hours)
Weed management systems including integration of cultural, biological, mechanical and chemical methods for vegetables, fruits, ornamentals, turf, small grains, corn, tobacco, cotton, peanuts, aquatic and non-cropland settings. Taught second 5 weeks of semester. Drop date is by last day of 3rd week of minicourse.

Prerequisite: CS 414
Typically offered in Fall only

CS 720/GN 720/HS 720  **Molecular Biology In Plant Breeding** (3 credit hours)
Theory and principles of molecular biology applied to plant breeding. Experimental approaches to induce genetic change, cytoplasmic recombination, haploid utilization and potentials of molecular techniques for solving breeding problems.

Prerequisite: CS(GN,HS) 741, GN 701, GN 702, GN 703
Typically offered in Spring only

CS 725/HS 725/SSC 725/TOX 725  **Pesticide Chemistry** (1 credit hours)
Chemical properties of pesticides including hydration and solvation, ionization, volatilization, lipophilicity, molecular structure and size, and reactivity and classification according to chemical description, mode of action or ionizability. Taught during the first 5 weeks of semester. Drop date is last day of 3rd week of minicourse.

Prerequisite: (CH 201 or CH 203) and (CH 221 or CH 225)
Typically offered in Fall only

CS 726/ANS 726/FOR 726  **Advanced Topics In Quantitative Genetics and Breeding** (3 credit hours)
Advanced topics in quantitative genetics pertinent to population improvement for quantitative and categorical traits with special applications to plant and animal breeding. DNA markers - phenotype associations. The theory and application of linear mixed models, BLUP and genomic selection using maximum likelihood and Bayesian approaches. Pedigree and construction of genomic relationships matrices from DNA markers and application in breeding.

Prerequisite: ST 511, Corequisite: ST 712
Typically offered in Fall only

CS 727/HS 727/SSC 727/TOX 727  **Pesticide Behavior and Fate In the Environment** (2 credit hours)
Sorption/desorption, soil reactivity, movement, volatilization, bioavailablity, degradation and stability of pesticides in the environment. Taught during the last 10 weeks of semester. Drop date is last day of 3rd week of the minicourse.

Prerequisite: CS(HS,SSC,TOX) 725,SSC 200
Typically offered in Fall only

CS 729/HS 729  **Herbicide Behavior In Plants** (2 credit hours)
Chemical, physiological and biochemical actions of herbicides in plants including uptake, translocation, metabolism and mechanism of action.

Prerequisite: BO 751 and BO 752 and CS(HS,SSC) 725
Typically offered in Spring only

CS 745/GN 745/HS 745  **Quantitative Genetics In Plant Breeding** (1 credit hours)
Theory and principles of plant quantitative genetics. Experimental approaches of relationships between type and source of genetic variability, concepts of inbreeding, estimations of genetic variance and selection theory.

Prerequisite: CS(GN, HS) 541, ST 712, course in quantitative genetics recommended
Typically offered in Spring only

CS 746/GN 746/HS 746  **Cytogenetics in Plant Breeding** (2 credit hours)
Theory and principles of plant breeding methodology including population improvement, selection procedures, genotypic evaluation, cultivar development and breeding strategies.

Typically offered in Spring only

CS 755  **Applied Research Methods and Analysis for Plant Sciences** (3 credit hours)
Students will gain understanding of the common principles of scientific method. They will gain knowledge and experience with planning for research, developing research objectives, methodology considerations, experimental design, statistical analyses, and presentation of data. Class will have a heavy focus on experimental methods in applied plant science research.

Prerequisite: ST 511
Typically offered in Fall only

CS 795  **Special Topics** (1-6 credit hours)
The study of special problems and selected topics of current interest in crop science and related fields.

CS 801  **Seminar** (1 credit hours)
Review and discussion of scientific articles, progress reports in research and special problems of interest to agronomists. Maximum of two credits allowed toward master's degree; however, additional credits toward doctorate allowed.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

CS 820  **Special Problems** (1-6 credit hours)
Special problems in various phases of crop science. Problems may be selected or will be assigned. Emphasis on review of recent and current research. Credits Arranged.

Typically offered in Fall, Spring, and Summer

CS 860/GN 860/HS 860  **Plant Breeding Laboratory** (1 credit hours)
Visitation of plant breeding projects in the Depts. of CS and HS at NC State, along with commercial seed companies. Discussion and viewing of breeding objectives, methods and equipment and teaching and practice of hybridization methods.

Prerequisite: CS(GN,HS)741
Typically offered in Spring only
CS 861/GN 861/HS 861 Plant Breeding Laboratory (1 credit hours)
Visitation of plant breeding projects in the Depts. of CS and HS at NC State, along with commercial seed companies. Discussion and viewing of breeding objectives, methods and equipment and teaching and practice of hybridization methods.

Prerequisite: CS(GN,HS)741
Typically offered in Fall only

CS 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

CS 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Spring and Summer

CS 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Spring only

CS 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CS 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

CS 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Curriculum and Instruction (ECI)

ECI 201 Intro to Instructional Technology for Educators (3 credit hours)
Introduction to effective technology integration in teaching practices across the curriculum for pre-service teachers. Exploration of different technology-based tools commonly integrated in instruction, including desktop, Internet/ Web-based, mobile, and cloud applications. Examination of integration challenges using relevant, real-world examples from current teacher practices. Planning for student-centered, project-based lessons that make use of diverse technologies.

Typically offered in Fall and Spring

ECI 204 Intro to Teaching (1-2 credit hours)
For prospective teachers in Middle and Secondary Business and Marketing, English, Foreign Languages, Language Arts, and Social Studies. Emphasis on what it means to be an educator as well as differing aspects and procedures of instruction and analysis of competencies required of teachers. The course has a required fieldwork component in local K-12 school, and students are responsible for their own transportation to and from the schools. Students are required to purchase internship liability insurance to participate in this course. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge. This course is restricted to Teacher Education majors.

Prerequisite: Sophomore standing; Corequisite: ED 204
Typically offered in Fall and Spring

ECI 205 Introduction to Teaching Humanities and Social Sciences (3 credit hours)
For prospective teachers in secondary and middle years social studies, English, language arts, and foreign languages. An emphasis on differing aspects and procedures of instruction and analysis of competencies required of teachers. Field work in a variety of education settings including an extended period in one curriculum area.

Prerequisite: Sophomore standing
Typically offered in Fall and Spring

ECI 296/ED 296 Special Topics in Education (1-3 credit hours)
Individual or group study of particular areas of education at the freshman and sophomore levels. Specific topics will vary from semester to semester.

Typically offered in Fall and Spring

ECI 305 Equity and Education (3 credit hours)
This course examines the intersection of diversity, inclusivity, equity, and P-16 education; specifically by considering multiple identity markers such as: gender, sexuality, race, socioeconomic status, ability, and all aspects of culture. This interdisciplinary course uses a sociological lens to examine educational materials, research studies, memoirs, and media to explore the following essential questions: In what ways do students' cultural identities impact their experiences in schools?; How are social inequalities perpetuated by and within the educational system?; What types of individual and systemic practices can help disrupt the marginalization of students in P-16 schools? How can schools celebrate and sustain students' cultural identities?

Prerequisite: ED 204 or AEE 206 or ELM 250 or Junior Status
GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Fall and Spring

ECI 306 Middle Years Reading (3 credit hours)
Reading skills in middle years education developed with emphasis on application of the reading process to content area.

Prerequisite: Six hours in ED or PSY
Typically offered in Spring only
ECI 307 Teaching Writing Across the Curriculum (3 credit hours)
For prospective teachers of all disciplines in middle/high school. Practical strategies for writing as a learning tool and for teaching writing. Lesson plans, assignments, experiences appropriate to content areas. Focus on writing, writing instruction, and technology. Separate sections for Middle Grades (MSL) and English (LTN) majors.
Prerequisite: ENG 101
Typically offered in Fall and Spring

ECI 309 Teaching in the Middle Years (3 credit hours)
Nature and purposes of middle grades education. Early adolescent development, curriculum, teaching/learning methods, school organization, and characteristics of effective middle years teachers. Includes field experience.
Prerequisite: Six hours in ED or PSY
Typically offered in Fall and Spring

ECI 332 Health Promotion and Disease Prevention (3 credit hours)
Emphasis on education of the public regarding general health concerns including cancer, cardiovascular disease, accident prevention, nutrition, drugs, alcohol, mental health, sexuality, and environmental hazards.
Prerequisite: For credentialed health professionals only
Typically offered in Spring only

ECI 333 Health Care Delivery (3 credit hours)
The historical basis of health care delivery in the U. S. with emphasis on hospitals, health maintenance organizations, ambulatory care centers, ambulatory surgery, nursing homes, and private care practice. Philosophical issues of funding health care, promoting health care, and the training of health care workers.

ECI 335 Planning Classroom and Clinical Curricula (3 credit hours)
Procedures for planning health occupations curricula for classroom and clinical settings. Practice in writing, updating, and refining health curriculum with emphasis on selection and sequencing. Comparison of styles of writing curricula. Roles and responsibilities of healthy curriculum planner.
Prerequisite: For Certification Majors: EOE 101, 205 ; For Non-Certification Majors: EOE 101. For credentialed health professionals

ECI 336 Strategies for Teaching a Health Occupations Course (3 credit hours)
Planning and implementation of effective instructional strategies for clinical and classroom settings. The nature of the teaching/learning process, psychological and philosophical aspects of teacher choice of various strategies.
Prerequisite: For credentialed health professionals
Typically offered in Spring only

ECI 405/ENG 405 Literature for Adolescents (3 credit hours)
The history, types, and characteristics of literature for adolescents. Emphasizes reading and analyzing the literature by exploring the themes, literary elements, and rationale for teaching literature for adolescents. Addresses ways in which this literature can be integrated and implemented in English/Language Arts curriculum.
Prerequisite: Junior standing.
Typically offered in Fall only

ECI 414 Human Relations and Discipline in the Classroom (3 credit hours)
Designed to help prospective teachers foster positive interpersonal relationships in classrooms, build a sense of community and create a purposive environment for learning. Investigates issues such as group building, active listening, and major approaches to discipline. Uses case studies and problem solving methods.
Prerequisite: PSY 304 or EDP 304 and 6 hours of education

ECI 416 Teaching Exceptional Students in the Mainstreamed Classroom (3 credit hours)
Provides classroom teachers in all disciplines and grade levels with a knowledge of various handicapping conditions, as well as with techniques to assist exceptional students within the mainstreamed classroom. Required for MSL majors.
Prerequisite: Six hours in ED or PSY
Typically offered in Fall, Spring, and Summer

ECI 423 Methods for Teaching Modern Foreign Languages K-12 (5 credit hours)
Methodology and pedagogy of teaching Foreign Languages grades K-12 with an emphasis on lesson and unit planning, second language acquisition, diversity, national and state standards, materials, assessment, proficiency oriented teaching, and demonstrations/practice teaching in micro-lessons. This course provides opportunities for prospective Foreign Language teachers to integrate knowledge of their language with effective materials, strategies, and methods of instruction to prepare students for K-12 Foreign Language teaching. The course has a required fieldwork component in local K-12 schools, and students are responsible for their own transportation to and from the schools.
Restriction: Open to FLL Education majors or by permission
Typically offered in Fall only

ECI 424 Student Teaching in Modern Foreign Languages (12 credit hours)
Teaching experience for prospective teachers of Modern Foreign Languages in a selected elementary, middle or high school under the supervision of a cooperating teacher and a university faculty supervisor. Additional school observations and on campus seminars are a part of this course. The course has a required fieldwork component in local K-12 schools, and students are responsible for their own transportation to and from the schools. Students are covered under the General Statute affording liability protection.
Prerequisite: Admission to Professional semester, ECI 423
Typically offered in Spring only

ECI 427/ECI 527/FL 527/FL 427 Methods and Materials in Teaching English as a Second Language (3 credit hours)
Methodologies and current approaches to teaching English as a Second Language. Techniques and strategies for teaching reading, writing, listening, speaking and culture. Selection, adaptation, and creation of instructional materials for various levels of proficiency and teaching situations. Evaluation and assessment of written and oral language proficiency through standardized and non-standardized assessment tools. Students cannot receive credit for both FL/ECI 427 and FL/ECI 527.
Typically offered in Fall only
ECI 430 Methods and Materials for Teaching Language Arts in the Middle Grades (4 credit hours)
Inquiry, activity-oriented course provides opportunities for prospective language arts middle school teachers to integrate knowledge of English with effective materials, strategies, methods of instruction. Students observe middle school classes, plan lessons, and units, practice varied classroom strategies, technologies in micro-lessons. Prepared students for teaching language arts with other content areas in middle schools.
Prerequisite: ECI 205, ELP 344, PSY 304 or EDP 304, ECI 309, ECI 306, ECI 307, Senior standing, candidacy in Middle Grades Teacher Education, Corequisite: ECI 435
Typically offered in Fall only

ECI 435 Methods and Materials for Teaching Social Studies in the Middle Grades (4 credit hours)
For preservice middle school social studies teachers. Focus on: teaching and evaluation skills, adaptation of instruction to individual learner differences, identification and creation of instructional materials appropriate for use in social studies teaching.
Prerequisite: Admission to professional semester
Typically offered in Fall only

ECI 436/FL 536/ECI 536/FL 436 Perspectives on English as a New Language (3 credit hours)
Examination of the complexity of multiculturalism in American society and the challenges faced by immigrant families in adapting to U.S. institutions. Emphasis on understanding historical, legal, cultural and pedagogical issues with respect to learning English as a new language [ENL]. No credit given for both FL/ECI 436 and FL/ECI 536.
Typically offered in Fall only

ECI 438 Medical Law and Ethics (3 credit hours)
Ethical and legal issues involved in delivering health care, such as euthanasia, reproductive technology, organ transplants, patients’ rights, and confidentiality. Classical ethical theories and principles. Systematic review procedures and current medical law used to examine current case dilemmas in the health professions.
Typically offered in Fall only

ECI 442 Field Experience in Business and Marketing Education (3 credit hours)
Supervised off-campus work experience in an approved business and marketing content related job. The work experience relates on-the-job experiences to the technical competencies taught in the North Carolina Standard Course of Study for business and marketing.
Prerequisite: Junior standing
Typically offered in Fall and Summer

ECI 444 Administration of Business and Marketing Education (3 credit hours)
Development of successful business and information technology, and marketing education programs. Program promotion, managing cooperative education experiences, managing DECA and FBLA chapters, and determining professional development strategies. Primary roles of the business and information technology and marketing education teachers’ classroom instruction. Program management, classroom management, management of career-technical student organizations, cooperative education, and program development.
Prerequisite: ED 204 and ECI 204 and MKE Business and Marketing Education Major
Typically offered in Fall only

ECI 445 New Literacies, Emerging Technologies, and Electronic Portfolios (2 credit hours)
Inquiry, activity-oriented course designed to engage students in theory and practice related to 21st century skills, new literacies, and emerging technologies, as well as focused support for developing the culminating electronic portfolio. Course provides opportunity for pre-service, English Language Arts/ Social Studies middle school teachers to integrate knowledge of English and Social Studies with emerging technologies and digital literacy applications.
Prerequisite: Senior Standing; Corequisite: ECI 430 and ECI 435
Typically offered in Fall only

ECI 446 Curriculum and Methods of Teaching Business and Marketing Education (4 credit hours)
Study of the curriculum common to business and information technology and marketing education and the research behind its development. Methods common to instructional planning, implementation, and evaluation of effective business and information technology and marketing education programs are topics included in this course. Twenty hours of field work are required. Students are expected to provide their own transportation to and from assigned public schools. Students are required to purchase internship liability insurance to participate in this course. Contact University Insurance & Risk Management for details in acquiring the insurance and the current charge. MKE students only.
Prerequisite: Admission to Teacher Education Candidacy; MKE Business and Marketing Education Majors
Typically offered in Fall only

ECI 447 Student Teaching in Business and Marketing Education (9 credit hours)
Fifteen weeks full-time student teaching business and marketing subjects in the public schools under the supervision of a cooperating teacher and university supervisor. Students will develop skills in instruction, evaluation, advisement, administration, and observation. Students are expected to provide their own transportation to and from assigned public schools. Students are required to purchase internship liability insurance to participate in this course. Contact University Insurance & Risk Management for details in acquiring the insurance and the current charge. MKE students only.
Prerequisite: Admission to Professional Semester; MKE Business and Marketing Education Majors, Corequisite: ECI 494
Typically offered in Spring only
ECI 448/ECI 548  E-Business Applications in Business and Marketing Education  (3 credit hours)
Emphasis on design and construction of advanced web pages, business and marketing applications of electronic commerce, as well as economic, social, legal, and ethical issues that are related to conducting business in a virtual environment. Content prepares students to apply principles to the business and marketing education curriculum in the public schools. Credit for both ECI 448 and ECI 548 is not allowed.

Typically offered in Fall only

ECI 450 Methods and Materials in Teaching English  (4 credit hours)
Methods and materials of teaching English in grades 9-12, with an emphasis on lesson planning and demonstrations/practice in teaching literature, study skills, speaking, listening, and writing. Taught during the first seven weeks of the semester.
Prerequisite: ECI 204, ELP 344, PSY 304 or EDP 304; Senior standing and admission to Teacher Education candidacy with a Major in English
Typically offered in Spring only

ECI 451 Teaching Reading Across Disciplines  (3 credit hours)
Facilitates study of methods and materials for teaching literacy across disciplines. Develops instructional strategies in the use of print and digital texts and media to support disciplinary learning.
Prerequisite: Six hours in ED or PSY
Typically offered in Fall and Spring

ECI 454 Student Teaching in English/Language Arts  (1-12 credit hours)
Provides the prospective teacher with experience in the techniques and skills involved in teaching English in secondary schools or Language Arts in middle schools in a selected off-campus station. Student interns become familiar with the total school program, eventually carrying a full teaching load, and participate in relevant school and community activities. Students are required to provide their own transportation. TED and MSL majors only.
Prerequisite: Admission to Student Teaching Professional Semester; For MSL students: ECI 430, 416, 464
Typically offered in Spring only

ECI 460 Methods and Materials in Teaching Secondary Social Studies  (4 credit hours)
Teaching techniques, innovations, and development of teaching and evaluation skills in the area of secondary school social studies. Adaptation of instruction to individual learner differences, and selection and design of instructional materials. Taught during the first six weeks of the semester. Taught during the first six weeks of the semester.
Prerequisite: ECI 205, ELP 344, Sr. standing and admission to professional semester with a major in either history, sociology, political science
Typically offered in Fall only

ECI 464 Student Teaching in Social Studies  (1-8 credit hours)
Skills and techniques in teaching social studies in secondary and middle schools. Each student spends ten weeks in a selected off-campus center. The student demonstrates competencies essential for teaching social studies, becomes familiar with the total school program, and participates in a variety of school and community activities.
Prerequisite: Admission to professional semester. Corequisite: For LTH, LTP, LTS students: ECI 460. For MSL students: ECI 454, 430, 416
Typically offered in Spring only

ECI 471 Educational Implications of Learning and Developmental Theory  (3 credit hours)
Topics related to human psychological development. Cognitive, social, physical changes, and their interaction among adolescence. Departmental Approval Required.
Prerequisite: NC TEACH Participants
Typically offered in Spring and Summer

ECI 472 Interaction of Classroom Management and Instruction  (3 credit hours)
Topics related to teaching in the content area and classroom management. Lesson planning, principles applied to education, measurement and evaluation procedures, behavior therapy, and student motivation. Departmental Approval Required.
Prerequisite: ECI 471 ; NC TEACH Participants
Typically offered in Spring and Summer

ECI 473 Subject Specific Methods  (3 credit hours)
Topics related to cultural factors and how they affect teachers and students in the classroom. Instructional techniques and the development of instructional plans that enhance schooling experiences of culturally diverse students. Departmental Approval Required.
Prerequisite: ECI 472 ; NC TEACH participants, Corequisite: ECI 474
Typically offered in Fall only

ECI 474 Curriculum and Instruction Practices 1  (3 credit hours)
Topics related to essential skills and concepts needed by beginning teachers. The class focuses on questioning, test preparation, discussion skills, familiarity with national standards, multiple teaching strategies, and assessment + evaluation of students. Departmental Approval Required.
Prerequisite: ECI 472 ; NC TEACH participants, Corequisite: ECI 473
Typically offered in Fall only

ECI 475 Peer Mentoring in Alternative Licensure  (3 credit hours)
Topics related to observing and evaluating fellow teachers in relation to the national state teaching competencies. Classroom observations, videotaping, and group evaluations that are shared and discussed with fellow teachers. Departmental Approval Required.
Prerequisite: ECI 474 ; NC TEACH Participants, Corequisite: ECI 475
Typically offered in Spring only

ECI 476 Curriculum and Instruction Practices 2  (3 credit hours)
Topics related to inquiry, activity based instruction, and constructivist principles. Analysis of principles, strategies and application of new teaching approaches. Departmental Approval Required.
Prerequisite: ECE 474 ; NC TEACH Participants, Corequisite: ECI 475
Typically offered in Spring only

ECI 494 Senior Seminar in Business and Marketing Education  (3 credit hours)
Discussion and analysis of problems, trends, and issues experienced while student teaching in the public schools.
Prerequisite: Admission to Professional Semester; MKE Business and Marketing Education Majors. Corequisite: ECI 447
Typically offered in Spring only
ECI 496/ED 496 Special Topics in Education (1-3 credit hours)
Individual or group study of special topics in professional education. The topic and mode of study are determined by the faculty member after discussion with the student.

Prerequisite: Junior standing or Senior standing
Typically offered in Fall and Spring

ECI 500 Theory and Practice In Teaching Diverse Populations (3 credit hours)
Analysis of literature and research in related to impact of cultural factors on teaching and learning in contemporary schools. Exploration of teaching techniques and curricular directions designed to improve school experiences for diverse populations.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ECI 501 Foundations of Curriculum (3 credit hours)
Origin, development, and current status of elementary and secondary school curriculum and an evaluation of trends and issues likely to influence the curriculum in the future.

Prerequisite: 12 sem. hrs. graduate ED and PSY
Typically offered in Summer only

ECI 502 Technology Program Evaluation (3 credit hours)
This course is about evaluation of instructional technology programs, which is the systematic process of collecting and analyzing data in order to determine whether and to what degree program goals have been or are being achieved.

Prerequisite: Graduate Standing
Typically offered in Fall and Spring

ECI 505/FL 505 Issues and Trends in Foreign Language Education: Theory & Practice (3 credit hours)
An exploration of theory and practice issues related to foreign language teaching. Inquiry into proficiency-oriented instruction, innovative methodological approaches, the National Standards and learning scenarios, integrating culture, options for testing and assessment, content-based instruction, the role of grammar in second language acquisition, teaching foreign language students with learning disabilities, and Foreign Language in the Elementary School (FLES) in North Carolina. Students will examine case studies related to these topics and engage in a classroom action research project.

Prerequisite: Graduate standing
Typically offered in Fall and Summer

ECI 507 Social Justice Education (3 credit hours)
Introduction to principles of social justice education and their centrality in progressive policies and pedagogies that lead to equity in all teaching contexts. Students will develop strategies for successfully incorporating a social justice education.

Prerequisite: ECI 500
Typically offered in Fall only

ECI 508 Teachers as Leaders (3 credit hours)
Examines teacher leadership research, theory, and practice. Prepares teachers to assume leadership roles in classrooms, schools, school systems, and the larger educational community. Independent research projects required.

Prerequisite: Graduate standing
Typically offered in Spring only

ECI 509 Special Problems in Curriculum and Instruction (1-6 credit hours)
In-depth study of topical problems in curriculum and instruction selected from areas of current concern to practitioners in education.

Prerequisite: Six hours of ED or PSY
Typically offered in Fall, Spring, and Summer

ECI 510 Research Applications In Curriculum and Instruction (3 credit hours)
Focus on current issues and research methods used in the areas of curriculum development and supervision, instructional technology, English education, middle grades education, reading education, social studies education and special education.

Prerequisite: ST 507, Doctoral student, C and I Major
Typically offered in Spring and Summer

ECI 511 Introduction to Learning Design and Technology (3 credit hours)
Introduction to the Learning, Design, and Technology master's program at North Carolina State University and to the field of instructional design and educational technology, with an investigation of relevant careers, important theories and models guiding practice, and noteworthy research findings by area.

Restriction: Graduate Standing
Typically offered in Fall only

ECI 512 Emerging Technologies for Teaching and Learning (3 credit hours)
Examination of emerging technologies as applied in educational settings with a focus on related research, case studies, theoretical underpinnings, and strategies for effective integration.

Typically offered in Spring and Summer

ECI 513 Teaching and Learning with Digital Video (3 credit hours)
Development and implementation of digital video within educational contexts and situations. Design of educational watching, analyzing, and creating activities with video. Application of conventions and genres of digital video capture and editing to sample technology projects across curricular areas.

Prerequisite: Graduate standing
Typically offered in Summer only

ECI 514 Developing and Delivering Online Instruction (3 credit hours)
Examination of learning theories and research-based principles to design and apply appropriate digital tools to create maximally effective educational products.

Prerequisite: Graduate Standing
Typically offered in Spring and Summer

ECI 515 Cultural Investigations and Technical Representations in Education (3 credit hours)
Examination of contemporary approaches that educators can use to help their students construct cultural understanding in education settings through investigations and technical representations of culture with emerging tools (e.g., mapped cultural tours, AR/VR heritage exhibition, documentary, social media, games, fabrication, data analytics and visualization).

Typically offered in Fall only
ECI 516 Design and Evaluation Of Instructional Materials (3 credit hours)
Characteristics and selection of various media for instruction and their use in educational settings. Design and production of instructional materials. Analysis of research in the field. Individualized projects and assignments. Application of grounded research.
Prerequisite: Graduate standing
Typically offered in Spring only

ECI 517 Theoretical Foundations of Advanced Learning Environments (3 credit hours)
Examination and application of behavioral, cognitive, and constructivist theoretical frameworks underlying the design and development of advanced technology-enhanced learning environments.
Typically offered in Fall only

ECI 518 Digital Learning Program and Staff Development (3 credit hours)
Study and application of principles related to digital learning program planning, facilities and resource management, and staff development in K-12 settings.
Prerequisite: ECI 511, ECI 514, ECI 515, ECI 642
Typically offered in Spring only

ECI 519 Special Problems in Learning Design and Technology (3 credit hours)
In-depth study of topical problems in Learning Design and Technology selected from areas of current concern to practitioners in education.
Typically offered in Fall, Spring, and Summer

ECI 520 The Teaching Of Composition (3 credit hours)
For classroom teachers. Practical field-tested ideas to help students improve as writers by focusing on composition as a process as well as a product. Activities for teaching prewriting, drafting, revising, proofreading, grammar and evaluating with suggestions for individual and group learning. Writing in content areas and composition research/ theory. To take this course in sum. as part of Capital Area Writing Project, student must apply and be selected.
Prerequisite: 9 hrs. of ED, PSY and/or ENG;
Typically offered in Spring only

ECI 521 Teaching Literature For Young Adults (3 credit hours)
Designed to acquaint in-service and pre-service teachers with breadth and diversity of contemporary literature for adolescents, with emphasis on teaching young adult literature. Addresses history and themes of young adult literature, readability of materials, reading preferences, literary merit, skills that can be taught through literature, censorship, motivating students to read and organizing literature units.
Prerequisite: Senior standing or Graduate standing or PBS status
Typically offered in Fall only

ECI 522 Trends and Issues in English Language Arts Education (3 credit hours)
Consideration of past, current, and future trends and issues in English Language arts instruction, standards, and methodologies. Examination of research, theory, and practice in concert with trends, issues, and questions. Independent research projects required.
Prerequisite: Graduate standing

ECI 523 Teacher as Researcher (3 credit hours)
This course is designed to introduce the methods and skills required for designing, conducting, interpreting, and applying action research - the systematic inquiry into curriculum, instruction, teaching, and learning. This course will focus on reflective inquiry and practical applications.
Prerequisite: Graduate standing
Typically offered in Fall only

ECI 524 Theory and Research in Global Learning (3 credit hours)
An examination of theoretical frameworks for global learning and comparative studies of various national approaches to K-12 education. This course provides students with multiple lenses through which to consider how we teach and learn given the demands.
Typically offered in Spring and Summer

ECI 525 Contemporary Approaches In the Teaching Of Social Studies (3 credit hours)
Analysis of principles, strategies and application of new teaching approaches. Structured projects and practical experiences.
Prerequisite: Advanced Undergraduate standing or Graduate standing
Typically offered in Fall only

ECI 526 Theory and Research On Teaching and Learning Social Studies (3 credit hours)
A critical analysis of the literature relating to the teaching and learning of social studies and the drawing of implications for instructional practices.
Prerequisite: ECI 530 or ECI 525
Typically offered in Spring only

ECI 527/FL 527/FL 427/ECI 427 Methods and Materials in Teaching English as a Second Language (3 credit hours)
Methodologies and current approaches to teaching English as a Second Language. Techniques and strategies for teaching reading, writing, listening, speaking and culture. Selection, adaptation, and creation of instructional materials for various levels of proficiency and teaching situations. Evaluation and assessment of written and oral language proficiency through standardized and non-standardized assessment tools. Students cannot receive credit for both FL/ECI 427 and FL/ECI 527.
Typically offered in Fall only

ECI 528 Strategies for Teaching English in Secondary Schools (3 credit hours)
Methods and materials of teaching English in grades 9-12, with and emphasis on lesson planning and demonstrations/practice in teaching literature, study skills, speaking, listening, media literacy, and writing. Some classes and assignments will be completed in a field setting.
Typically offered in Fall only

ECI 530 Social Studies In the Elementary School (3 credit hours)
Advanced professional training in teaching of social studies for middle grades and elementary teachers, including in-depth introduction to research-based teaching strategies, instructional resources and literature of the field.
Prerequisite: Six hrs. in ECI
ECI 531  Advanced Writing in Education  (3 credit hours)
Appropriate for any specialty area in Education. Focus on writing
required in graduate courses, research reviews for educational reports
and National Board Certification, writing for educational journals,
theses, and dissertations. Opportunities to gain knowledge, tools, and
strategies to meet the academic community's standards. Strategies to
develop and/or enhance form, style, content, quality of academic writing,
and on researching, composing, revising, and editing. Students will
compose, self-evaluate and give feedback on the work of their peers.
Graduate status.

ECI 535  Methods and Materials for Teaching Social Studies in the
Middle Grades  (3 credit hours)
For preservice middle school social studies teachers. Focus on:
teaching and evaluation skills, adaptation of instruction to individual
learner differences, identification and creation of instructional materials
appropriate for use in social studies teaching. Cannot earn credit for
ECI 435 and ECI 535.

Typically offered in Fall only

ECI 536/FL 436/ECI 436/FL 536  Perspectives on English as a New
Language  (3 credit hours)
Examination of the complexity of multiculturalism in American society and
the challenges faced by immigrant families in adapting to U.S. institutions.
Emphasis on understanding historical, legal, cultural and pedagogical
issues with respect to learning English as a new language [ENL]. No
credit given for both FL/ECI 436 and FL/ECI 536.

Typically offered in Fall only

ECI 537/ELM 537  Teaching Children's Literature  (3 credit hours)
Instructions for educators in quality children's literature, specific needs
of young reader, genres of children's literature, strategies for instructing
children's literature, ways to target reader's interests, and design of
literature units.

Typically offered in Summer only

ECI 540  Reading In the Elementary School  (3 credit hours)
Theoretical foundations of reading instruction and current methods
and materials for teaching reading, with emphasis on planning and
implementing reading programs for children in kindergarten through
grade six.

Prerequisite: Six hrs. ED or PSY
Typically offered in Fall only

ECI 541  Reading In the Content Areas  (3 credit hours)
Methods in instruction for applying reading to content areas, with
emphasis on means of improving comprehension, vocabulary and
learning strategies in subject matter classrooms.

Prerequisite: Six hours in ED or PSY
Typically offered in Fall, Spring, and Summer

ECI 543  Literacy Assessment and Intensified Instruction I  (3 credit
hours)
Designed for students to expand their knowledge and skills in diagnostic
assessment and instruction in alphabets and word study needed
for K-12 Reading Specialist licensure. Topics include assessment
and instruction in word recognition, word analysis, spelling, and early
reading skills such as phonological awareness, alphabet knowledge, and
concepts of print. Emphasis is placed on critical examination of reading
intervention practices in these areas and implementation of innovative
research-informed approaches for supporting diverse learners when they
have difficulties with literacy in school.

Prerequisite: ECI 540 or ECI 541
Typically offered in Spring only

ECI 544  Literacy Assessment and Intensified Instruction II  (3 credit
hours)
Designed for students to expand their knowledge and skills in diagnostic
assessment and instruction in language, comprehension, and inquiry
needed for K-12 Reading Specialist licensure. Topics include assessment
and instruction in fluency and print processing, comprehension,
vocabulary/language, and text-based inquiry. Emphasis is placed on
critical examination of reading intervention practices in these areas
and implementation of innovative research-informed approaches for
supporting diverse learners when they have difficulties with literacy in
school.

Prerequisite: ECI 543
Typically offered in Fall only

ECI 545  Theory and Research in Literacy  (3 credit hours)
Advanced study of theoretical models of reading, research issues in
reading and in other language processes. In-depth theoretical models
of reading. Emphasis on critical examination and analysis of research
investigating reading acquisition, maturereading behavior and related
language processes.

Prerequisite: ECI 540
Typically offered in Spring only

ECI 546  New Literacies & Media  (3 credit hours)
Critical analysis of new literacies that are prompted by emerging
technologies and participatory media in K-12. Design and application of
new literacies and media instructional practices to literacy curriculum and
other discipline areas.

Typically offered in Fall only

ECI 547  Knowledge Construction: Implications for Multicultural
Education  (3 credit hours)
Exploration of sociopolitical factors involved in the construction of
knowledge in education as well as the implications for practitioners
and learners in schools and other educational settings. Particular
emphasis on critiquing traditional epistemologies that limit the production,
dissemination, and validation of progressive discourses in education in
order to promote the production of knowledge that affirms the principles
of social justice education.

Prerequisite: ECI 500
Typically offered in Fall only
ECI 548/ECI 448  E-Business Applications in Business and Marketing Education  (3 credit hours)
Emphasis on design and construction of advanced web pages, business and marketing applications of electronic commerce, as well as economic, social, legal, and ethical issues that are related to conducting business in a virtual environment. Content prepares students to apply principles to the business and marketing education curriculum in the public schools. Credit for both ECI 448 and ECI 548 is not allowed.

Typically offered in Fall and Summer

ECI 549  Special Problems in Reading  (1-6 credit hours)
In-depth study of topical problems in reading education selected from areas of current concern to practitioners in education.

Prerequisite: Six hours of ED or PSY
Typically offered in Fall, Spring, and Summer

ECI 550  Foundations Of Middle Years Education  (3 credit hours)
Examination of five major aspects of middle years education: (a) history and purposes of middle/junior high school, (b) pre- and early adolescent needs, interests and abilities, (c) curriculum design and content, (d) teaching methods and (e) school organization. Emphasis on both theoretical understandings and effective classroom strategies.

Prerequisite: 6 hours of ED or PSY
Typically offered in Fall and Spring

ECI 551  Teaching/Learning Approaches For Emerging Adolescents  (3 credit hours)
Exploration of teaching/learning approaches appropriate to emerging adolescents. Learning styles; interdisciplinary inquiry; community-based curriculum; simulations and games; learning centers; minicourses; design of physical space; all-school activities.

Prerequisite: ECI 550; Graduate standing
Typically offered in Spring only

ECI 552/YFCS 552  Program Development & Evaluation in Youth & Family Settings  (3 credit hours)
Historical and contemporary foundations of program development and evaluation in non-formal, community-based family life and youth development settings are examined including theory, research, and three holistic program development constructs: 1) planning; 2) design and implementation; 3) impact evaluation and accountability.

Typically offered in Spring only

ECI 553/YFCS 553  Applied Concepts in Child and Youth Development  (3 credit hours)
This course explores the fundamental concepts of child and youth development (including early childhood through adolescence) as applied to programmatic and organizational contexts. A special focus is placed upon the concepts as applied to Community You

Typically offered in Fall only

ECI 554/YFCS 554  Collaborations & Partnerships in Family & Youth Settings  (3 credit hours)
To prepare educators (formal and non-formal) to better establish, lead and manage collaborations and partnerships in family settings and those that support holistic community-based youth development organizational systems. Specific foci include: types and levels of partnerships; environmental scanning and socio-organizational linkage contextual factors affecting community collaborations; leadership factors affecting community collaborations; and human, financial, and programmatic management in collaborations. Some on-campus meetings are required.

Typically offered in Fall only

ECI 555/YFCS 555  Organizational Systems in Youth and Family Settings  (3 credit hours)
Preparation for current and future community family and youth development professionals leading and managing community-based organizations. Course includes: fundamentals of management and leadership; institutional and organizational structures; administrative and strategic planning; working with advisory and governing groups; marketing and program delivery systems; information management systems; and human resource, financial, facilities, and risk management systems.

Prerequisite: ECI 506
Typically offered in Fall only

ECI 556/YFCS 556  Volunteerism in Youth and Family Settings  (3 credit hours)
Preparation for current and future community-based youth and family professionals to better manage volunteers in local program service delivery. Specific foci include: volunteerism as a social phenomenon; volunteer resource management; new forms of vol

Typically offered in Spring only

ECI 557/YFCS 557  Professional Development in Business and Marketing Education  (3 credit hours)
Designed to prepare business and marketing educators with the knowledge and skills necessary to design and implement strategies for organizational improvement that will benefit business and marketing education programs. Attendance and participation meaningful, organized professional development activity is an integral component of the course.

Prerequisite: Graduate standing
Typically offered in Summer only

ECI 560  Curriculum and Instruction in Business and Marketing Education  (3 credit hours)
Designed to develop competencies needed to be a successful Business and Marketing Education Teacher-Coordinator. Focus primarily on the activities involved in planning and managing the curriculum and instructional skills needed to effectively implement

Prerequisite: Graduate standing
Typically offered in Fall and Spring
ECI 562 Program Management in Business and Marketing Education (3 credit hours)
This course includes the administration of middle and secondary business and marketing education programs, including career guidance; the management of DECA or FBLA chapter; supervision of work-based learning strategies; and school program promotion and development. ED & MKZ students only. Requires permission of instructor.
Prerequisite: ECI 561
Typically offered in Fall and Spring

ECI 563 Methods and Materials in Teaching Secondary Social Studies (3 credit hours)
ECI 563 is a course that involves teaching techniques, innovations, development of teaching and evaluation skills, and in-depth subject matter inquiry in the area of secondary school social studies. Adaptation of instruction to individual learner differences, and selection and design of instructional materials will be explored. Must be enrolled in Secondary Social Studies MAT Program.
Typically offered in Fall only

ECI 566 Advanced Instructional Strategies in Business and Marketing (3 credit hours)
Advanced strategies and techniques related to teaching and learning in the business and marketing education curriculum, classrooms, work places, and technology environments in middle and secondary education. MKZ students only.
Prerequisite: ECI 561
Typically offered in Spring only

ECI 567 Career and Technical Education Fundamentals and Program Administration (3 credit hours)
Emphasis on assisting various school district personnel in acquiring the knowledge and skills needed to effectively provide quality career and technical education (CTE) programming at the district level. Content includes federal CTE legislation, theory and research on educational reform, local and regional economic development, sources of funding for CTE programming and continuous improvement.
Typically offered in Fall only

ECI 568 Designing College and Career Ready Programs (3 credit hours)
Examination of current school system instructional practices to assist various school district personnel in aligning core academic and career and technical education programming to prepare students for successful post-secondary education, careers, and life-long learning. Content includes an examination of education reform initiatives with an emphasis on foundational theory and research, needed workplace knowledge and skills, innovative education programs/models, and research-based best practices for success in transitioning students to post-secondary success.
Typically offered in Fall and Spring

ECI 569 Special Problems in Business and Marketing Education (1-6 credit hours)
In-depth study of topical problems in business and marketing education selected from areas of current concern to practitioners in education.
Typically offered in Fall only

ECI 570 Learning Disabilities (3 credit hours)
Field of learning disabilities, including definitions, prevalence, etiology, characteristics and current educational trends for educating students with learning disabilities.
Prerequisite: ECI 585
Typically offered in Summer only

ECI 571 Instructional Strategies for Students with Disabilities (3 credit hours)
Methods and materials for teaching students with disabilities in elementary and secondary school. Focus on research-supported instructional strategies for teaching academic skills, Universal Design for Learning, implementation of appropriate academic interventions, and evaluation of instructional outcomes within the context of Response to Intervention and Multi-Tier Systems of Supports.
Prerequisite: Graduate standing
Typically offered in Spring only

ECI 572 Resource Teaching In Special Education (3 credit hours)
Resource teaching in area of special education, with emphasis on resource teaching with students with special needs. Types of resource programs, establishment and maintenance of a program, selection of students, curriculum and materials.
Prerequisite: ECI 585
Typically offered in Summer only

ECI 573 Applied Behavior Analysis & Positive Behavior Intervention and Support in Schools (3 credit hours)
Concepts and procedures involved in design and implementation of techniques for managing the behavior of students in classroom setting. Focus on methods for defining, measuring, increasing, decreasing, maintaining, and generalizing classroom behaviors in all learners. An exploration of Multi-Tiered Systems of Support, and Positive Behavior Intervention and Support in school settings.
Typically offered in Fall only

ECI 574 Intellectual Disabilities (3 credit hours)
Content presented includes definitions, classifications, and assessment of person with intellectual disability from medical, sociological, and educational points of view. Issues related to labeling, etiology, characteristics, levels of severity, litigation, legislation, family and societal issues, history, and controversies are emphasized related to persons with intellectual disability.
Prerequisite: ECI 585
Typically offered in Fall only

ECI 575 Communication Disorders In the Classroom (3 credit hours)
Occurrence of communication disorders in the school-age population, including types of disorders, prevalence, etiology, characteristics and corrective therapy. Focus on communication disorders among exceptional students and classroom teacher’s role in working with communication disorders.
Prerequisite: ECI 570
ECI 576 Teaching Functional and Life Skills to Students with Disabilities (3 credit hours)
Methods of instruction and materials related to teaching children and persons with mild-moderate levels of disability are emphasized. Effective general pedagogical approaches are stressed, as well as the teaching of functional academic skills, curricula used in instructions, teaching social and adaptive behavior as well as daily living skills, and transition-related skills necessary for independent adult life. Multi-tiered Systems of Support as well as Positive Behavior Intervention and Support are also discussed.

Typically offered in Spring only

ECI 577 Education Of Severely Handicapped (3 credit hours)
Severe and profound mental retardation and autism, including assessment procedures, educational and social/vocational programs, instructional strategies and evaluation. Legal and ethical issues involved in working with severely handicapped.

Prerequisite: ECI 585 or ECI 574

ECI 579 Organization and Behavioral Management of Inclusive Classrooms (3 credit hours)
To increase students' knowledge of persons with high incidence disabilities (i.e., learning disability, mild intellectual disability, and serious emotional disability), and how to manage the behavior of all pupils in educational environments. Characteristics of students with high incidence disabilities will be emphasized, as well as strategies to reduce the likelihood of problem behavior of all pupils in the classroom.

Typically offered in Fall, Spring, and Summer

ECI 580 Transition Program For Students With Mild Disabilities (3 credit hours)
Educational and other procedures involved in providing transition programming to students with mild disabilities. Examination of secondary-level special education service delivery, as well as post-secondary interventions, from critical, practical, empirical and theoretical perspectives.

Prerequisite: ECI 585

Typically offered in Summer only

ECI 581 Educational Diagnosis and Prescription For Children With Exceptionalities (3 credit hours)
Concept of educational diagnosis of students with exceptionalities, including examination of educational diagnostic procedures in current use in special education. Development of informal diagnostic techniques and procedures for adapting curriculum and instruction for learner with exceptionalities.

Prerequisite: ECI 585

Typically offered in Fall only

ECI 583 Behavior Disorders (3 credit hours)
Definitions, etiology, characteristics, philosophies and approaches to educational programming for children and youth with behavior disorders, including emotionally handicapped, autistic and socially maladjusted.

Prerequisite: ECI 585

Typically offered in Fall only

ECI 584 Intervention for Behavior Problems of Students with Disabilities (3 credit hours)
Curriculum materials, instructional strategies and behavior management techniques related to teaching children and youth with behavioral disorders including individualized instruction, group process, organization and evaluation of classroom programs, parent involvement, community resources and teachers' personal and professional growth and development.

Prerequisite: ECI 583

Typically offered in Spring only

ECI 585 Education of Children with Exceptionalities (3 credit hours)
Introduction to field of special education. Focus on historical overview, definitions and terminology in basic areas of exceptionality; etiological factors in exceptionality; developmental and learning characteristics of each area of exceptionality; educational settings and strategies employed in special education including Multi-Tiered Systems of Support and Positive Behavior Intervention and Support. Review of current educational laws and policies affecting special education.

Prerequisite: 9 hours of ED or PSY

Typically offered in Fall and Spring

ECI 586 Introduction to Learning Analytics (3 credit hours)
As the use of digital resources continues expand in education, an unprecedented amount of new data is becoming available to educational researchers and practitioners. In response, Learning Analytics (LA) has emerged over the past decade as an interdisciplinary field encompassing Learning (e.g. educational technology, learning and assessment sciences), Analytics (e.g. visualization, computer/data sciences), and Teacher-Centered Design (e.g. usability, participatory design). This course will provide students with an overview of the field, examples of its use in educational contexts, and applied experience with widely adopted tools and techniques for working with and exploring data. As participants gain experience in the collection, analysis, and reporting of data throughout the course, they will be better prepared help educational organizations understand and improve learning and the contexts in which learning occurs.

Typically offered in Fall only

ECI 587 Machine Learning in Education (3 credit hours)
This class is meant to teach the practical side of machine learning for applications in mining educational data. There will be a heavy project focus, and when you have completed the course, you should be fully prepared to attack new problems using machine learning in the field of education.

Typically offered in Spring only

ECI 588 Text Mining in Education (3 credit hours)
This course will provide students with an overview of text mining as an analytical approach in education research, examples of its use in educational contexts, and applied experience with widely adopted tools and techniques (e.g. topic modeling and sentiment analysis). Students develop practical skills in the collection, analysis, and reporting of text data from sources such as Learning Management Systems, social media, and other online sources. Students can complete projects using a programming approach with R, a popular free open source software program for data science, or using non-programming point-and-click tools (i.e., SAS Visual Text Analytics).

Typically offered in Summer only
ECI 589 Analyzing Learning Networks (3 credit hours)
Although social network analysis and its educational antecedents date back to the early 1900s, the popularity of social networking sites like Twitter and Facebook have raised awareness of and renewed interests in networks and their influence. As the use of digital resources continues to expand in education, data collected by these educational technologies has also greatly facilitated the application of network analysis to teaching and learning. This introductory course is designed to prepare researchers and practitioners to apply network analysis in order to better understand and improve student learning and the contexts in which learning occurs. This course will provide students with an overview of social network theory, examples of network analysis in educational contexts, and applied experience with widely adopted tools and techniques. As participants gain experience in the collection, analysis, and reporting of data throughout the course, they will be better prepared help educational organizations understand and improve both

Typically offered in Summer only

ECI 603 Advanced Seminar in Literacy Research (3-6 credit hours)
Critical analyses of research and methodology in reading comprehension processes and strategies for comprehension and retention of written discourse. Opportunity for design and conduct of a research project in reading or related area.

Prerequisite: ECI 648
Typically offered in Spring only

ECI 606 Seminar on Teacher as Learner: Developmental Theory, Research and Practice (3 credit hours)
Analysis of major contemporary theories and research of learning and development as a basis for individual and organizational change and development in educational settings.

Prerequisite: Graduate standing (6 hrs course work at 500-level)
Typically offered in Fall only

ECI 607 Advanced Seminar in Multicultural Education (3 credit hours)
Application and analysis of research and scholarship in multicultural education and topics related to effective schools for contemporary culturally diverse student populations in K-12 settings.

Prerequisite: Graduate standing and ECI 500
Typically offered in Spring only

ECI 620 Special Problems in Curriculum and Instruction (1-6 credit hours)
In-depth study of topical problems in curriculum and instruction selected from areas of current concern to practitioners in education.

Prerequisite: Six hrs. of ED or PSY
Typically offered in Fall, Spring, and Summer

ECI 630 Independent Study in Curriculum and Instruction (1-3 credit hours)
Independent curriculum or research project in curriculum and instruction.

Typically offered in Fall, Spring, and Summer

ECI 640 Practicum in Curriculum and Instruction (1-6 credit hours)
Supervised practical experiences in schools and area agencies concerned with curriculum and instruction or educational supervision.

Prerequisite: Graduate standing in Col. of ED and PSY
Typically offered in Fall and Spring

ECI 641 Practicum in Mentoring and Coaching (1-6 credit hours)
Supervised practical experiences in which participants become mentor to a student teacher or a teacher in a school system.

Prerequisite: ECI 705, Graduate standing in College of ED and PSY
Typically offered in Fall only

ECI 645 Supervised Practicum in Literacy (3 credit hours)
Supervised teaching experience with school-aged children identified as having reading difficulties. Students use diagnostic assessment data to design, implement, and evaluate individualized literacy instruction. Emphasis is placed on research-informed practices of intensified instruction embedded within engaging and authentic literacy experiences.

Prerequisite: ECI 540, ECI 541 and ECI 543; Graduate standing in College of ED
Typically offered in Spring only

ECI 647 Practicum in Business and Marketing Education (3 credit hours)
Supervised practical experiences in schools and area agencies concerned with business and marketing education.

Prerequisite: ECI 569
Typically offered in Spring only

ECI 648 Practicum in Special Education (1-6 credit hours)
Supervised practical experiences in schools and area agencies concerned with teaching children and adolescents with disabilities.

Prerequisite: Graduate standing in College of ED and PSY
Typically offered in Fall, Spring, and Summer

ECI 650 Internship in Curriculum and Instruction (1-6 credit hours)
Supervised opportunities for advanced professional development in contexts concerned with curriculum development and/or educational supervision.

Prerequisite: Graduate standing in Col. of ED and PSY
Typically offered in Fall and Spring

ECI 652 Field-Based Applications of Learning Design and Technology (1-6 credit hours)
Supervised opportunities to design, test, and revise learning design and technology solutions in authentic, field-based settings.

Typically offered in Fall and Spring

ECI 654 Internship in Elementary Education (1-6 credit hours)
Supervised opportunities for advanced professional development in contexts concerned with elementary grades education.

Prerequisite: 3 hrs. grad.-level elementary education course work, Graduate standing in Col. of ED and PSY
Typically offered in Spring only

ECI 656 Internship in Middle Grades Education (1-6 credit hours)
Supervised opportunities for advanced professional development in contexts concerned with the education of young adolescents.

Prerequisite: ECI 550, ECI 551, Graduate standing in College of ED and PSY
Typically offered in Fall, Spring, and Summer
ECI 657  Internship in Business and Marketing Education  (1-6 credit hours)
Supervised opportunities for advance professional development in contexts concerned with business and marketing education. Requires instructor approval.

Prerequisite: ECI 561
Typically offered in Fall and Spring

ECI 658 Internship In Special Education  (1-6 credit hours)
Supervised opportunities for advanced professional development in contexts concerned with special education.

Prerequisite: Graduate standing in Col. of ED and PSY
Typically offered in Fall and Spring

ECI 681 Seminar in Special Education Literacy  (3 credit hours)
A case study approach is used in the seminar that requires the application of assessment techniques and instructional intervention methodologies in literacy for K-12 students with disabilities. Assigned activities require access to and experience in schools and/or related settings. This seminar is designed to be completed during the last half of the graduate program. It is restricted to graduate students in SPE, SPL, SPM, SPB or consent of instructor.

Prerequisite: ECI 540 or ECI 541 and ECI 581, ECI 585

ECI 682 Spe Ed Seminar in Teaching Numerical Concepts  (3 credit hours)
This seminar is designed to prepare special education teachers to provide empirically supported instruction in numerical concepts and skills to students with disabilities in special education and general education settings. Particular attention will be paid to student characteristics that impact learning in arithmetic and mathematics and to addressing state and national curriculum standards using instructional organization and strategies that have been shown through research to be effective for this population. Field work in schools and/or related settings is required. Restricted to students in SPE, SPB, SPL, SPM or by consent of instructor.

Prerequisite: ECI 585
Typically offered in Summer only

ECI 683 Seminar in Special Education Learning Strategies  (3 credit hours)
This seminar is designed to prepare special education teachers to evaluate and teach empirically supported learning strategies to students with disabilities in special education and collaborative settings. Particular attention will be paid to learning strategies shown to help students with disabilities organize, learn, and apply facts, skills and routines that provide access to and mastery of critical information across the curriculum. Field work in schools and/or related settings is required. Restricted to graduate students in SPE, SPB, SPL, SPM or consent of instructor.

Prerequisite: ECI 585

ECI 685 Master's Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ECI 688 Non-Thesis Masters Continuous Registration - Half Time Registration  (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ECI 689 Non-Thesis Master Continuous Registration - Full Time Registration  (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall only

ECI 690 Master's Examination  (1-9 credit hours)
For students in non-thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall and Spring

ECI 692 Research Projects In Curriculum and Instruction  (1-3 credit hours)
Project or problem in research in education for graduate students, supervised by members of graduate faculty. Research chosen on basis of individual students’ interests and not to be part of thesis or dissertation research.

Prerequisite: ELP 532
Typically offered in Fall, Spring, and Summer

ECI 693 Master's Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ECI 695 Master's Thesis Research  (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ECI 696 Summer Thesis Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

ECI 699/ELP 699/EMS 699/EOE 699/EAC 699/ECD 699 Master's Thesis Preparation  (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall and Spring
ECI 700 Curriculum Theory and Development (3 credit hours)
Theory and research in behavioral sciences and education designed to provide theoretical background for development of elementary and secondary curricula. Exploration of knowledge base and skills for critical review of curricula and instructional materials.
Prerequisite: 9 sem. hrs. graduate PSY, ECI 502, ECI 514
Typically offered in Fall only

ECI 705 Instructional Coaching and Supervision Of Teachers (3 credit hours)
Theory, research and practice of the professional role of a supervisor in the development of the effective and self-analytic teacher: pre-service (student teacher) and in-service (beginning and experienced teacher). For persons with at least two years of teaching experience in K-12 schools.
Typically offered in Spring only

ECI 709 Special Problems In Curriculum and Instruction (1-6 credit hours)
In-depth study of topical problems in curriculum and instruction selected from areas of current concern to practitioners in education.
Prerequisite: Six hrs. of ED or PSY
Typically offered in Fall, Spring, and Summer

ECI 711 Computer Applications and Curriculum Integration (3 credit hours)
Use and evaluation of existing educational software, research findings with respect to integration of computers and new technologies in instruction.
Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

ECI 714 Multimedia Design and Applications in Instruction (3 credit hours)
Emphasis on use and evaluation of existing educational software and research findings with respect to uses of computers in instruction.
Prerequisite: Six hrs. ED or PSY
Typically offered in Fall and Spring

ECI 715 Internet Applications and Web Page Design in Instruction (3 credit hours)
Instructional design principles underlying development of microcomputer-based instructional software and accompanying materials and programming principles and their implementation in courseware development. Additional topics include authoring languages, programming languages and graphics.
Prerequisite: Six hrs. ED or PSY
Typically offered in Fall only

ECI 716 Design and Evaluation Of Instructional Materials (3 credit hours)
Characteristics and selection of various media for instruction and their use in educational settings. Design and production of instructional materials. Analysis of research in the field. Individualized projects and assignments. Application of grounded research.
Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

ECI 717 Advanced Multimedia Design and Applications in Instruction (3 credit hours)
Advanced study and application of instructional design principles underlying development, evaluation, and integration of multimedia and hypermedia in K-12 settings.
Prerequisite: ECI 511, ECI 514
Typically offered in Spring only

ECI 718 Digital Learning Program and Staff Development (3 credit hours)
Study and application of principles related to digital learning program planning, facilities and resource management, and staff development in K-12 settings.
Prerequisite: ECI 511, ECI 514, ECI 515, ECI 642
Typically offered in Spring only

ECI 719 Special Problems in Learning Design and Technology (1-6 credit hours)
In-depth study of topical problems in Learning Design and Technology selected from areas of current concern to practitioners in education.
Typically offered in Fall, Spring, and Summer

ECI 720 The Teaching Of Composition (3 credit hours)
For classroom teachers. Practical field-tested ideas to help students improve as writers by focusing on composition as a process as well as a product. Activities for teaching prewriting, drafting, revising, proofreading, grammar and evaluating with suggestions for individual and group learning. Writing in content areas and composition research/ theory.
Prerequisite: 9 hrs. of ED, PSY and/or ENG; to take this course in sum. as part of Capital Area Writing Project, student must apply and be selected
Typically offered in Spring only

ECI 721 Technology and Informal Learning Environments (3 credit hours)
Survey of theory and research grounding popular informal after-school technology environments, such as computer clubhouses, music studios, video clubs, coding camps, robotics clubs, and makerspaces. Examination of strategies for planning experiential, hands-on activities supportive of informal learning, sourcing necessary materials, outfitting spaces, facilitating student design and collaboration, and engaging the community and other resources to sustain facilities/clubs.
Typically offered in Fall only

ECI 722 Theory and Research in Distance Education (3 credit hours)
Introduction to distance education foundations, models, and underlying theories. Analysis of distance education research findings, research and evaluation methods, and management in varied settings--virtual schools, higher education, continuing education, and corporate e-learning. Application of distance education standards and research-based findings to the design of original course plans and materials prototypes, including appropriate recommendations for online teaching and community building, online student support, and online student assessment.
Typically offered in Spring only
ECI 727 Special Problems in Social Studies Education (1-6 credit hours)
In-depth study of topical problems in social studies education selected from areas of current concern to practitioners in education.
Prerequisite: Six hours of ED or PSY
Typically offered in Fall, Spring, and Summer

ECI 729 Special Problems in English Education (1-6 credit hours)
In-depth study of topical problems in English education selected from areas of current concern to practitioners in education.
Prerequisite: Six hours of ED or PSY
Typically offered in Fall, Spring, and Summer

ECI 745 Literacy Theory and Research (3 credit hours)
Advanced study of theoretical models of reading, research issues in reading and in other language processes. In-depth theoretical models of reading. Emphasis on critical examination and analysis of research investigating reading acquisition, maturereading behavior and related language processes.
Prerequisite: ECI 540
Typically offered in Fall only

ECI 801 Seminar in Curriculum and Instruction (1-3 credit hours)
Consideration of contemporary issues, trends and recent research and development findings in curriculum and instruction.
Prerequisite: Doctoral student
Typically offered in Fall only

ECI 803 Advanced Seminar In Literacy (3 credit hours)
Critical analyses of research and methodology in reading comprehension processes and strategies for comprehension and retention of written discourse. Opportunity for design and conduct of a research project in reading or related area.
Prerequisite: ECI 545
Typically offered in Fall only

ECI 804 Seminar On Attention Deficit Hyperactivity Disorder, Research and Treatment (3-6 credit hours)
Critical analysis of theory, research and interventions in Attention-Deficit-Hyperactivity-Disorder. Reading and synthesis of literature and student-led class discussions of such topics as characteristics, diagnosis, etiology, long-term outcomes and management of ADHD.
Prerequisite: 9 hrs. grad. credit in PSY or SPE
Typically offered in Spring only

ECI 806 Seminar on Teacher as Learner: Developmental Theory, Research and Practice (3-6 credit hours)
Analysis of major contemporary theories and research of learning and development as a basis for individual and organizational change and development in educational settings.
Prerequisite: Graduate standing (6 hrs course work at 500-level)
Typically offered in Fall only

ECI 807 Advanced Seminar in Multicultural Education (3 credit hours)
Application and analysis of research and scholarship in multicultural education and topics related to effective schools for contemporary culturally diverse student populations in K-12 settings.
Prerequisite: Graduate standing and ECI 500
Typically offered in Spring only

ECI 820 Special Problems In Curriculum and Instruction (1-6 credit hours)
In-depth study of topical problems in curriculum and instruction selected from areas of current concern to practitioners in education.
Prerequisite: Six hrs. of ED or PSY
Typically offered in Summer only

ECI 830 Independent Study in Curriculum and Instruction (1-3 credit hours)
Independent curriculum or research project in curriculum and instruction.
Typically offered in Fall, Spring, and Summer

ECI 840 Practicum In Curriculum and Instruction (1-6 credit hours)
Supervised practical experiences in schools and area agencies concerned with curriculum and instruction or educational supervision.
Prerequisite: Graduate standing in Col. of ED and PSY
Typically offered in Fall and Spring

ECI 841 Practicum In Mentoring and Coaching (1-6 credit hours)
Supervised practical experiences in which participants become mentor to a student teacher or a teacher in a school system.
Prerequisite: ECI 705, Graduate standing in College of ED and PSY
Typically offered in Fall only

ECI 847 Practicum in Business and Marketing Education (1-6 credit hours)
Supervised practical experiences in schools and area agencies concerned with business and marketing education.
Typically offered in Fall, Spring, and Summer

ECI 850 Internship In Curriculum and Instruction (1-6 credit hours)
Supervised opportunities for advanced professional development in contexts concerned with curriculum development and/or educational supervision.
Prerequisite: Graduate standing in Col. of ED and PSY
Typically offered in Fall and Spring

ECI 851 Internship In Mentoring (1-6 credit hours)
Supervised opportunities teaching educational personnel in local school systems how to serve as mentors to their colleagues.
Prerequisite: ECI 845 and ECI 705, Graduate standing in Col. of ED and PSY
Typically offered in Fall and Spring

ECI 880 Directed Study in Curriculum and Instruction (1-6 credit hours)
Curriculum or research project in curriculum and instruction under the direct supervision of a faculty member.
Typically offered in Fall, Spring, and Summer

ECI 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall and Spring
ECI 890  Doctoral Preliminary Examination  (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

ECI 892  Research Projects In Curriculum and Instruction  (1-3 credit hours)
Project or problem in research in education for graduate students, supervised by members of graduate faculty. Research chosen on basis of individual students' interests and not to be part of thesis or dissertation research.
Prerequisite: ELP 732
Typically offered in Spring only

ECI 893  Doctoral Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ECI 895  Doctoral Dissertation Research  (1-9 credit hours)
Dissertation research.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ECI 896  Summer Dissertation Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Summer only

DAN 210  Current Trends in Afrocentric and World Dance  (1 credit hours)
This course provides direct experience in choreographic and performance processes for members of Panoramic Dance Project, NC State Dance Program's student company dedicated to Afrocentric and other culturally driven dance works. The course includes study of dance technique, choreographic craft, and the examination of content and identity in dance. Choreographic content varies from semester to semester. Permission only; acceptance by formal audition.
Typically offered in Fall and Spring

DAN 260  Hip-hop Dance  (1 credit hours)
This course introduces students to the physical, social, communal, historical, and cultural aspects of hip-hop dance. Students might have to provide transportation and/or pay a minimal cost for a performance not to exceed $15.

GEP Health and Exercise Studies, GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Fall and Spring

DAN 272  Dance Composition - Solo Forms  (1 credit hours)
This course introduces principles of dance composition through creative problem solving. Course content includes: movement invention; creation of a thematic phrase; manipulation and development of theme through application of choreographic devices; etc.
Prerequisite: ELSM 320 or instructor permission
GEP Visual and Performing Arts
Typically offered in Fall only

DAN 290  Special Topics in Dance  (1-4 credit hours)
Examination of selected topics in dance. May be repeated for credit provided course content is different each time.

DAN 295  Problems of Dance Performance  (2 credit hours)
Practical performing experience in a company setting. Rehearsal, performance and production of concert dance.
Prerequisite: Audition
Typically offered in Fall and Spring

DAN 490  Adv Spec Top Dance  (1-4 credit hours)

DAN 498  Independent Study in Dance  (1-3 credit hours)
Independent study in special choreographic or performance projects approved by and done under the direction of the Dance Program. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard C"
Prerequisite: DAN 272, Dan 295, Dance Program approval required.
Typically offered in Fall only

Design (D)

D 100  Design Inquiry I: Methods and Processes  (3 credit hours)
Design Inquiry I asks students to think critically about and experiment with expanding their toolkit of process and methods in solving large scale problems with innovative solutions. Through discussion sections, students will also be introduced to methods of critical reading and writing as a reflective practice. Topics students will consider and implement include lateral thinking, metaphorical thinking, abductive reasoning, networked thinking, discourse as thought, systems thinking and more. Students in Design must receive a C- to pass the course.

GEP Interdisciplinary Perspectives
Typically offered in Fall only
D 101 Design Inquiry II: Methods and Processes  (3 credit hours)
As an important extension of the first semester, Design Inquiry II asks students to engage in the critical evaluation of the making process and how design and the artifacts that we create contribute to material culture. Lecture topics are both historical and contemporary and include: design in the age of reason, the age of composition, and the age of experience; consumption and material culture; designing the obsolete; human-centered design, and universal design. Student in Design must receive a C- to pass the course.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

D 104 First Year Studio I  (6 credit hours)
First Year Studio I provides College of Design freshman with an introduction to foundational design concepts and methods representative of creative activity across design and artistic disciplines. This 6-credit fall semester course encourages entering freshman to think critically and act creatively about and upon design, art and the world around them as they secure a skillful level of craftsmanship in the conception, development, and making of all studio-based work. Semester work focuses on key design issues such as process, method, technique, technology and the production of visual and physical items necessary for the envisioning and development of design. College of Design Studio Majors Only; Students must receive a C- to pass the course.

Co-requisite: D 100; restricted to Design majors only
Typically offered in Fall only

D 105 First Year Studio II  (6 credit hours)
First Year Studio II is the continuation of a comprehensive introduction to foundational design concepts and methods begun in First Year Studio I. This 6-credit fall semester course asks freshman to think critically and act creatively about and upon design, art, and the world around them as they apply a skillful level of craftsmanship in the conception, development, and making of all studio-based work. Semester work focuses on key design issues such as process, method, technique, technology and the production of visual and physical items necessary for the envisioning and development of design. College of Design Studio Majors Only; Students must receive a C- to pass the course.

Prerequisite: D 100 and D 104; Restricted to Design majors only
Typically offered in Fall only

D 231 Design History for Engineers and Scientists  (3 credit hours)
Study of historical connections among various disciplines and across cultures from prehistory to the present, with an emphasis on design. Students develop visual timelines of events to better understand how seemingly disparate disciplines affect one another. Special attention paid to scientific, artistic, and philosophical "revolutions" and their impact upon each other and upon other intellectual and practical endeavors. There are no prerequisites or corequisites for this course. Design Studies students should consult with the Instructor prior to enrollment for their own benefit.

GEP Visual and Performing Arts
Typically offered in Fall only

D 292 Special Topics in Design  (1-3 credit hours)
Topics of current interest in the college of Design. Used to develop new courses.

Typically offered in Fall, Spring, and Summer

D 492 Special Topics in Design  (1-6 credit hours)
Topics of current interest in the College of Design. Used to develop new courses.

Typically offered in Fall, Spring, and Summer

D 592 Special Topics in Design  (1-6 credit hours)
Topics of current interest in the College of Design. Used to develop new courses.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

D 684 Teaching Design at the College Level  (3 credit hours)
Preparation for college level teaching in the design disciplines. Discussion of the history of design education, curriculum development, pedagogical strategies, assessment, and teaching and research demands on college design faculty. Meets partial requirements for the university Certificate of Accomplishment in Teaching. Restricted to students enrolled in College of Design masters and doctoral programs.

Typically offered in Spring only

Design courses for Graduate Students (DDN)

DDN 685 Master's Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's Student
Typically offered in Fall only

DDN 696 Summer Thesis Res (1 credit hours)

DDN 701 Research Methods in Design  (3 credit hours)
Survey of research methods in the field of design including overall systems of inquiry, criteria for assessing quality, strategies and tactics. Strengths and weaknesses of various research designs. Experimental and quasi-experimental research, correlational research, qualitative research strategies, simulation and modeling research, action research and design intervention, case study, and combined strategies.

Prerequisite: Graduate standing
Typically offered in Spring only

DDN 702 Research Paradigms in Design  (3 credit hours)
Overview of contributions and limitations of various theoretical perspectives that inform the field of design inquiry. Knowledge and theory construction. Nature, scope, and merits of scientific approach. Criticism of the scientific approach and examination of alternative approaches utilized in design research and practice. Linking philosophy, research, and action/practice/application.

Prerequisite: Graduate standing
Typically offered in Fall only
DDN 740 Introduction to Practice-Based Design Research (3 credit hours)
This course presents an introduction and overview of interdisciplinary research theories, strategies, and methods as applied to issues in professional practice of design. Special emphasis is placed on the roles, values, and specific methods related to design practice, including (not limited to) case study analysis and evaluation; design typology; engaged research; research and development (e.g. prototyping); and design process. Course content is adaptable to student needs and interests. Restricted to Doctor of Design (D.Des) students; other advanced post-professional design students may enroll with permission of instructor. Although course content and instruction is predominantly online, the course requires one week of face-to-face intensive on-campus instruction and other activities before Fall term begins (TBA).

Restriction: Doctor of Design Students or other advanced students (PhD or other DDes programs off campus) may be enrolled by permission of instructor only.

Typically offered in Fall only

DDN 741 Case Study Analysis in Design (3 credit hours)
The case study method addresses the importance of learning how to learn as an essential element of professional growth as well as a means toward building a culture of reflective design practice. Case studies provide orientation and perspective on the complexity of design practice, both for novices and seasoned professionals. When closely examined, lessons learned from design processes and decision-making provide opportunities to build a body of professional knowledge. Course content is adaptable to student needs and interests. Restricted to Doctor of Design (D.Des) students; other advanced post-professional design students may enroll with permission of instructor. Although course content and instruction is predominantly online, the Fall course requires one week of face-to-face intensive on-campus instruction and other activities prior to the start of Fall term. The Spring course requires one week of face-to-face intensive on-campus instruction and other activities during Spring term (TBA).

Corequisite: DDN 740

Typically offered in Fall and Spring

DDN 771 Design as Cognitive Artifact (3 credit hours)
Relationship between theories of human cognition and design. Analysis and critique of design objects as cognitive artifacts and extension, transformation, or diminishing of human thought by their form and content. A critical examination of cognitive, linguistic and social science theories shaping design.

Prerequisite: Doctoral student, Design Majors, Corequisite: DDN 830 or 831

Typically offered in Fall and Spring

DDN 772 Design as Cultural Artifact (3 credit hours)
Recent theories in various disciplines concerning a cultural understanding of graphic design. Theories of mass and popular culture, critiques of creativity and authorial intentionality, influences of interpretive criticism, theories of consumption and issues of cultural representation. Emphasis on adaptation of these theories to an understanding of the cultural significance of graphic design. Non-majors by permission only.

Prerequisite: Doctoral student, Design Majors, Corequisite: DDN 830 or 831

Typically offered in Fall only

DDN 773 New Information Environments (3 credit hours)
Changing role of design in new information environments. Implications of new technology on social construction of meaning, impact of electronic media on culture and cognition, and differences in designing artifacts and designing interactions.

Prerequisite: Doctoral student, Design Majors, Corequisite: DDN 830 or 831

Typically offered in Spring only

DDN 779 Human Use of the Urban Landscape (3 credit hours)

Typically offered in Spring only

DDN 795 Special Topics (3-6 credit hours)

Typically offered in Fall and Spring

DDN 809 Dissertation Colloquium (1 credit hours)
Prerequisite: Doctoral student in Design

Typically offered in Spring only

DDN 810 Special Topics (1-6 credit hours)

DDN 830 Independent Study (1-3 credit hours)

Typically offered in Fall and Spring

DDN 831 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student in Design

Typically offered in Fall, Spring, and Summer

DDN 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student in Design

Typically offered in Fall, Spring, and Summer

DDN 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student in Design

Typically offered in Fall, Spring, and Summer

DDN 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student in Design

Typically offered in Summer only

DDN 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student in Design

Typically offered in Fall, Spring, and Summer
Design Studies (DS)

**DS 100 Design in Culture and Context** (3 credit hours)
Design in Culture and Context is a first year seminar for Design Studies majors. The course examines design action and the relationships between design and other systems, chiefly the natural and built environment, society and culture, and technology and economics. Recent independent studies, field projects, and special initiatives by artists, designers, and principal investigators will introduce students to the negotiations that take place among the decision-makers, manufacturers, and civic and community patrons in understanding the nature and limits of a variety media, processes of design, and the cultural implications of researching meaningful solutions to current challenges and public needs.

Prerequisite: D 100; Design Studies Majors only
Typically offered in Spring only

**DS 200/ADN 200 A Survey of Design Studies** (3 credit hours)
This course will introduce students to a variety of perspectives and lenses through which to examine and evaluate design in the world. Students will consider design studies through theory and criticism of design, as well as applied to business administration, museum studies, and environmental studies. In addition, students will be encouraged to find evidence of and define design studies in areas that are uniquely suited to their individual areas of interest. As an advised elective, this course is required for Design Studies majors who are sophomores in their major.

Typically offered in Fall only

**DS 481 Design Studies Senior Research Seminar** (3 credit hours)
Each student in Design Studies will develop a topic for his or her Senior Capstone Research Paper to be done during the Spring term. During the Research semester, each student will develop a comprehensive bibliography for the topic and an outline of the paper. One paper will be written before the end of the term that addresses issues directly related to the Capstone Research paper. Throughout the term, students will share their research with others in the seminar.

Prerequisite: Completion of all course work in DS through junior year; Design Studies Majors
Typically offered in Fall only

**DS 482 Design Studies Capstone Seminar** (1 credit hour)
Students will meet on a weekly basis to discuss their individual research papers. Drafts of papers will be due at the end of the eighth week of class. Drafts will be read by the instructor, other instructors of the student's choosing, and by two other members of the class for critical analysis.

Prerequisite: DS 481; Design Studies Majors
Typically offered in Spring only

**DS 483 Design Studies Capstone Research Paper** (3 credit hours)
Course consists of guided independent study resulting in a serious research paper. Students will work on their own, with meetings with faculty advisor(s) at weekly intervals.

Prerequisite: DS 481; Design Studies Majors
Typically offered in Spring only

**DS 494 Design Studies Internship** (1-6 credit hours)
Supervised internships in museums, galleries, schools, or other approved venues, in which students are engaged in activities related to Design Studies. Students are responsible for transportation to and from internship. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: Junior or Senior Standing in Design Studies Program; Design Studies Majors
Typically offered in Fall and Spring

Ecology (ECO)

**ECO 601 Ecology Seminar** (1 credit hours)
Scientific articles, progress reports and special problems of interest to ecologists are reviewed and discussed. Minimum of one seminar presentation required for credit.

Prerequisite: Graduate standing
Typically offered in Spring only

Economics (EC)

**EC 201 Principles of Microeconomics** (3 credit hours)
Scarcity, production possibilities, and opportunity cost. Supply and demand analysis, free markets, the price system, and government policy. Microeconomic analysis of business decisions in competitive and noncompetitive markets. Labor markets, capital, and natural resource markets, and externalities. Market breakdown, income redistribution, and role of government. Free trade, tariffs, and gains from international trade. Credit will not be given for both EC 201 and either ARE 201 or EC 205.

Credit is not allowed for both EC 201 and EC 205 or ARE 201.
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

**EC 202 Principles of Macroeconomics** (3 credit hours)
Aggregate economic analysis emphasizing current public policy issues. Determinants of level and rate of growth of total output. Causes of unemployment and business cycles, inflation, and exchange rate fluctuations. Effects of monetary policy (money supply) and fiscal policy (government spending, taxes, deficits) on these problems. Trade surpluses/deficits and impact of international events and policies on national economies. Credit will not be given for both EC 202 and EC 205.

Prerequisite: EC 201 or ARE 201 or EC 205
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

**EC 205 Fundamentals of Economics** (3 credit hours)
Fundamental ideas in economics: scarcity, substitution, opportunity cost, marginal analysis, gross domestic product, real and nominal magnitudes. Supply and demand analysis. Microeconomic analysis of pricing in competitive and noncompetitive markets. Macroeconomic analysis of production, employment, the price level, and inflation. Monetary and fiscal policy and the stabilization of the economy. Comparative advantage and international trade. Credit will not be given for both EC 205 and either EC 201 or ARE 201. Credit will not be given for both EC 205 and EC 202.

Credit is not allowed for both EC 205 and EC 201 or ARE 201 or EC 202.
GEP Social Sciences
Typically offered in Fall, Spring, and Summer
EC 301/ARE 301 Intermediate Microeconomics (3 credit hours)
Functioning of the market economy, role of prices in determining the allocation of resources, the functioning of the firm in the economy, forces governing the production and consumption of economic goods.
Prerequisite: MA 121 or MA 131 or MA 141 and EC 201 or EC 205 or ARE 201
Typically offered in Fall, Spring, and Summer

EC 302 Intermediate Macroeconomics (3 credit hours)
Applied, analytical course in aggregate economics: business cycles, stabilization policy, inflation, costs of disinflation, international trade, and economic growth. Interaction of consumers and businesses with government economic policies; unemployment, interest rates, and output growth. Impacts of government deficits, trade deficits, and monetary policies.
Prerequisite: (EC 201 or EC 205 or ARE 201) and (MA 121 or MA 131 or MA 141)
Typically offered in Fall, Spring, and Summer

EC 305 A Closer Look at Capitalism (3 credit hours)
Comparison of market allocation to government allocation. Criteria for evaluating economic systems. How markets create value. Relationship of economic freedom to political freedom and economic growth. Applications to policies such as antitrust policy, education policy, and environmental policy.
Prerequisite: EC 201 or EC 205 or ARE 201.
Typically offered in Fall only

EC 336/ARE 336 Introduction to Resource and Environmental Economics (3 credit hours)
Application of basic economic tools to understand and evaluate environmental/resource policies. Concepts such as property rights, non-market goods, allocation over time, externalities, and public goods. Current policy issues such as global climate change, evaluating natural resource damages from oil spills, reducing the costs of regulations, protecting estuaries, and dealing with non-point source pollution.
Prerequisite: ARE 201 or EC 201 or EC 205
GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

EC 348 Introduction to International Economics (3 credit hours)
Application of basic economic analysis to international economic events and policies. Gains from trade, impacts of trade restrictions, international systems of payments, global capital markets, and balancing international with domestic macroeconomic policies. Current policy issues such as economic integration (customs unions and free trade areas), a common currency, and the role of international trade in economic growth and development.
Prerequisite: EC 201 or EC 205 or ARE 201.
Typically offered in Fall and Spring

EC 351 Econometrics I (3 credit hours)
Tools for describing and analyzing data as used in economics. Probability, random variables, sampling, point and interval estimation. Hypothesis testing and regression analysis with emphasis on economic applications. Statistics majors may not enroll in EC 351. Statistics majors interested in enrolling in EC 451 will satisfy the prerequisite of EC 351 with ST 430.
Prerequisite: BUS/ST 350 or ST 312 or ST 370 or ST 372
Typically offered in Fall and Spring

EC 404 Money, Financial Markets, and the Economy (3 credit hours)
Prerequisite: EC 302 and (BUS/ST 350, or ST 312, or ST 370, or ST 372)
Typically offered in Spring only

EC 410 Public Finance (3 credit hours)
A micro-economic analysis of the rationale for public expenditure and taxation. Externalities, pollution and public policy, income redistribution and public welfare, public goods, collective choice and political institutions, public budgeting techniques and cost-benefit analysis, taxation and tax policy, state-local finance and fiscal federalism.
Prerequisite: EC/ARE 301
Typically offered in Spring only

EC 413 Industrial Organization (3 credit hours)
An overview of industrial organization, including the study of monopoly, oligopolistic behavior, monopolistic competition, product differentiation and the dynamic behavior of competitive industries under uncertainty.
Prerequisite: EC/ARE 301
Typically offered in Spring only

EC 431 Labor Economics (3 credit hours)
An economic approach to the labor market and its problems including unemployment and the determination of wages, hours and working conditions under various labor market structures. The economic effects of trade unions. Introduction to human capital theory.
Prerequisite: EC/ARE 301
Typically offered in Fall and Spring

EC 437 Health Economics (3 credit hours)
Application of micro-economic tools to the analysis of public and private policy issues concerning health care financing and delivery in the United States.
Prerequisite: EC/ARE 301
Typically offered in Fall only

EC 449 International Finance (3 credit hours)
Study of international markets and their effects on firms, investors and national economics. Topics include: futures and options in foreign exchange, management of foreign exchange risk, exchange rate determination, and macroeconomic policy in an open economy.
Prerequisite: EC/ARE 301
Typically offered in Fall only

EC 451 Econometrics II (3 credit hours)
The measurement, specification, estimation and interpretation of functional relationships through single equation least-square techniques. Applications of simple and multiple regression, curvilinear regression and various transformations to demand, cost, production, consumption and investment relationships.
Prerequisites: EC/ARE 301, EC 302, and EC 351 (or ST 430 for Statistics majors)
Typically offered in Fall and Spring
EC 468  Game Theory  (3 credit hours)
Studies the competitive and cooperative behavior that results when several parties with conflicting interests must work together. Learn how to use game theory to analyze situations of potential conflict. Applications are drawn from economics, business, and political science.
Prerequisite: EC 301
Typically offered in Fall and Spring

EC 474  Economics of Financial Institutions and Markets  (3 credit hours)
Prerequisite: (MA 121 or MA 131 or MA 141) and EC 302
Typically offered in Spring only

EC 480  Introduction to Economic Research  (3 credit hours)
Finding economic data. Critically analyzing newspaper and journal articles using economic reasoning. Developing, writing, and presenting economic analysis.
Prerequisite: EC/ARE 301 and (BUS/ST 350 or ST 312 or ST 370 or ST 372)
Typically offered in Fall only

EC 490  Research Seminar in Economics  (3 credit hours)
The final course for students completing the undergraduate programs in economics. Students study a selected economic issue, make classroom presentations related to the seminar topic, and write research papers.
Prerequisite: EC/ARE 301 and EC 302 and (BUS/ST 350 or ST 312 or ST 370 or ST 372)
Typically offered in Fall and Spring

EC 495  Special Topics in Economics  (1-6 credit hours)
Examination of special topics in economics not normally treated in other courses, or offering of new courses on a trial basis.

EC 498  Independent Study in Economics  (1-6 credit hours)
Detailed investigation of topics of particular interest to advanced undergraduates under faculty direction on a tutorial basis. Credits and content determined by faculty member in consultation with Director of Undergraduate Programs. Individualized/In

Typically offered in Fall, Spring, and Summer

Educ Leadership & Program Eval (ELP)

ELP 296  Special Topics in Education: General Studies  (1-3 credit hours)
Individual or group study of particular areas of education at the freshman and sophomore levels. Specific topics will vary from semester to semester.

Typically offered in Fall, Spring, and Summer

ELP 344  School and Society  (3 credit hours)
The interrelationship between the school and other institutions, values, and patterns of thought in American society.
Prerequisite: Junior standing.
Typically offered in Fall and Spring

ELP 496  Special Topics in Education: General Studies  (1-3 credit hours)
Individual or group study of special topics in professional education. The topic and mode of study are determined by the faculty member after discussion with the student.
Prerequisite: Junior standing or Senior standing
Typically offered in Fall, Spring, and Summer

ELP 515  Education and Social Diversity  (3 credit hours)
Overview of role of education within a culturally diverse society. Major attention to racial, socioeconomic and regional subpopulations. Issues discussed include subcultural influences on public school performances, equality of educational opportunity, social stratification and mobility, and the impact of schooling on intergroup relations.
Typically offered in Fall and Spring

ELP 518  Introduction To Education Law  (3 credit hours)
Relationship of constitutional, statutory and case law to elementary and secondary public school settings, particularly in areas of students, teachers and liability. Particular emphasis on N.C. and federal law.
Typically offered in Spring only

ELP 532  Introduction To Educational Inquiry  (3 credit hours)
Basic concepts and methods of educational inquiry. Emphasis on logic underlying various approaches to problem definition and solution and on tools of investigator, as well as on sources and interpretation of research information related to student’s particular area of study.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

ELP 534  Ethics and Educational Decision Making  (3 credit hours)
Application of moral theories and methods of moral reasoning to problems and issues involving educational policy and decision making. Character of morality; moral autonomy and leadership; intellectual freedom and public interest; authority and education

Typically offered in Spring only

ELP 550  Principles of Educational Leadership and Empowerment  (3 credit hours)
Examines school organization theories and critical domains of leadership (e.g., school vision, culture, management, collaboration, ethics, and environments). Develops conceptual, managerial and interpersonal leadership skills through analysis of school goals and purpose; organizational design, development and improvement; curricular and instructional leadership; and school-community relationships. Instructional activities will include lecture, seminar discussion, case and problem-based analysis. Graduate standing required.
Typically offered in Fall only
ELP 551  Context and Challenges of School Improvement  (3 credit hours)
Examination of social, cultural, political and policy environment of schooling with emphasis on NC. Analysis of major theories of school change and development, critical examination of opportunities and barriers to strategic change efforts. Instructional activities will include lecture, seminar discussion, case and problem-based analysis.

Typically offered in Spring only

ELP 552  School-Based Planning, Management, and Evaluation in Professional Learning Communities  (3 credit hours)
Prepares administrators to strategically plan, manage and evaluate core programs and systems for the safe and efficient operation of schools. Operational domains examined will include information systems, management systems, curriculum, instruction, student behavior and school security systems. Instructional activities include lecture, seminar discussions, case, situation and problem-based analysis.

Typically offered in Fall only

ELP 553  Organizational Management I: Human Resource Management in K-12 Education  (3 credit hours)
Examination and application of models, theories, and research pertaining to personnel appraisal in education, including recruitment hiring, retention, and dismissal; evaluation models for professional and classified staff; use of effective professional development models to support professional growth and development.

Typically offered in Fall and Spring

ELP 554  Organizational Management II: Resource Support and Sustainability in K-12 Education  (3 credit hours)
Theories and practices of funding K-12 education including examination of: political frameworks and policy issues; concepts central to education finance and budgeting; purposes, designs, and uses of school budgets; procedures for generating, analyzing and interpreting issues related to education finance and school budgeting. Construct, manage and analyze school and district-level budgets; address issues of economic efficiency, equity and fiscal adequacy and their fiscal impact on the school community. Understand North Carolina's Uniform Chart of Accounts accounting structure for school budgeting.

Corequisite: ELP 553
Typically offered in Fall and Spring

ELP 595  Special Topics  (1-6 credit hours)
Typically offered in Fall and Spring

ELP 620  Special Problems In Education  (1-6 credit hours)
Opportunity for graduate students in education to study problem areas in professional education under direction of member of graduate faculty.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

ELP 641  Practicum In Education Administration  (1-6 credit hours)
Supervised experience in appropriate educational setting to enable student to gain practice in applying concepts, principles and theories of education administration.

Typically offered in Fall and Spring

ELP 651  Internship In Educational Leadership and Program Evaluation  (1-9 credit hours)
Utilization of participant-observer role and required participation in selected educational situations with emphasis upon development of observational skills, ability to record relevant observations by means of written journals, skills in analyzing experiences identifying critical incidents and projection of events and consequences. Required development of possible alternative courses of action in various situations, selection of one of alternatives and evaluation of consequences of selected course of action.

Prerequisite: Nine hrs. in grad.-level courses
Typically offered in Fall and Spring

ELP 685  Master's Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: ELP 532
Typically offered in Fall and Spring

ELP 692  Master's Research Projects In Educational Leadership and Program Evaluation  (1-3 credit hours)
A project or problem in research in education for graduate students, supervised by members of graduate faculty. Research chosen on basis of individual students' interests and not to be part of thesis or dissertation research.

Prerequisite: ELP 532
Typically offered in Fall, Spring, and Summer

ELP 693  Master's Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: ELP 532
Typically offered in Fall and Spring

ELP 695  Master's Thesis Research  (1-9 credit hours)
Thesis research.

Prerequisite: ELP 532
Typically offered in Fall and Spring

ELP 696  Summer Thesis Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: ELP 532
Typically offered in Summer only

ELP 699/EMS 699/EOE 699/EAC 699/ECD 699/ECI 699  Master's Thesis Preparation  (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall and Spring
ELP 720 Cases In Educational Administration (3 credit hours)
Utilization of case study and case simulation approach to study of school administration. Development and application of administrative concepts to simulated situations and to actual case histories. View of administrative process as a decision-making process.
Prerequisite: Graduate standing
Typically offered in Fall only

ELP 724 Contemporary Educational Thought (3 credit hours)
Reading and discussion of 20th-century works in educational philosophy. Consideration of such movements as pragmatism, reconstruction, perennialism and existentialism.
Typically offered in Fall, Spring, and Summer

ELP 728 School Law For the Administrator (3 credit hours)
Comprehensive study of constitutional, statutory and case law as related to elementary and secondary school administration. Emphasis on legal issues associated with governance, finance, property, personnel and curriculum.
Typically offered in Spring only

ELP 729 Educational Finance (3 credit hours)
Historical and sociopolitical contextual analysis of underlying values, methodologies and policies associated with economic and financial planning of K-12 education (e.g., efficiency, equity, and liberty) and the economic and financial mechanisms used to generate, distribute, and expend revenues for educational purposes.
Typically offered in Fall only

ELP 735 Policy Research in Education (3 credit hours)
This course will draw on both classic and contemporary materials in educational policy research and will primarily focus on the substance of policy research rather than methodology. It addresses research pertaining to the foundations, implementation and evaluation of policy in all levels and sectors of the educational system. Major attention will be given to education in the United States, with comparative perspectives included.
Typically offered in Fall, Spring, and Summer

ELP 736 Qualitative Research In Education and Policy Analysis (3 credit hours)
Provision of public school personnel and educational policy analysts with research training and experience to address educational research and policy problems using qualitative methods. Qualitative research design and strategies; data collection, management and analysis; interpretation and writing; qualitative evaluation and formation as applied particularly to educational research and policy analysis.
Typically offered in Fall only

ELP 737 Advanced Qualitative Applications in School Administration and Policy (3 credit hours)
Application of advanced qualitative methods and action research in school administration and policy analysis. Research proposal development, article preparation, evaluation of qualitative and action research, discussion of theoretical and methodological issues, computer analysis of qualitative data.
Prerequisite: ELP 736
Typically offered in Spring only

ELP 742 Applied Research Methods In Education (3 credit hours)
Through use of simulated educational settings, consideration given to development of research proposals or plans, selection and/or development of appropriate measurement instruments and purposes and functions of various statistical designs and procedures. Preparation and analysis of simulated data using computer-based statistical packages, interpretation of results and production of a research report.
Typically offered in Spring only

ELP 751 Politics of P-12 Education (3 credit hours)
Analysis of political interactions of individuals and groups in P-12 education, specifically, how politics shapes educational decisions within a federal system of governance. Topics covered include micropolitics and macropolitical systems at the school, district, municipal, state, and federal levels, as well as political culture, interest groups, advocacy coalitions, and institutions. Doctoral student standing required.
Typically offered in Fall only

ELP 752 Theories Framing Curriculum Inquiry (3 credit hours)
Introduction to different curricula research paradigms and/or epistemologies and the philosophies upon which they are founded within the context of education. Develop an understanding of the philosophies upon which different research paradigms or epistemologies are found, particularly positivism, realism, neo-realism, interpretivism, phenomenology, hermeneutics, narrative orientations, critical theory, feminism, race-based approaches, lesbian/gay orientations, and postmodernism.
Prerequisite: Graduate standing
Typically offered in Spring only

ELP 753 Data Decision Making for School Administrators (3 credit hours)
Understand the purposed and uses of school data for research-based school improvement. Understand different types of assessment needed for school and district-wide improvement. Develop models of administrative decision making incorporating key goals, resources, curriculum alignment, data, assessment, and evaluation. Doctoral student status required.
Typically offered in Spring only

ELP 756 Organizational Leadership & Management for School Leaders (3 credit hours)
Prepares district-level administrators to analyze the changing nature of the superintendency, including major management and leadership responsibilities and leadership approaches. Operational domains examined include school governance and organizational theory, school boards, school district policy, collaborative leadership, material and human resource management, systemic and sustainable reform, contemporary challenges, and personal practices management. Doctoral standing required.

ELP 757 Research in P-12 Administrative Leadership (3 credit hours)
Apply theories of administrative leadership to daily practice. Understand, develop, and utilize theory and research in leadership to inform and improve practice. Analysis of macro and micro level forces impacting administrative leadership at the building and district level. Doctoral student status required.
Typically offered in Spring only
ELP 780 Evaluation Theory and Practice In Education (3 credit hours)
Review of educational program evaluation with emphasis on (1) theory and conceptual models of evaluation, (2) evaluation design, and (3) environmental practical factors influencing design and implementation of evaluation studies.

Typically offered in Fall only

ELP 789 Personnel Recruitment, Selection, Development and Appraisal in Education (3 credit hours)
Issues, models, theories, research and applications in the evolving field of educational personnel and human resources administration with emphasis on recruitment, selection, and development.

Typically offered in Summer only

ELP 795 Special Topics (1-6 credit hours)
Special Topics in Educational Research and Leadership

ELP 820 Special Problems In Education (1-6 credit hours)
Opportunity for graduate students in education to study problem areas in professional education under direction of member of graduate faculty.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

ELP 851 Internship In Educational Leadership and Program Evaluation (1-9 credit hours)
Utilization of participant-observer role and required participation in selected educational situations with emphasis upon development of observational skills, ability to record relevant observations by means of written journals, skills in analyzing experiences identifying critical incidents and projection of events and consequences. Required development of possible alternative courses of action in various situations, selection of one of alternatives and evaluation of consequences of selected course of action.

Prerequisite: Nine hrs. in grad.-level courses
Typically offered in Fall, Spring, and Summer

ELP 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall only

ELP 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

ELP 891 Problems Of Research Design In Education (1-3 credit hours)
 Provision of individualized but structured investigation of alternative problem definitions, research methodologies and statistical analyses for a problem of student's choosing, usually associated with thesis or dissertation. In small groups or individually with instructor, student consideration of research design, measurements and statistical analysis necessary to conduct research.

Prerequisite: ELP 742
Typically offered in Fall, Spring, and Summer

ELP 892 Research Projects In Educational Leadership and Program Evaluation (1-3 credit hours)
A project or problem in research in education for graduate students, supervised by members of graduate faculty. Research chosen on basis of individual students' interests and not to be part of thesis or dissertation research.

Typically offered in Fall, Spring, and Summer

ELP 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

ELP 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ELP 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

ELP 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

Education (ED)

ED 100 Intro to Education (2 credit hours)
This course serves as an introduction to the field of education and as an orientation to the College and University experience. Students will examine the knowledge, skills, and dispositions necessary to become effective educators of diverse populations. Topics include student success strategies, professional standards for teachers, and resources in the College of Education. This course is restricted to College of Education students only.

Restriction: College of Education Students only, others by permission of the College of Education
GEP U.S. Diversity
Typically offered in Fall only
ED 101  Freshman Teaching Fellows Forum I  (1 credit hours)
Topics related to educational issues and requirements of the Teaching Fellows program. Topics will include current practices, policies and research in education. Restricted to Students Admitted to the Teaching Fellows Program

Typically offered in Fall only

ED 103  Intro to University Education  (1 credit hours)
Developmental and academic topics to assist students as they make well-informed decisions about majors and careers. Through technology-assisted plenary and small group seminars, students will examine the knowledge, skills and dispositions necessary to become globally aware, ethical, reflective students of diverse populations in the 21st century. Topics include academic skills, student success strategies, community and diversity; major and career decision making; assessment of interests, skills, and values; available university resources; overview of university majors and minors as well as policies and procedures. This course is restricted to Wake STEM Early College students only.

Typically offered in Fall only

ED 104  Intro to University Education II  (1 credit hours)
Developmental and academic topics to assist students as they make well-informed decisions about majors and careers. Through technology-assisted plenary and small group seminars, students will examine the knowledge, skills, and dispositions necessary to become globally aware, ethical, reflective students of diverse populations in the 21st century. Topics include academic skills, student success strategies, community, and diversity; major and career decision making; assessment of interests, skills, and values; available university resources; overview of university majors and minors as well as policies and procedures. This course is restricted to Wake STEM Early College students only. Students will be required to provide their own transportation if they choose a co-curricular activity that is off campus.

Restriction: This course is restricted to NC State Wake STEM Early College students.

Typically offered in Spring only

ED 150  Students Advocating for Youth I  (1 credit hours)

Typically offered in Fall only

ED 151  Students Advocating for Youth II  (1 credit hours)
Continuing to build upon a passion for advocacy. Understanding how legislation and policy affects youth advocacy and youth organizations. Exploring changes within the career field. Exploring peer influence processes among youth. Practical youth advocacy.

Prerequisite: ED 150

Typically offered in Spring only

ED 201  Sophomore Teaching Fellows Forum I  (1 credit hours)
Topics related to educational issues and requirements of the Teaching Fellows program. Topics will include current practices, policies and research in education.

Prerequisite: Students in Teaching Fellows Program

Typically offered in Fall only

ED 204  Introduction to Teaching in Today's Schools  (2 credit hours)
Overview of teaching as work and as a profession in today's schools. Course focuses on establishing a respectful environment for a diverse student population, dispositions and practices required for effective teaching, integration of digital technology into K-12 settings, and taking informed action through service learning. The course has a required fieldwork component in local K-12 schools, and students are responsible for their own transportation to and from the schools. Students are required to purchase intern liability insurance to participate in this course. Contact University Insurance and Risk Management for details on acquiring the insurance and the current charge, which typically ranges between $12-50 depending on the year and organization used.

Prerequisite: Sophomore standing; Corequisite: ECI 204, or EMS 204, or EMS 205, or TDE 202

Typically offered in Fall and Spring

ED 296/ECI 296  Special Topics in Education  (1-3 credit hours)
Individual or group study of particular areas of education at the freshman and sophomore levels. Specific topics will vary from semester to semester.

Typically offered in Fall and Spring

ED 299/FL 299  Field Experience for 21st Century Teaching  (1 credit hour)
This course has a required fieldwork component in local K-12 schools, and students are responsible for their own transportation to and from the schools. Students are required to purchase intern liability insurance to participate in this course. Contact University Insurance and Risk Management for details on acquiring the insurance and the current charge. This course is restricted to Foreign Language Education majors.

Prerequisite: ECI 204 and ED 204

Typically offered in Spring only

ED 301  Junior Teaching Fellows Forum I  (1 credit hours)
Topics related to educational issues and requirements of the Teaching Fellows program. Topics will include current practices, policies and research in education. Restricted to Students Admitted to the Teaching Fellows Program

Typically offered in Fall only

ED 302  Junior Teaching Fellows Forum II  (1 credit hours)
Topics related to educational issues and requirements of the Teaching Fellows program. Topics will include current practices, policies and research in education. Restricted to Students Admitted to the Teaching Fellows Program

Typically offered in Spring only
ED 311 Classroom Assessment Principles and Practices (2 credit hours)
This course will enable candidates to understand and use appropriate classroom assessment practices to promote positive student achievement. Candidates will learn to use knowledge of standards, student needs, and data-driven instruction to design and implement formative and summative assessments. ED 311 also examines the rationale for assessment, implications of assessment, and the varied ways assessment data is used by stakeholders both within and outside of the K-12 classroom.

Prerequisite: Admission to Teacher Education Candidacy (gpa 2.75) AND course prerequisite of ED 204, or ELM 250, or AEE 206; Co-requisite: ED 311

Typically offered in Fall and Spring

ED 312 Classroom Assessment Principles and Practices Professional Learning Lab (1 credit hours)
This class is a co-requisite professional learning lab to ED 311. Classroom Assessment Principles and Practices, wherein teacher candidates are exposed to practical applications of the ED 311 course topics. The course has a required fieldwork component in local K-12 schools, and candidates are responsible for their own transportation to and from the schools. Candidates are required to purchase internship liability insurance to participate in this course. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge. This course is restricted to Teacher Education majors.

Course Prerequisite / Co-requisite: P-R: Admission to Candidacy; Co-R: ED 311

Prerequisite: Admission to Teacher Education Candidacy (gpa 2.75) and ED 204, ELM 250, or AEE 206; Co-requisite: ED 311

Typically offered in Fall and Spring

ED 403 Teaching Fellows Senior Seminar (1 credit hours)
A casebook study of first-year teacher experiences and an examination of professional, ethical, and legal issues in education as found in cases dealing with new teachers.

Prerequisite: Senior standing

Typically offered in Fall and Spring

ED 496/ECI 496 Special Topics in Education (1-3 credit hours)
Individual or group study of special topics in professional education. The topic and mode of study are determined by the faculty member after discussion with the student.

Prerequisite: Junior standing or Senior standing

Typically offered in Fall and Spring

ED 507 Principles of Developing and Interpreting Assessment (2 credit hours)
Designed to enable students to understand and use appropriate classroom assessment practices by applying knowledge of pedagogy and development to high-quality strategies for formative and summative assessment. Students will explore best practices using developmentally-appropriate assessment strategies including authentic assessment, portfolios, and electronic portfolios, real-time feedback, open-and closed-ended formal assessments, and standardized testing. Particular attention will be paid to examining the rationale for assessment, and the implications of assessment.

Typically offered in Fall, Spring, and Summer

ED 508 Exploring Diversity in Classroom and Community (3 credit hours)
Students will explore and apply the major philosophical and historical influences to current educational context as they relate to issues of diversity. Focus will be placed on theoretical and practical issues of diversity in classroom settings, especially related to culture, race, gender, ethnicity, language, and socio-economic levels. (Field-based experiences will be required).

Typically offered in Fall, Spring, and Summer

ED 569 Teaching Internship: MAT (4 credit hours)
A supervised teaching experience requiring a minimum of 10 consecutive full-time weeks in an appropriate school classroom. Designed to develop the knowledge, skills, and dispositions necessary for teaching at the elementary, middle and/or secondary level. Includes regularly scheduled clinical observations and conferences. Requires successful completion of at least 21 hrs. in the MAT program and approval by specialty area faculty. Student responsible for transportation to placement site.

Typically offered in Fall and Spring

ED 570 Classroom Action Research (1 credit hours)
Provides a brief introduction to educational research focusing specifically on classroom action research. Requires admission to MAT; completion of 6 hours in the program.

Typically offered in Fall and Spring

ED 571 Inquiry and Professional Development (1 credit hours)
Builds on earlier course work (ED 570) preparing students to refine an action research proposal, collect data in a school setting, write a report, and to identify resources and activities that will support their ongoing professional development; requires 9 hours of graduate credit in the MAT curriculum.

Typically offered in Fall, Spring, and Summer

ED 572 Teacher Leadership (1 credit hours)
This course explores the multiple contexts, roles, and approaches to teacher leadership in classrooms, schools, communities, and professional organizations. Requires at least 30 credit hours in the MAT program.

Typically offered in Fall and Spring

ED 590 Special Problems in Teaching and Learning (1-6 credit hours)
In-depth study of topical problems in teaching and learning of current and special interest to K-12 Classroom teachers.

Typically offered in Fall, Spring, and Summer

ED 605 Special Problems in Teaching (1-3 credit hours)
In-depth study of topical problems in teaching selected from areas of current concern to K-12 teachers.

Prerequisite: Graduate standing

ED 700 Introduction to Research Design in Education (3 credit hours)
Survey of the field of educational research specifically with regard to the modes of inquiry, variety of methodologies, and ethical standards for conducting research with human participants. Limited to doctoral students in Education or by permission of instructor.

Typically offered in Fall only
ED 710  Applied Quantitative Methods in Education I (3 credit hours)
This course is designed for educational researchers and leaders to gain experience with designing and evaluating research using a quantitative approach to answer research questions in educational research and policy analysis. Students will examine design issues in research, create data sets, develop research questions from data provided, use a variety of descriptive and inferential procedures to answer formulated research questions, interpret the results and write the results in the language of educational research. Restricted to doctoral students in Education or by permission of instructor.

Prerequisite: ED 700, or ECI 510, or ELP 532, or ST 507
Typically offered in Fall, Spring, and Summer

ED 711  Applied Quantitative Methods in Education II (3 credit hours)
Students will apply and enhance their quantitative skills through analysis of existing datasets. Course goals include practicing and extending Multiple Regression knowledge and skills, generating and testing hypotheses in a multiple regression framework, and appropriately disseminating results. Restricted to doctoral students in Education Research only.

Prerequisite: ED 710
Typically offered in Fall and Spring

ED 712  Survey Methods in Educational Research (3 credit hours)
Introduces students to the skills and resources needed to design and conduct a survey in educational settings. Students who take this course will be able to identify and develop specific survey objectives, design survey studies, sample respondents, develop reliable and valid self-administered questionnaires, administer surveys, and process data.

Prerequisite: ED 710
Typically offered in Fall only

ED 730  Introduction to Qualitative Research in Education (3 credit hours)
Design of qualitative studies, conduct of field work including open-ended interviews and participant observation, analysis of data and understanding of theoretical and philosophical background of this research approach.

Typically offered in Fall, Spring, and Summer

ED 731  Advanced Qualitative Research and Data Analysis in Education (3 credit hours)
Intensive course in the use of field-based and general qualitative research data analysis methods in the social study of education. The course is to help participants acquire skills and gain experience in using various methodological and analytical research techniques. The course emphasis is on the collection, management, analysis, and interpretation of qualitative data.

Prerequisite: ELP 736, EAC 785 or ED 730
Typically offered in Fall and Spring

ED 750/EDP 750  Mixed Methods Research in Education (3 credit hours)
Explores the theoretical and practical issues surrounding the combining of quantitative and qualitative methods in educational research studies. It addresses how to design, implement and write-up mixed methods research as well as how to critically review and interpret mixed methods research studies.

Prerequisite: ED 711, ED 730, ST 507, ELP 736 or equivalent and/or permission of the instructor
Typically offered in Fall and Spring

ED 755  Scholar Leader: Diversity and Equity in Schools and Communities (3 credit hours)
The objective of this course is to inform you about the research and theories related to diversity (race/ethnicity, gender, social class, sexuality, ability, intersectionality and more) and equity in schools and communities for application to your own personal and professional experiences. This process will provide you with a foundation from which you may base your own decisions in your profession. As the course proceeds, your role will be to try to understand what you hear and read and to ask questions, to formulate an opinion about the theories/concepts that are presented, and to connect what you read to your own experiences as a human being, graduate student, and professional.

Restriction: Doctoral standing and (13ELPPHD, 13LTSPHD, 13TELSPHD)
Typically offered in Fall, Spring, and Summer

ED 756  Scholar Leader: Systemic Change in Education (3 credit hours)
This is a required course for students in College of Education PhD programs. It is designed to help prepare students to engage in informed analysis, critique and planning of education policies and programs designed to foster systemic changes in K-16 education. A central focus will be the intersection of research, policy, and practice in efforts to update and improve education systems, and the social and political complexities of educational reform.

Restriction: Doctoral standing and (13ELPPHD, 13LTSPHD, 13TELSPHD)
Typically offered in Fall and Spring

ED 795  Special Topics in Education Research (3-6 credit hours)
This course provides in-depth instruction and applications in new or emerging areas of educational research, studies or venues. May be repeated for credit if topic changes. Doctoral students in education only.

Typically offered in Fall, Spring, and Summer
Educational Psychology (EDP)

EDP 304 Educational Psychology (3 credit hours)
Psychological principles applied to education, including cognitive and personality development, individual differences, learning and behavior theory, cognitive strategies for learning and remembering, critical thinking and problem-solving strategies, student motivation, classroom management techniques, components of teacher effectiveness, measurement and student evaluation procedures, characteristics of exceptional children, mainstreaming in the classroom, and multicultural education.

Prerequisite: Sophomore standing
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

EDP 370 Applied Child Development (3 credit hours)
Students will explore how biological, cognitive, and social/emotional development affects children's learning and behavior. The course will focus on applying important theories and current findings in development to issues in education such as lesson planning, curriculum design, behavior management, motivation, an appropriate assessment. Students will also apply knowledge of development to issues such as creating actively engaging individuated experiences to deal with gifted students, students with diverse ethnic or cultural backgrounds, and students with exceptionalities or disabilities.

Prerequisite: Sophomore standing
GEP Social Sciences
Typically offered in Fall only

EDP 476/PSY 476 Psychology of Adolescent Development (3 credit hours)
Theories, principles, and issues of human psychological development emphasizing adolescence. Cognitive, social, and physical changes; their interaction. Implications for teaching and parenting adolescents.

Prerequisite: PSY 200 or EDP 304
Typically offered in Summer only

EDP 504 Advanced Educational Psychology (3 credit hours)
A critical appraisal of current psychological findings relevant to educational practice and theory.

Prerequisite: Graduate standing
Typically offered in Spring only

EDP 560 Educational Testing and Measurement (3 credit hours)
The study of principles of educational testing and measurement, particularly classroom assessment, including norm and criterion referenced assessment, classroom testing methods and principles, standardized testing and measurement, item analysis, and an introduction to basic descriptive statistics. A brief introduction to innovative assessment is also included.

Prerequisite: Graduate standing
Typically offered in Spring only

EDP 575/ECD 575 Multicultural Lifespan Development (3 credit hours)
This course surveys theories, principles, and issues of psychological development throughout the lifespan. Emphasis will be placed on understanding current developmental research and its application to the enhancement of development from birth to late adulthood. Implications for helping professionals working in multicultural contexts will be provided.

Prerequisite: Six Hours of Graduate Study
Typically offered in Spring and Summer

EDP 582/PSY 582 Adolescent Development (3 credit hours)
Current theories and research on development during adolescence. Topics include: physical growth, cognitive changes, relationships with peers, parents and teachers, quest for identity and independence, morality and sexuality.

Prerequisite: 6 hours in PSY
Typically offered in Fall only

EDP 590 Special Problems in Educational Psychology (1-6 credit hours)
In-depth study of topical problems in cognitive, motivation, assessment, or other educational psychology area of current and special interest to educators.

Typically offered in Fall, Spring, and Summer

EDP 605 Special Problems in Educational Psychology (1-6 credit hours)
In-depth study of topical problems in educational psychology selected from areas of current concern to educators.

Typically offered in Fall, Spring, and Summer

EDP 696 Summer Thesis Res (1 credit hours)

EDP 704 Theories and Research in Educational Psychology (3 credit hours)
Review and synthesis of pertinent literature in specialized topics and areas of research in educational psychology. Topic selection will vary by semester and instructor. Graduate standing or permission of instructor.

Doctoral students only (DR)
Typically offered in Fall only

EDP 723 Motivation in Education (3 credit hours)
The purpose of this course is to inform students about motivation theories and how various concepts from these theories are related to education practice. The course components are designed to provide students with an understanding of research in motivation, as well as the relationships between theoretical perspectives of human motivation and the teaching practice.

P: ED 700 or equivalent
Typically offered in Spring only
EDP 750/ED 750  Mixed Methods Research in Education  (3 credit hours)
Explores the theoretical and practical issues surrounding the combining of quantitative and qualitative methods in educational research studies. It addresses how to design, implement and write-up mixed methods research as well as how to critically review and interpret mixed methods research studies.
Prerequisite: ED 711, ED 730, ST 507, ELP 736 or equivalent and/or permission of the instructor
Typically offered in Fall and Spring

EDP 896  Summer Dissert Res  (1 credit hours)

EGR-Engineering Master’s (EGR)

EGR 501  Engineering Leadership and Strategic Change  (3 credit hours)
In the current business environment, an understanding of leadership and change management is essential to career success. The objective of this course is to provide practitioners in technical fields the knowledge to lead, align and transform the human element, individuals and teams, to achieve organizational performance excellence. The class includes both individual and collaborative (team) learning. An engineering, technical, or scientific undergraduate degree is required.
Typically offered in Fall and Spring

EGR 503  Statistical Engineering using Six Sigma DMAIC Process  (3 credit hours)
Statistical Engineering: systematic approach (Six Sigma DMAIC methodology) for improving manufacturing and business processes and products using advanced graphical and statistical methods. Defining the improvement opportunity, measurement system analysis (MSA), Failure Mode and Effects Analysis (FMEA), data collection, graphical and statistical analysis, design of experiment (DOE) methods, and statistical process control (SPC) methods. Application of statistical engineering to business and manufacturing case studies.

ST 361 or ST 370 or Entry Level Statistics
Typically offered in Fall and Spring

EGR 505  Managerial Finance for Engineers  (3 credit hours)
In the current business environment, familiarity with and appreciation of finance is essential to career success. Technically competent managers must be able to speak the common language of business and to understand how their work affects the performance of their organization. The objective of this course is to provide practitioners in technical fields the financial know-how to plan, control and make decisions that achieve organizational performance excellence. The class includes both individual and collaborative (team) learning. An engineering, technical or scientific undergraduate degree is required.
Typically offered in Fall and Spring

EGR 506  Managing New Hi Tech Product Launches  (3 credit hours)
This course covers new high-tech product development and launch from the perspective of the technical manager responsible for developing and launching new products and new lines of business within the high tech firm. Topics cover the entire spectrum of

Requirement: Graduate standing in Engineering
Typically offered in Spring and Summer

EGR 507  Product Life Cycle Management  (3 credit hours)
This course covers the management of complex technical products during all phases of the product life cycle. It is a broad survey of all the tools needed by the technical product manager throughout the life cycle of a complex product. The course is taught

Requirement: Graduate standing in Engineering
Typically offered in Fall, Spring, and Summer

EGR 590  Special Topics in Engineering  (1-6 credit hours)
Discussion of special topics in engineering. Identification of various specific topics and prerequisites for each section from term to term.
Typically offered in Fall, Spring, and Summer

EGR 688  Non-Thesis Masters Continuous Registration-Half Time Registration  (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, final master's exam, etc.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

Electrical and Computer Engineering (ECE)

ECE 109  Introduction to Computer Systems  (3 credit hours)
Introduction to key concepts in computer systems. Number representations, switching circuits, logic design, microprocessor design, assembly language programming, input/output, interrupts and traps.
Typically offered in Fall, Spring, and Summer

ECE 200  Introduction to Signals, Circuits and Systems  (4 credit hours)
Ohm's law and Kirchoff's laws; circuits with resistors, phototransistors, diodes and LEDs; rectifier circuits; first order RC circuits; periodic signals in time and frequency domains, instantaneous, real and apparent power; DC and RMS value; magnitude and power spectra, dB, dBW, operational amplifier circuits, analog signal processing systems including amplification, clipping, filtering, addition, multiplication, AM modulation sampling and reconstruction. Weekly hardware laboratory utilizing multimeter, function generator, oscilloscope and spectrum analyzer and custom hardware for experiments on various circuits and systems.
Prerequisite: Cum GPA 2.5 or above (or NTR), C or better in MA 241 and PY 205
Typically offered in Fall, Spring, and Summer

ECE 209  Computer Systems Programming  (3 credit hours)
Computer systems programming using the C language. Translation of C into assembly language. Introduction to fundamental data structures: array, list, tree, hash table.
Prerequisite: Grade of C- or better in ECE 109
Typically offered in Fall, Spring, and Summer
ECE 211 Electric Circuits (4 credit hours)
Introduction to theory, analysis and design of electric circuits. Voltage, current, power, energy, resistance, capacitance, inductance. Kirchhoff's laws node analysis, mesh analysis, Thévenin's theorem, Norton's theorem, steady state and transient analysis, AC, DC, phasors, operational amplifiers, transfer functions.
Prerequisite: C- or better in ECE 200 and Corequisite: ECE 220
Typically offered in Fall, Spring, and Summer

ECE 212 Fundamentals of Logic Design (3 credit hours)
Introduction to digital logic design. Boolean algebra, switching functions, Karnaugh maps, modular combinational circuit design, latches, flip-flops, finite state machines, synchronous sequential circuit design, datapaths, memory technologies, caches, and memory hierarchies. Use of several CAD tools for simulation, logic minimization, synthesis, state assignment, and technology mapping.
Prerequisite: C- or better in ECE 109
Typically offered in Fall, Spring, and Summer

ECE 220 Analytical Foundations of Electrical and Computer Engineering (3 credit hours)
This course is designed to acquaint you with the basic mathematical tools used in electrical and computer engineering. The concepts covered in this course will be used in higher level courses and, more importantly, throughout your career as an engineer. Major topics of the course include complex numbers, real and complex functions, signal representation, elementary matrix algebra, solutions to linear systems of equations, linear differential equations, Laplace transforms used for solving linear differential equations, Fourier series and transforms and their uses in solving ECE problems. EE and CPE Majors Only.
Prerequisite: C- or better in ECE 200
Typically offered in Fall, Spring, and Summer

ECE 230 Linear Systems (3 credit hours)
Prerequisite: C- or better in ECE 211 and ECE 220.
Typically offered in Fall, Spring, and Summer

ECE 302 Microelectronics (4 credit hours)
Introduction to the physics of semiconductors, PN Junctions, BJTs and MOS field Effect Transistors: Physics of operation, IV characteristics, load line, quiescent point of operation, PSPICE analysis; diode circuit analysis; voltage regulation; Single Stage Transistor Amplifiers: Common Emitter and Common Source configurations, biasing, inverting and non-inverting amplifiers; follower circuits; calculation of small signal voltage gain, current gain, coupling and bypass capacitors; Multistage ac-coupled amplifiers; small signal modeling; input resistance and output resistance; logic inverters.
Prerequisite: A grade of C- or better in ECE 211
Typically offered in Fall, Spring, and Summer

ECE 303 Electromagnetic Fields (3 credit hours)
This course prepared the students to formulate and solve electromagnetic problems relevant to all fields of electrical and computer engineering and that will find application in subsequent courses in RF circuits, photonics, microwaves, wireless networks, computers, bioengineering, and nanoelectronics. Primary topics include static electric and magnetic fields, Maxwell's equations and force laws, wave propagation, reflection and refraction of plane waves, transient and steady-state behavior of waves on transmission lines. Restriction: EE and CPE Majors Only.
Prerequisite: A grade of C- of better in ECE 211 and ECE 220
Typically offered in Fall, Spring, and Summer

ECE 305 Principles of Electromechanical Energy Conversion (3 credit hours)
Three-phase circuits and power flow, analysis of magnetic circuits, performance of single-phase and three-phase transformers, principles of electromechanical energy conversion, steady-state characteristics and performance of alternating current and direct current machinery.
Prerequisite: C- or better in ECE 211 or ECE 331
Typically offered in Fall and Spring

ECE 306 Introduction to Embedded Systems (3 credit hours)
Introduction to designing microcontroller-based embedded computer systems using assembly and C programs to control input/output peripherals. Use of embedded operating system.
Prerequisite: C- or better in ECE 209 and ECE 212
Typically offered in Fall and Spring

ECE 308 Elements of Control Systems (3 credit hours)
Analog system dynamics, open and closed loop control, block diagrams and signal flow graphs, input-output relationships, stability analyses using Routh-Hurwitz, root-locus and Nyquist, time and frequency domain analysis and design of analog control systems. Use of computer-aided analysis and design tools. Class project. EE, CPE, BME majors only.
Prerequisite: (ECE 220 and ECE 211) or BME 311; Co-requisite: ECE 301
Typically offered in Fall and Spring

ECE 309 Data Structures and Object-Oriented Programming for Electrical and Computer Engineers (3 credit hours)
Advanced programming topics focusing on data structures and object-oriented programming. Common data structures, including linked lists, hash tables, trees, balanced trees, heaps, graphs, and B-trees, are described, analyzed, and implemented. Object-oriented programming topics, classes, inheritance, polymorphism, abstract types, and generic types are described and applied to program design.
Prerequisite: C- or better in ECE 209
Typically offered in Fall and Spring

ECE 310 Design of Complex Digital Systems (3 credit hours)
Design principles for complex digital systems. Decomposition of functional and interface specifications into block-diagrams and simulation with hardware description languages. Synthesis of gate-level descriptions from register-transfer level description
Prerequisite: A grade of C- or better in ECE 212
Typically offered in Fall and Spring
ECE 331 **Principles of Electrical Engineering** (3 credit hours)
Concepts, units and methods of analysis in electrical engineering. Analysis of d-c and a-c circuits, characteristics of linear and non-linear electrical devices; principles of operational amplifiers; transformers; motors; and filters.
Prerequisite: PY 208 and a C or better in MA 241
Typically offered in Fall, Spring, and Summer

ECE 380 **Engineering Profession for Electrical Engineers** (1 credit hours)
Introduction to engineering as a profession including issues surrounding electrical engineering. Topics include professional and ethical responsibilities, risks and liabilities, intellectual property, and privacy. Economic issues including entrepreneurship and globalization.
Pre-requisites: C- or better in ECE 211 and ECE 212 and ECE 220
Typically offered in Fall and Spring

ECE 381 **Engineering Profession for Computer Engineers** (1 credit hours)
Introduction to engineering as a profession including issues surrounding computer engineering. Topics include professional and ethical responsibilities, risks and liabilities, intellectual property, and privacy. Economic issues including entrepreneurship and globalization.
Pre-requisites: C- or better in ECE 211 and ECE 212 and ECE 220
Typically offered in Fall and Spring

ECE 383 **Introduction to Entrepreneurship and New Product Development** (1 credit hours)
This course is part of the Engineering Entrepreneurs Program. Students work as team members on projects being led by seniors completing their senior capstone design. Students will be exposed to many areas of product development and will assist in the

Typically offered in Fall and Spring

ECE 384 **Practical Engineering Prototyping** (3 credit hours)
This course will teach prototyping skills, standard tools, and best practices to convert a project concept into a functioning, verifiable prototype. Course topics include understanding component specifications, system schematics, system functionality verification, power calculations and measurements, driver circuit designs, soldering and wiring procedures, basic MCU programming, Printed Circuit Board design and test, and debugging/test/verification tools/methods and procedures. Quick workshops on sensor interfacing, standard circuits and off-the-shelf systems, mobile app design, prototype packaging, and patent search resources will also be included in this course. Students will be required to complete several prototyping activities outside of class. This course is an open elective recommended to be taken before or at the same time as the capstone classes for Electrical and Computer (ECE) Engineering. Students are expected to have some basic knowledge about what is ac-dc, dc-dc voltage converters, motors, transistors, op-amps, and MOSFETS.
Prerequisites: (ECE 200 and ECE 209 and ECE 211) or their equivalent
Typically offered in Summer only

ECE 402 **Communications Engineering** (3 credit hours)
An overview of digital communications for wireline and wireless channels which focuses on reliable data transmission in the presence of bandwidth constraints and noise. The emphasis is on the unifying principles common to all communications systems, examples include digital telephony, compact discs, high-speed modems and satellite communications.
P: ECE 301 and ST 371; R: EE and CPE Majors Only
Typically offered in Fall, Spring, and Summer

ECE 380 **Introduction to Solid-State Devices** (3 credit hours)
Basic principles required to understand the operation of solid-state devices. Semiconductor device equations developed from fundamental concepts. P-N junction theory developed and applied to the analysis of devices such as varactors, detectors, solar cells, bipolar transistors, field-effect transistors. Emphasis on device physics rather than circuit
design.
P: ECE 302 or E 304; C: EE, CPE, NanoScience and Technology Majors Only
Typically offered in Fall and Spring

ECE 406/CSC 406/CSC 506/ECE 506 **Architecture Of Parallel Computers** (3 credit hours)
The need for parallel and massively parallel computers. Taxonomy of parallel computer architecture, and programming models for parallel architectures. Example parallel algorithms. Shared-memory vs.
switch design. Brief overview of advanced topics such as multiprocessor
prefetching and speculative parallel execution. Credit is not allowed for
more than one course in this set: ECE 406, ECE 506, CSC 406.

Typically offered in Fall and Spring

ECE 407 **Introduction to Computer Networking** (3 credit hours)
This course focuses on engineering principles of computer communications and networking, including layering concepts, overview of
protocols, architectures for local, metropolitan, and wide-area networks, routing protocols, internet operations, transport control and applications, emerging issues in computer networks. EE and CPE majors only.
Prerequisite: ECE 301
Typically offered in Fall and Spring
ECE 418/BME 418/BME 518 ECE 518 Wearable Biosensors and Microsystems (3 credit hours)
This course surveys the methods and application of wearable electronics and microsystems to monitor human biometrics, physiology, and environmental conditions. Topics covered include wearable electrocardiograms, blood-glucose monitors, electronic tattoos, wearable energy harvesting, "smart" clothing, body area networks, and distributed population networks. Critical comparison of different sensor modalities, quantitative metrics, and how their limitations in realistic applications define the selection, design, and operation criteria of one type of sensor over another will be considered.
Prerequisite: Senior standing
Typically offered in Fall only

ECE 420 Wireless Communication Systems (3 credit hours)
A study of applications of communication theory and signal processing to wireless systems. Topics include an introduction to information theory and coding, basics and channel models for wireless communications, and some important wireless communication techniques including spread-spectrum and OFDM. MATLAB exercises expose students to engineering considerations.
Prerequisite: ECE 402
Typically offered in Fall and Spring

ECE 421 Introduction to Signal Processing (3 credit hours)
Prerequisite: ECE 301
Typically offered in Fall, Spring, and Summer

ECE 422 Transmission Lines and Antennas for Wireless (3 credit hours)
Review of time-varying electromagnetic theory. A study of the analytical techniques and the characteristics of several useful transmission lines and antennas. Examples are coaxial lines, waveguides, microstrip, optical fibers and dipole, monopole and array antennas.
Prerequisite: ECE 303
Typically offered in Fall only

ECE 423 Introduction to Photonics and Optical Communications (3 credit hours)
This course investigates photonic devices at the component level and examines the generation, propagation, and detection of light in the context of optical communication systems. Topics include the design of simple optical systems and focuses on the use of lasers, fiber optics, and photodetectors. The labs include building a Michelson interferometer, preparing and coupling light to an optical fiber, characterizing LEDs and laser diodes and making a fiber optical link.
Prerequisite: ECE 303 or Permission of the Instructor
Typically offered in Fall only

ECE 424/ECE 524 Radio System Design (3 credit hours)
Introduction to communication theory and radio system design. Design and analysis of radio systems, such as heterodyne transceivers, and effects of noise and nonlinearity. Design and analysis of radio circuits: amplifiers, filters, mixers, baluns and other transmission line and discrete circuits.
Prerequisite: ECE 302
Typically offered in Spring only

ECE 426 Analog Electronics Laboratory (3 credit hours)
A hands on laboratory based course with two construction projects (dual power supply, high frequency buffer amplifier) and six breadboard based activities with a focus on operational amplifiers and their applications. Student must have a portable computer and 'Digilent Analog Discovery'. Topics include: amplifier performance, integrator/differentiator, filters, converters (I to V, V to I) and audio circuits.
Prerequisite: ECE 302
Typically offered in Fall and Spring

ECE 434 Fundamentals of Power Electronics (3 credit hours)
Design, analysis, modeling and control of DC-DC converters, DC-AC inverters, AC-DC rectifiers/converters, and AC-to-AC converters. Power conversion using switched high-voltage high-current semiconductors in combination with inductors and capacitors. Design of DC-DC, DC-AC, AC-DC, and AC-AC power converters as well as an introductions to design of magnetic components for use in power converters, applications to fuel cells, photovoltaics, motor drives, and uninterruptable power supplies.
Prerequisite: ECE 302 or equivalent
Typically offered in Fall only

ECE 436 Digital Control Systems (3 credit hours)
Discrete system dynamics, sampled-data systems, mathematical representations of analog/digital and digital/analog conversions, open-and -closed-loop systems, input-output relationships, state-space and stability analyses, time and frequency domain analysis with emphasis on time domain. Design and implementation of digital controllers. Design project including hardware implementation.
Prerequisite: ECE 308
Typically offered in Fall only

ECE 442 Integrated Circuit Technology and Fabrication (3 credit hours)
Semiconductor device and integrated-circuit processing and technology. Wafer specification and preparation, oxidation, diffusion, ion implantation, photolithography, design rules and measurement techniques.
Prerequisite: ECE 404
Typically offered in Spring only

ECE 451 Power System Analysis (3 credit hours)
Long-distance transmission of electric power with emphasis on load flow, economic dispatch, fault calculations and system stability. Applications of digital computers to power-system problems. Major design project.
Prerequisite: ECE 305
Typically offered in Fall only
ECE 452/ECE 552 Renewable Electric Energy Systems (3 credit hours)
Principles and characteristics of renewable energy based electric power generation technologies such as photovoltaic systems, wind turbines, and fuel cells. Main system design issues. Integration of these energy sources into the power grid. Economics of distributed generation. Credit is not allowed for both ECE 452 and ECE 552.
Prerequisite: ECE 305 or ECE 331
Typically offered in Spring only

ECE 453 Electric Motor Drives (3 credit hours)
Principles of electromechanical energy conversion; analysis, modeling, and control of electric machinery; steady state performance characteristics of direct-current, induction, synchronous and reluctance machines; scalar control of induction machines; introduction to direct- and quadrature-axis theory; dynamic models of induction and synchronous motors; vector control of induction and synchronous motors.
Prerequisite: A grade of C or better in ECE 305.
Typically offered in Spring only

ECE 455 Industrial Robotic Systems (3 credit hours)
Techniques of computer control of industrial robots: interfacing with synchronous hardware including analog/digital and digital/analog converters, interfacing noise problems, control of electric and hydraulic actuators, kinematics and kinetics of robots, path control, force control, sensing including vision. Major design project. EE, CPE, BME, JEM majors only.
Prerequisite: ECE 308
Typically offered in Spring only

ECE 456/ECE 556 Mechatronics (3 credit hours)
The study of electro-mechanical systems controlled by microcomputer technology. The theory, design and construction of smart systems; closely coupled and fully integrated products and systems. The synergistic integration of mechanisms, materials, sensors, interfaces, actuators, microcomputers, controllers, and information technology.
Prerequisite: ECE 308
Typically offered in Spring only

ECE 460/ECE 560 Embedded System Architectures (3 credit hours)
Concepts of architectures for embedded computing systems. Emphasis on hands-on implementation. CPU scheduling approaches to support multithreaded programs, including interrupts, cooperative schedulers, state machines, and preemptive scheduler (real-time kernel). Communication and synchronization between threads. Basic real-time analysis. Using hardware peripherals to replace software. Architectures and design patterns for digital control, streaming data, message parsing, user interfaces, low power, low energy, and dependability. Software engineering concepts for embedded systems. Students may not receive credit for both ECE 460 and ECE 560.
Prerequisite: C- or better in ECE 306
Typically offered in Fall only

ECE 461/ECE 561 Embedded System Design (3 credit hours)
Design and implementation of software for embedded computer systems. The students will learn to design systems using microcontrollers, C and assembly programming, real-time methods, computer architecture, interfacing system development and communication networks. System performance is measured in terms of power consumption, speed and reliability. Efficient methods for project development and testing are emphasized. Credit will not be awarded for both ECE 461 and ECE 561. Restricted to CPE and EE Majors.
Prerequisite: Grade of C- or better in ECE 460
Typically offered in Spring only

ECE 463/ECE 563 Microprocessor Architecture (3 credit hours)
Architecture of microprocessors. Measuring performance. Instruction-set architectures. Memory hierarchies, including caches, prefetching, program transformations for optimizing caches, and virtual memory. Processor architecture, including pipelining, hazards, branch prediction, static and dynamic scheduling, instruction-level parallelism, superscalar, and VLIW. Major projects.
Prerequisite: ECE 209 and ECE 212
Typically offered in Fall and Spring

ECE 464/ECE 564 ASIC and FPGA Design with Verilog (3 credit hours)
Design of digital application specific integrated circuits (ASICs) and Field Programmable Gate Arrays (FPGAs) based on hardware description languages (Verilog) and CAD tools. Emphasis on design practices and underlying methods. Introduction to ASIC specific design issues including verification, design for test, low power design and interfacing with memories. Required design project. Expected Prior Experience or Background: ECE 310 is useful but not assumed. Functionally, I assume that students are familiar with logic design, including combinational logic gates, sequential logic gates, timing design, Finite State Machines, etc.
Prerequisite: Grade of C or better in ECE 212 or equivalent.
Typically offered in Fall only

ECE 466/ECE 566 Compiler Optimization and Scheduling (3 credit hours)
Provide insight into current compiler designs dealing with present and future generations of high performance processors and embedded systems. Introduce basic concepts in scanning and parsing. Investigate in depth program representation, dataflow analysis, scalar optimization, memory disambiguation, and interprocedural optimizations. Examine hardware/software trade-offs in the design of high performance processors, in particular VLIW versus dynamically scheduled architectures. Investigate back-end code generation techniques related to instruction selection, instruction scheduling for local, cyclic and global acyclic code, and register allocation and its interactions with scheduling and optimization.
Prerequisites: ECE 209 or competency in any machine language programming and ECE 309 or CSC 316 or proficiency in either C or C++ programming using advanced data structures, like hash tables and linked lists. P: ECE 209 or competency in an
Typically offered in Spring only
ECE 468/CHE 468/CHE 568/ECE 568 Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems (3 credit hours)

Conventional and emerging nano-manufacturing techniques and their applications in the fabrication of various structures and devices. Review of techniques for patterning, deposition, and etching of thin films including emerging techniques such as an imprint and soft lithography and other unconventional techniques. Electronic and mechanical properties of 0 to 3-D nanostructures and their applications in nano-electronics, MEMS/NEMS devices, sensing, energy harvesting, storage, flexible electronics and nano-medicine. Credit for both ECE/CHE 468 and ECE/CHE 568 is not allowed.

Prerequisite: E 304
Typically offered in Fall only

ECE 470 Internetworking (3 credit hours)
Introduction, Planning and Managing networking projects, networking elements-hardware, software, protocols, applications; TCP/IP, ATM, LAN emulation. Design and implementation of networks, measuring and assuring network and application performance; metrics, tools, quality of service. Network-based applications, Network management and security.

Prerequisite: ECE 407 or CSC 401
Typically offered in Spring only

ECE 482/MAE 482 Engineering Entrepreneurship and New Product Development I (3 credit hours)
Applications of engineering, mathematics, basic sciences, finance, and business to the design and development of prototype engineering products. This course requires a complete written report and an end-of-course presentation. This is the first course in a two semester sequence. Students taking this course will implement their designed prototype in ECE 483; Senior Design Project in Electrical Engineering and Computer Engineering II-Engineering Entrepreneurs. Departmental approval required.

Typically offered in Fall and Spring

ECE 483/MAE 483 Engineering Entrepreneurship and New Product Development II (3 credit hours)
Applications of engineering, science, management and entrepreneurship to the design, development and prototyping of new product ideas. Based on their own new product ideas, or those of others, students form and lead entrepreneurship teams (eTeams) to prototype these ideas. The students run their eTeams as ‘virtual’ startup companies where the seniors take on the executive roles. Joining them are students from other grade levels and disciplines throughout the university that agree to participate as eTeam members. Departmental approval required.

Prerequisite: ECE 482
Typically offered in Fall and Spring

ECE 484 Electrical and Computer Engineering Senior Design Project I (3 credit hours)
Applications of engineering and basic sciences to the total design of electrical and/or computer engineering circuits and systems. Consideration of the design process including concept and feasibility study, systems design, detailed design, project management, cost effectiveness, along with development and evaluation of a prototype accomplished through design-team project activity. Supported with introduction to a parallel functions impacting engineering design process to including: industrial design, finance, operations, etc. EE and CPE Majors only.

Prerequisite: ECE 380 and ECE 301 and ECE 302 and ENG 331; Coreq: One 400-level ECE Elective
Typically offered in Fall and Spring

ECE 485 Electrical and Computer Engineering Senior Design Project II (3 credit hours)
Applications of engineering and basic sciences to the total design of electrical engineering circuits and systems. Consideration of the design process including feasibility study, preliminary design detail, cost effectiveness, along with development and evaluation of a prototype accomplished through design-team project activity. Complete written and oral engineering report required. EE and CPE majors only.

Prerequisite: ECE 484
Typically offered in Fall and Spring

ECE 488/PB 588/ECE 588/PB 488 Systems Biology Modeling of Plant Regulation (3 credit hours)
This course provides an introduction to the field of systems biology with a focus on mathematical modeling, gene regulatory network and metabolic pathway reconstruction in plants. Students will learn how to integrate biological data with mathematical, statistical, and computational approaches to gain new insights into structure and behavior of complex cellular systems. Students are expected to have a minimal background in calculus and basic biology. The course will build on these basic concepts and provide all students, regardless of background or home department, with the fundamental biology, mathematics, and computing knowledge needed to address systems biology problems.

Prerequisite: MA 131 or MA 141
Typically offered in Fall only
Solar and Thermal Energy Harvesting (3 credit hours)
This course studies the fundamental and recent advances of energy harvesting from two of the most abundant sources, namely solar and thermal energies. The first part of the course focuses on photovoltaic science and technology. The characteristics and design of common types of solar cells is discussed, and the known approaches to increasing solar cell efficiency will be introduced. After the review of the physics of solar cells, we will discuss advanced topics and recent progresses in solar cell technology. The second part of the course is focused on thermoelectric effect. The basic physical properties, Seebeck coefficient, electrical and thermal conductivities, are discussed and analyzed through the Boltzmann transport formalism. Advanced subject such as carrier scattering time approximations in relation to dimensionality and the density of states are studied. Different approaches for further increasing efficiencies are discussed including energy filtering, quantum confinement, size effects, band structure engineering, and phonon confinement.

ECE 492 Special Topics in Electrical and Computer Engineering (1-4 credit hours)
Offered as needed for development of new courses in electrical and computer engineering.

Typically offered in Fall and Spring

ECE 495 Individual Study in ECE (1-3 credit hours)
Independent investigation of a topic or research problem under faculty supervision. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty.

P: Appropriate 300-level Course; R: EE and CPE Majors Only. Department Approval Required

Typically offered in Fall, Spring, and Summer

ECE 498 Special Projects in ECE (1-3 credit hours)
Faculty-supervised special projects in electrical and/or computer engineering. Projects involve small groups of students, working collaboratively or independently, focused on a single theme, such as the design of a component or system. Requires a "Course Agreement for Students Enrolled in Non-Standard Courses," completed by the student and faculty member prior to registration by the department.

Prerequisite: At least one 300-level ECE course, 3.0 GPA; Restricted to: EE or CPE majors

Typically offered in Fall, Spring, and Summer

ECE 505 Neural Interface Engineering (3 credit hours)
This course investigates the engineering techniques to understand, repair, replace, or enhance neural systems. The topics to be covered includes the following: the history of bioelectricity phenomena, the basics of modern neuroscience in electrical engineering terms and models, design of functional electrical interfaces with the nervous system for stimulating and recording purposes, basics of electrochemistry development of various systems for neuromodulation, neuroprosthetics and neurorobotics applications such as pacemakers, cochlear implants and neuromotors.

Senior or graduate standing.

Typically offered in Fall only

ECE 506/ECE 406/CSC 406/CSC 506 Architecture Of Parallel Computers (3 credit hours)
The need for parallel and massively parallel computers. Taxonomy of parallel computer architecture, and programming models for parallel architectures. Example parallel algorithms. Shared-memory vs. distributed-memory architectures. Correctness and performance issues. Cache coherence and memory consistency. Bus-based and scalable directory-based multiprocessors. Interconnection-network topologies and switch design. Brief overview of advanced topics such as multiprocessor prefetching and speculative parallel execution. Credit is not allowed for more than one course in this set: ECE 406, ECE 506, CSC 406.

Typically offered in Fall and Spring

ECE 511 Analog Electronics (3 credit hours)
Analog integrated circuits and analog integrated circuit design techniques. Review of basic device and technology issues. Comprehensive coverage of MOS and Bipolar operational amplifiers. Brief coverage of analog-to-digital conversion techniques and swit

Prerequisite: ECE403

Typically offered in Fall only

ECE 513 Digital Signal Processing (3 credit hours)
Digital processing of analog signals. Offline and real-time processing for parameter, waveshape and spectrum estimation. Digital filtering and applications in speech, sonar, radar, data processing and two-dimensional filtering and image processing.

Prerequisite: ECE 421, B average in ECE and MA; Signals and Linear Systems

Typically offered in Fall only

ECE 514 Random Processes (3 credit hours)
Probabilistic descriptions of signals and noise, including joint, marginal and conditional densities, autocorrelation, cross-correlation and power spectral density. Linear and nonlinear transformations. Linear least-squares estimation. Signal detection.

Prerequisite: Statistics 371; Signals and Linear Systems; Linear Algebra; Calculus

Typically offered in Fall only

ECE 515 Digital Communications (3 credit hours)
This course is a first graduate-level course in digital communications. Functions and interdependence of various components of digital communication systems will be discussed. Statistical channel modeling, modulation and demodulation techniques, optimal receiver design, performance analysis methods, source coding, quantization, and fundamentals of information theory will be covered in this course.

Prerequisite: ECE 514, ST 371, Signals and Linear Systems; Linear Algebra

Typically offered in Spring and Summer
ECE 516  System Control Engineering  (3 credit hours)
Introduction to analysis and design of continuous and discrete-time dynamical control systems. Emphasis on linear, single-input, single-output systems using state variable and transfer function methods. Open and closed-loop representation; analog and digital simulation; time and frequency response; stability by Routh-Hurwitz, Nyquist and Liapunov methods; performance specifications; cascade and state variable compensation. Assignments utilize computer-aided analysis and design programs.
Prerequisite: ECE 435 or ECE 301  
Typically offered in Spring only

ECE 517/CSC 517  Object-Oriented Design and Development  (3 credit hours)
The design of object-oriented systems, using principles such as the GRASP principles, and methodologies such as CRC cards and the Unified Modeling Language (ULM). Requirements analysis. Design patterns Agile Methods. Static vs. dynamic typing. Metaprogramming. Open-source development practices and tools. Test-first development. Project required, involving contributions to an open-source software project.
Prerequisite: CSC 326 or ECE 309
Typically offered in Fall and Spring

ECE 518/ECE 418/BME 418/BME 518  Wearable Biosensors and Microsystems  (3 credit hours)
This course surveys the methods and application of wearable electronics and Microsystems to monitor human biometrics, physiology, and environmental conditions. Topics covered include wearable electrocardiograms, blood-glucose monitors, electronic tattoos, wearable energy harvesting, "smart" clothing, body area networks, and distributed population networks. Critical comparison of different sensor modalities, quantitative metrics, and how their limitations in realistic applications define the selection, design, and operation criteria of one type of sensor over another will be considered.
Prerequisite: Senior standing
Typically offered in Fall only

ECE 522/BME 522  Medical Instrumentation  (3 credit hours)
Fundamentals of medical instrumentation systems, sensors, and biomedical signal processing. Example instruments for cardiovascular and respiratory assessment. Clinical laboratory measurements, therapeutic and prosthetic devices, and electrical safety requirements. Students should have background in electronics design using operational amplifiers.
Typically offered in Spring only

ECE 523  Photonics and Optical Communications  (3 credit hours)
This course investigates photonic devices at the component level and examines the generation, propagation and detection of light in the context of optical communication systems. Topics include planar and cylindrical optical waveguides, LEDs, lasers, optical amplifiers, integrated optical and photodetectors, design tradeoffs for optical systems, passive optical networks, and wavelength division multiplexed systems.
Prerequisite: Graduate standing or Senior standing; Engineering Majors or Physics Majors
Typically offered in Spring only

ECE 524/ECE 424  Radio System Design  (3 credit hours)
Introduction to communication theory and radio system design. Design and analysis of radio systems, such as heterodyne transceivers, and effects of noise and nonlinearity. Design and analysis of radio circuits: amplifiers, filters, mixers, baluns and other transmission line and discrete circuits.
Prerequisite: ECE 302  
Typically offered in Spring only

ECE 530  Physical Electronics  (3 credit hours)
Properties of charged particles under influence of fields and in solid materials. Quantum mechanics, particle statistics, semiconductor properties, fundamental particle transport properties, p-n junctions.
Prerequisite: ECE 303, B average in ECE and MA
Typically offered in Fall only

ECE 531  Principles Of Transistor Devices  (3 credit hours)
Analysis of operating principles of transistor structures. Basic semiconductor physics reviewed and used to provide explanation of transistor characteristics. Development and usage of device-equivalent circuits to interpret semi-conductor-imposed limitations on device performance. Devices analyzed include MISFIT'S, HEMT'S, Bipolar transistors, PBT'S, heterojunction BJT'S and SIT's.
Prerequisite: ECE 404
Typically offered in Fall only

ECE 532  Principles Of Microwave Circuits  (3 credit hours)
Principles required to understand behavior of electronic circuits operating at microwave frequencies. Review of electromagnetics and establishing an understanding of techniques required for working with electronic circuits at microwave and millim
Prerequisite: ECE 422
Typically offered in Spring only

ECE 533  Power Electronics Design & Packaging  (3 credit hours)
This course introduces design of high-performance power electronic circuits where the integrated physical topology must be considered as part of the circuit, and provides an understanding of the multitude of parasitic elements created by circuit layout, materials and fabrication techniques. This prepares the student for high-density, high-frequency design of converters, gate drive circuits and resonant topologies. The student is also introduced to a power-electronics packaging lab and primary fabrication processes, such as Direct Bonded Copper (DBC) module construction with heavy-wire bonding, two-sided and 3D power modules in layered polymers, and high-voltage isolation of circuits with encapsulate in modules.
Prerequisite: ECE 434 or with permission of instructor  
Typically offered in Spring only

ECE 534  Power Electronics  (3 credit hours)
DC and AC analysis of isolated and non-isolated switch mode power supply. Basic converter topologies covered include: buck, boost and buck-boost and their transformer-couples derivatives. Design of close loop of these DC/DC converters. Power devices and their applications in DC/DC converters. Inductor and transformer design.
Prerequisite: ECE 302
Typically offered in Fall and Spring
ECE 535/MAE 535 Design of Electromechanical Systems (3 credit hours)
A practical introduction to electromechanical systems with emphasis on modeling, analysis, design, and control techniques. Provides theory and practical tools for the design of electric machines (standard motors, linear actuators, magnetic bearings, etc). Involves some self-directed laboratory work and culminates in an industrial design project. Topics include Maxwell's equations, electromechanical energy conversion, finite element analysis, design and control techniques.
Prerequisite: MA 341
Typically offered in Spring and Summer

ECE 536 Digital Control System Projects (3 credit hours)
Discrete system dynamics, sampled-data systems, mathematical representations of analog/digital and digital/analog conversions, open- and closed-loop systems, input-output relationships, state-space and stability analyses, time and frequency domain analysis with emphasis on time domain. Design and implementation of digital controllers. Case studies. Design project including hardware implementation.
Prerequisite: Graduate standing & ECE 436 or similar or consent of instructor
Typically offered in Fall only

ECE 538 Integrated Circuits Technology and Fabrication (3 credit hours)
Prerequisite: ECE 404
Typically offered in Fall only

ECE 540 Electromagnetic Fields (3 credit hours)
Brief review of Maxwell's Equations, constitutive relations and boundary conditions. Reflection and refraction of plane waves; power and energy relations in isotropic media. Potential functions, Green's functions and their applications to radiation and scattering. Antenna fundamentals: linear antennas, uniform linear arrays and aperture antennas, microstrip antennas. Fundamentals of numerical methods for electromagnetic simulation and antenna design.
Prerequisite: ECE 422
Typically offered in Spring only

ECE 542 Neural Networks (3 credit hours)
Introduction to neural networks and other basic machine learning methods including radial basis functions, kernel methods, support vector machines. The course introduces regularization theory and principle component analysis. The relationships to filtering, pattern recognition and estimation theory are emphasized.
Typically offered in Spring only

ECE 544 Design Of Electronic Packaging and Interconnects (3 credit hours)
A study of the design of digital and mixed signal interconnect and packaging. Topics covered include: Single chip (surface mount and through-hole) and multi-chip module packaging technology; packaging technology selection; thermal design; electrical design of printed circuit board, backplane and multi-chip module interconnect; receiver and driver selection; EMI control; CAD tools; and measurement issues.
Prerequisite: ECE 302
Typically offered in Spring only

ECE 546 VLSI Systems Design (3 credit hours)
Digital systems design in CMOS VLSI technology: CMOS device physics, fabrication, primitive components, design and layout methodology, integrated system architectures, timing, testing future trends of VLSI technology.
Prerequisite: ECE 302
Typically offered in Spring only

ECE 547/CSC 547 Cloud Computing Technology (3 credit hours)
Study of cloud computing principles, architectures, and actual implementations. Students will learn how to critically evaluate cloud solutions, how to construct and secure a private cloud computing environment based on open source solutions, and how to federate it with external clouds. Performance, security, cost, usability, and utility of cloud computing solutions will be studied both theoretically and in hands-on exercises. Hardware-, infrastructure-, platform-, software-, security-, - "as-a-service".
Prerequisites: CSC 501 and either ECE/CSC 570 or ECE/CSC 573
Typically offered in Spring only

ECE 549 RF Design for Wireless (3 credit hours)
Design of the hardware aspects of wireless systems with principle emphasis on design of radio frequency (RF) and microwave circuitry. Introduction of system concepts then functional block design of a wireless system. RF and microwave transistors, noise, power amplifiers, CAE, linearization and antennas.
Prerequisite: ECE 303, ECE 302
Typically offered in Fall only

ECE 550 Power System Operation and Control (3 credit hours)
Fundamental concepts of economic operation and control of power systems. Real and reactive power balance. System components, characteristics and operation. Steady state and dynamic analysis of interconnected systems. Tieline power and load-frequency control with integrated economic dispatch.
Prerequisite: ECE 305, ECE 435
Typically offered in Fall only

ECE 551 Smart Electric Power Distribution Systems (3 credit hours)
Features and components of electric power distribution systems, power flow, short circuit and reliability analysis, basic control and protection, communications and SCADA, new "smart" functionality such as integrated volt/var control, automated fault location isolation and restoration, demand response and advanced metering infrastructure, integration of distributed generation and energy storage.
Prerequisite: ECE 451
Typically offered in Spring only
ECE 552/ECE 452 Renewable Electric Energy Systems (3 credit hours)
Principles and characteristics of renewable energy based electric power generation technologies such as photovoltaic systems, wind turbines, and fuel cells. Main system design issues. Integration of these energy sources into the power grid. Economics of distributed generation. Credit is not allowed for both ECE 452 and ECE 552.
Prerequisite: ECE 305 or ECE 331
Typically offered in Spring only

ECE 553 Semiconductor Power Devices (3 credit hours)
The operational physics and design concepts for power semiconductor devices. Relevant transport properties of semiconductors. Design of breakdown voltage and edge terminations. Analysis of Schottky rectifiers, P-i-N rectifiers, Power MOSFETs, Bipolar Transistors, Thyristors and Insulated Gate Bipolar Transistors.
Prerequisite: ECE 404
Typically offered in Fall only

ECE 554 Electric Motor Drives (3 credit hours)
Topics covered in this course: Principles of Electromechanical energy conversion; analysis, modeling and control of electric machinery; steady state performance characteristics of direct current, induction, synchronous and reluctance machines; scalar control of induction machines; introduction to direct and quadrature axis theory; dynamic models of induction and synchronous machines; vector control of induction and synchronous machines.
Prerequisite: ECE 405 or equivalent
Typically offered in Spring only

ECE 555 Computer Control of Robots (3 credit hours)
An introduction to robotics: history and background, design, industrial applications and usage. Manipulator sensors, actuators and control, linear, non-linear, and force control. Manipulator kinematics: position and orientation, frame assignment, transformations, forward and inverse kinematics. Jacobian: velocities and static forces. Manipulator Kinetics: velocity, acceleration, force, Trajectory generation. Programming languages: manipulator level, task level, and object level. Introduction to advanced robotics. Credit not allowed for both ECE 455 and 555.
Prerequisite: ECE 435; ECE 436; ECE 456
Typically offered in Spring only

ECE 556/ECE 456 Mechatronics (3 credit hours)
The study of electro-mechanical systems controlled by microcomputer technology. The theory, design and construction of smart systems; closely coupled and fully integrated products and systems. The synergistic integration of mechanisms, materials, sensors, interfaces, actuators, microcomputers, controllers, and information technology.
Prerequisite: ECE 308
Typically offered in Fall only

ECE 557 Principles Of MOS Transistors (3 credit hours)
MOS capacitor and transistor regions of operation. Depletion and enhancement mode MOSFETs. MOSFET scaling, short and narrow channel effects. MOSFETs with ion-implanted channels. High field effects in MOSFETs with emphasis on recent advances in design of hit carrier suppressed structures. Small and large signal MOSFET models. State of the art in MOS process integration.
Prerequisite: ECE 404
Typically offered in Fall only

ECE 558 Digital Imaging Systems (3 credit hours)
Foundation for designing and using digital devices to accurately capture and display color images, spatial sampling, frequency analysis, quantization and noise characterization of images. Basics of color science are presented and applied to image capture and output devices.
Prerequisites: ECE 301 and ST 372
Typically offered in Fall only

ECE 560/ECE 460 Embedded System Architectures (3 credit hours)
Concepts of architectures for embedded computing systems. Emphasis on hands-on implementation. CPU scheduling approaches to support multithreaded programs, including interrupts, cooperative schedulers, state machines, and preemptive scheduler (real-time kernel). Communication and synchronization between threads. Basic real-time analysis. Using hardware peripherals to replace software. Architectures and design patterns for digital control, streaming data, message parsing, user interfaces, low power, low energy, and dependability. Software engineering concepts for embedded systems. Students may not receive credit for both ECE 460 and ECE 560.
Prerequisite: C- or better in ECE 306
Typically offered in Fall only

ECE 561/ECE 461 Embedded System Design (3 credit hours)
Design and implementation of software for embedded computer systems. The students will learn to design systems using microcontrollers, C and assembly programming, real-time methods, and interfacing system development and communication networks. System performance is measured in terms of power consumption, speed and reliability. Efficient methods for project development and testing are emphasized. Credit will not be awarded for both ECE 461 and ECE 561. Restricted to CPE and EE Majors.
Prerequisite: Grade of C- or better in ECE 460
Typically offered in Spring only

ECE 563/ECE 463 Microprocessor Architecture (3 credit hours)
Architecture of microprocessors. Measuring performance. Instruction-set architectures. Memory hierarchies, including caches, prefetching, program transformations for optimizing caches, and virtual memory. Processor architecture, including pipelining, hazards, branch prediction, static and dynamic scheduling, instruction-level parallelism, superscalar, and VLIW. Major projects.
Prerequisite: ECE 209 and ECE 212
Typically offered in Fall and Spring

ECE 564/ECE 464 ASIC and FPGA Design with Verilog (3 credit hours)
Design of digital application specific integrated circuits (ASICs) and Field Programmable Gate Arrays (FPGAs) based on hardware description languages (Verilog) and CAD tools. Emphasis on design practices and underlying methods. Introduction to ASIC specific design issues including verification, design for test, low power design and interfacing with memories. Required design project. Expected Prior Experience or Background: ECE 310 is useful but not assumed. Functionally, I assume that students are familiar with logic design, including combinational logic gates, sequential logic gates, timing design, Finite State Machines, etc.
P: Grade of C or better in ECE 212 or equivalent
Typically offered in Fall only
ECE 566/ECE 466 Compiler Optimization and Scheduling (3 credit hours)
Provide insight into current compiler designs dealing with present and future generations of high performance processors and embedded systems. Introduce basic concepts in scanning and parsing. Investigate in depth program representation, dataflow analysis, scalar optimization, memory disambiguation, and interprocedural optimizations. Examine hardware/software trade-offs in the design of high performance processors, in particular VLIW versus dynamically scheduled architectures. Investigate back-end code generation techniques related to instruction selection, instruction scheduling for local, cyclic and global acyclic code, and register allocation and its interactions with scheduling and optimization.
Prerequisites: ECE 209 or competency in any machine language programming and ECE 309 or CSC 316 or proficiency in either C or C++ programming using advanced data structures, like hash tables and linked lists. P: ECE 209 or competency in an
Typically offered in Spring only

ECE 568/ECE 468/CHE 468/CHE 568 Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems (3 credit hours)
Conventional and emerging nano-manufacturing techniques and their applications in the fabrication of various structures and devices. Review of techniques for patterning, deposition, and etching of thin films including emerging techniques such as an imprint and soft lithography and other unconventional techniques. Electronic and mechanical properties of 0 to 3-D nanostructures and their applications in nano-electronics, MEMS/NEMS devices, sensing, energy harvesting, storage, flexible electronics and nano-medicine. Credit for both ECE/CHE 468 and ECE/CHE 568 is not allowed.
Prerequisite: E 304
Typically offered in Fall only

ECE 570/CSC 570 Computer Networks (3 credit hours)
General introduction to computer networks. Discussion of protocol principles, local area and wide area networking, OSI stack, TCP/IP and quality of service principles. Detailed discussion of topics in medium access control, error control coding, and flow control mechanisms. Introduction to networking simulation, security, wireless and optical networking.
Prerequisite: ECE 206 or CSC 312, ST 371, CSC 258 and Senior standing or Graduate standing
Typically offered in Fall and Spring

ECE 573/CSC 573 Internet Protocols (3 credit hours)
Principles and issues underlying provision of wide area connectivity through interconnection of autonomous networks. Internet architecture and protocols today and likely evolution in future. Case studies of particular protocols to demonstrate how fund
Prerequisite: CSC/ECE 570
Typically offered in Fall, Spring, and Summer

ECE 574/CSC 574 Computer and Network Security (3 credit hours)
Security policies, models, and mechanisms for secrecy, integrity, and availability. Basic cryptography and its applications; operating system models and mechanisms for mandatory and discretionary controls; introduction to database security; security in distributed systems; network security (firewalls, IPsec, and SSL); and control and prevention of viruses and other rogue programs.
Prerequisite: (CSC 316) and (CSC 401 or CSC/ECE 570)
Typically offered in Fall and Spring

ECE 575/CSC 575 Introduction to Wireless Networking (3 credit hours)
Introduction to cellular communications, wireless local area networks, ad-hoc and IP infrastructures. Topics include: cellular networks, mobility management, connection admission control algorithms, mobility models, wireless IP networks, ad-hoc routing, sensor networks, quality of service, and wireless security.
Prerequisite: ECE/CSC 570
Typically offered in Spring and Summer

ECE 576/CSC 576 Networking Services: QoS, Signaling, Processes (3 credit hours)
Topics related to networking services, signaling for setting up networking services, such as SIP and IMS, networking architectures for providing QoS for networking services, such as MPLS, DiffServ and RAC, signaling protocols for setting up QoS connections in the transport stratum, such as LDP and RSVP-TE, video-based communications, and capacity planning models for dimensioning services.
Prerequisite: CSC/ECE 570
Typically offered in Fall and Spring

ECE 577/CSC 577 Switched Network Management (3 credit hours)
Topics related to design and management of campus enterprise networks, including VLAN design; virtualization and automation methodologies for management; laboratory use of open space source and commercial tools for managing such networks.
Typically offered in Fall only

ECE 578 LTE and 5G Communications (3 credit hours)
The course provides an introduction to the theoretical fundamentals and practical/experimental aspects of Long Term Evolution (LTE) and 5G systems. A basic understanding of digital communications and radio access networks is required. Following topics will be studied: 1) User and control plane protocols, 2) physical layer for downlink, 3) physical layer for uplink, 4) practical deployment aspects, 5) LTE-Advanced, 6) 5G communications. Fundamental concepts to be covered in the context of LTE/5G systems include OFDMA/SC-FDMA, synchronization, channel estimation, link adaptation, MIMO, scheduling, and millimeter wave systems. Students are recommended to have the prior knowledge gained from ECE 570 or ECE 582 before taking this course. The course will also require using Matlab software for homeworks, including its LTE and 5G toolboxes.
Typically offered in Fall only
ECE 579/OR 579/CSC 579 Introduction to Computer Performance Modeling (3 credit hours)
Workload characterization, collection and analysis of performance data, instrumentation, tuning, analytic models including queuing network models and operational analysis, economic considerations.

Prerequisite: CSC 312 or ECE 206 and MA 421
Typically offered in Fall and Spring

ECE 581 Electric Power System Protection (3 credit hours)
Protection systems used to protect the equipment in an electric power system against faults, fault analysis methods, basic switchgear used for protection, basic protection schemes, such as overcurrent, differential, and distance protection and their application.

Prerequisite: ECE 451
Typically offered in Fall and Spring

ECE 582 Wireless Communication Systems (3 credit hours)
Theory and analysis of wireless portable communication systems. Provides a fundamental understanding of the unique characteristics of these systems. Topics include: Code Division Multiple Access (CDMA), mobile radio propagation, characterization of a Rayleigh fading multipath channel, diversity techniques, adaptive equalization, channel coding, and modulation/demodulation techniques. Although contemporary cellular and personal communication services (PCS) standards are covered, the course stresses fundamental theoretical concepts that are not tied to a particular standard.

Prerequisite: Senior level digital communications course, e.g., ECE402, Corequisite: ECE 714
Typically offered in Fall only

ECE 583 Electric Power Engineering Practicum I (3 credit hours)
This course introduces fundamentals of project management and system engineering principles in a wide range of electric power applications from concept through termination. The course also provides opportunities for students to adapt technical content

Prerequisite: ECE 451
Typically offered in Spring only

ECE 584 Electric Power Engineering Practicum II (3 credit hours)
In this capstone course students will apply electric engineering and science knowledge to an electrical power engineering project. Consideration of the design process including feasibility study, preliminary design detail, cost effectiveness, along with development and evaluation of a prototype accomplished through design-team project activity. Complete written and oral engineering report required. Restricted to Master of Science in Electric Power Systems Engineering.

Prerequisite: ECE 583
Typically offered in Fall and Summer

ECE 585 The Business of the Electric Utility Industry (3 credit hours)
Evolution of the electric utility industry, the structure and business models of the industry, the regulatory factors within which the utilities operate, the operations of the utility industry and the current policy and emerging technology issues facing the business. The course includes significant interaction with industry officials and utility business operations.

Prerequisite: ECE 451
Typically offered in Fall only

ECE 586 Communication and SCADA Systems for Smart Grid (3 credit hours)
This is an introductory course on communication technologies and SCADA (supervisory control and data acquisition) systems for smart electric power applications. The fundamental concepts, principles, and practice of how communication systems operate are introduced and the function of main components reviewed. Application of communication systems for electric power, in particular SCADA architecture and protocols are also introduced. The course includes hands-on experience with typical intelligent electronic devices interconnected by a communication system.

R: Graduate Students Only
Typically offered in Fall only

ECE 587 Power System Transients Analysis (3 credit hours)
Review of solutions to first and second order differential equations for electric power circuit transients. Applications to fault current instantaneous, shunt capacitor transients, circuit switching transients and overvoltages, current interruption and transformer transient behavior. Computer solution techniques for transient analysis using PSCAD and Matlab/Simulink. Modeling of utility power electronics circuits including single and three-phase rectifiers and inverters. Applications of power electronics for transmission system control and renewable generation. Distributed line modeling for traveling wave analysis of surge events. Introduction to voltage insulation, surge arrestor operation and lightning stroke analysis.

Typically offered in Fall only

ECE 588/PB 488/ECE 488/PB 588 Systems Biology Modeling of Plant Regulation (3 credit hours)
This course provides an introduction to the field of systems biology with a focus on mathematical modeling, gene regulatory network and metabolic pathway reconstruction in plants. Students will learn how to integrate biological data with mathematical, statistical, and computational approaches to gain new insights into structure and behavior of complex cellular systems. Students are expected to have a minimal background in calculus and basic biology. The course will build on these basic concepts and provide all students, regardless of background or home department, with the fundamental biology, mathematics, and computing knowledge needed to address systems biology problems.

Prerequisite: MA 131 or MA 141
Typically offered in Fall only
ECE 589/MSE 489/MSE 589/PHY 489/ECE 489  Solid State Solar and Thermal Energy Harvesting  (3 credit hours)
This course studies the fundamental and recent advances of energy harvesting from two of the most abundant sources, namely solar and thermal energies. The first part of the course focuses on photovoltaic science and technology. The characteristics and design of common types of solar cells is discussed, and the known approaches to increasing solar cell efficiency will be introduced. After the review of the physics of solar cells, we will discuss advanced topics and recent progresses in solar cell technology. The second part of the course is focused on thermoelectric effect. The basic physical properties, Seebeck coefficient, electrical and thermal conductivities, are discussed and analyzed through the Boltzmann transport formalism. Advanced subject such as carrier scattering time approximations in relation to dimensionality and the density of states are studied. Different approaches for further increasing efficiencies are discussed including energy filtering, quantum confinement, size effects, band structure engineering, and phonon confinement.

P: ECE 302 or E 304 or MSE 355 or PHY 407
Typically offered in Fall only

ECE 591  Special Topics In Electrical Engineering  (1-6 credit hours)
Two-semester sequence to develop new courses and to allow qualified students to explore areas of special interest.
Prerequisite: B average in technical subjects
Typically offered in Fall and Spring

ECE 592  Special Topics In Electrical Engineering  (1-6 credit hours)
Two-semester sequence to develop new courses and to allow qualified students to explore areas of special interest.
Prerequisite: B average in technical subjects
Typically offered in Fall and Spring

ECE 600  ECE Graduate Orientation  (1 credit hours)
Introduction of the Electrical and Computer Engineering Department graduate program. Introduction to computing and library facilities; Review of NC State student code of conduct and ethics. Structure of the ECE department. General information for sta
Typically offered in Fall and Spring

ECE 633  Individual Topics In Electrical Engineering  (1-3 credit hours)
Provision of opportunity for individual students to explore topics of special interest under direction of a member of faculty.
Prerequisite: B average in technical subjects
Typically offered in Fall and Spring

ECE 634  Individual Studies In Electrical Engineering  (1-3 credit hours)
The study of advanced topics of special interest to individual students under direction of faculty members.
Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

ECE 650  Internship  (3 credit hours)
This course requires an internship with a company or organization outside the University. The student will secure an internship of a technical nature and complete and submit a Coop report for evaluation.
Restricted: 14EEMS, 14CPEMS, 14CNEMS, 14EPSEMS
Typically offered in Fall and Spring

ECE 685  Master's Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Spring only

ECE 690  Master's Exam  (1-9 credit hours)
Typically offered in Fall and Spring

ECE 693  Master's Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall and Spring

ECE 695  Master's Thesis Research  (1-9 credit hours)
Thesis research.
Prerequisite: Master's student
Typically offered in Summer only

ECE 696  Summer Thesis Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ECE 699  Master's Thesis Preparation  (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.
Prerequisite: Master's student
Typically offered in Summer only

ECE 705  Memory Systems  (3 credit hours)
Covers recent research on overcoming the problem of memory access and memory speed, two major limitations on the speed of computers. Overview of the current state of memory technologies, novel cache structures and management techniques, prefetching, memory compression, and parallelism at the instruction and thread levels. Research papers required.
Prerequisite: ECE 521, Computer Design and Technology

ECE 706  Advanced Parallel Computer Architecture  (3 credit hours)
Advanced topics in parallel computer architecture. Hardware mechanisms for scalable cache coherence, synchronization, and speculation. Scalable systems and interconnection networks. Design or research project required.
Prerequisite: ECE/CSC 506, ECE 521
Typically offered in Spring only
ECE 712 Integrated Circuit Design for Wireless Communications (3 credit hours)
Analysis, simulation, and design of the key building blocks of an integrated radio: amplifiers, mixers, and oscillators. Topics include detailed noise optimization and linearly performance of high frequency integrated circuits for receivers and transmitters. Introduction to several important topics of radio design such as phase-locked loops, filters and large-signal amplifiers. Use of advanced RF integrated circuit simulation tools such as SpectreRF or ADS for class assignments.
Prerequisite: ECE 511
Typically offered in Spring only

ECE 714 Advanced Integrated Circuit Design: Data Converters (3 credit hours)
This course is a graduate level course in Analog-to-digital converters. Students will learn the fundamentals of sampling and the translation of signals form the digital to analog and analog to digital domains. Students will learn the basic circuits unique to data converters and how they impact design. Students will learn to design digital-to-analog converter as well as 3 ADCs: Pipeline, Sigma-Delta and Successive-approximation. After completion of this course you will have the background to successfully design an ADC and DAC.
Prerequisite: ECE 511
Typically offered in Fall only

ECE 718 Computer-Aided Circuit Analysis (3 credit hours)
Steady state and transient analysis of circuits with emphasis on circuit theory and computer methods. Consideration of many analysis techniques, including linear nodal, signal flow graph, state equation, time-domain and functional simulation and analysis of sampled data systems. Sensitivity and tolerance analysis, macromodeling of large circuits and nonlinear circuit theory.
Prerequisite: ECE 511

ECE 719 Advanced Microwave Design (3 credit hours)
Development and examination of techniques used in the design of microwave and millimeter wave components and systems. Specific topics include frequency planning, system design using modules, and design of microwave amplifiers and oscillators. Design for specified frequency, noise, power, mixer or oscillator performance will be covered. There are three design projects: system planning, amplifier design, and oscillator design all using commercial microwave computer aided design tools.
Prerequisite: ECE 549
Typically offered in Spring only

ECE 720 Electronic System Level and Physical Design (3 credit hours)
Study of transaction-level modeling of digital systems-on-chip using SystemC. Simulation and analysis of performance in systems with distributed control. Synthesis of digital hardware from high-level descriptions. Physical design methodologies, including placement, routing, clock-tree insertion, timing, and power analysis. Significant project to design a core at system and physical levels. Knowledge of object-oriented programming with C and register-transfer-level design with verilog or VHDL is required.
Prerequisite: ECE 520
Typically offered in Fall only

ECE 721 Advanced Microarchitecture (3 credit hours)
Survey of advanced computer microarchitecture concepts. Modern superscalar microarchitecture, complexity-effective processors, multithreading, advanced speculation techniques, fault-tolerant microarchitectures, power and energy management, impact of new technology on microarchitecture. Students build on a complex simulator which is the basis for independent research projects.
Prerequisite: ECE 521
Typically offered in Fall only

ECE 722 Electronic Properties of Solid-State Materials (3 credit hours)
Materials and device-related electronic properties of semiconductors. Included topics: energy band structure, electrical and thermal transport phenomena, scattering processes, localized energy states, equilibrium and non-equilibrium semiconductor statistics.
Prerequisite: ECE 530
Typically offered in Spring only

ECE 723 Optical Properties of Semiconductors (3 credit hours)
Materials and device-related properties of compound optical semiconductors. Included topics: band structure, heterojunctions and quantum wells, optical constants, waveguides and optical cavities, absorption and emission processes in semiconductors, photodetectors, light emitting diodes, semiconductor lasers.
Prerequisite: ECE 530
Typically offered in Spring only

ECE 724 Electronic Properties of Solid-State Devices (3 credit hours)
Basic physical phenomena responsible for operation of solids-state devices. Examination and utilization of semiconductor transport equations to explain principles of device operation. Various solid-state electronics devices studied in detail.
Prerequisite: ECE 530
Typically offered in Spring only

ECE 725 Quantum Engineering (3 credit hours)
Development of advanced engineering concepts at the quantum level relevant to nanoscience, nanoelectronics, and quantum photonics. Topics include tunneling phenomena, specifics of time dependent and time independent perturbation methodology for addressing applications under consideration, including the WKB approach, and an introduction to second quantization for engineers. Applications include, but are not limited to, tunneling in a two-level system, molecular rotation through excitation, field emission, van der Waal interactions, optical absorption in quantum wells, and electron transport through model molecules.
Prerequisite: ECE 530, and PY 401
Typically offered in Spring only

ECE 726 Advanced Feedback Control (3 credit hours)
Advanced topics in dynamical systems and multivariable control. Current research and recent developments in the field.
Prerequisite: ECE 516
Typically offered in Fall only
ECE 732  Dynamics and Control of Electric Machines  (3 credit hours)
Dynamic behavior of AC electric machines and drive systems; theory of field orientation and vector control for high performance induction and synchronous machines; permanent magnet and reluctance machines and their control; principles of voltage source and current source inverters, and voltage and current regulation methods.
Prerequisite: ECE 453 or ECE 592
Typically offered in Fall only

ECE 733  Digital Electronics  (3 credit hours)
In-depth study of digital circuits at the transistor level. Topics include fundamentals; high speed circuit design; low-power design; RAM; digital transceivers; clock distribution; clock and data recovery; circuits based on emerging devices. Project.
Prerequisite: ECE 546
Typically offered in Fall only

ECE 734  Power Management Integrated Circuits  (3 credit hours)
Review of modern power management converters and circuits; Review modeling and control of converters; Detail discussion of voltage and current mode controllers; Understanding of power converter losses and optimization method, as well as management of power; Integrated circuit design of various power management chips.
Prerequisite: ECE 511 and ECE 534
Typically offered in Spring only

ECE 735  Wide Band Gap Semiconductor Power Devices  (3 credit hours)
This course provides students with an in-depth knowledge of power devices built from wide bandgap semiconductors: the design of high breakdown voltages, the physics of unique power rectifier structures suitable for SiC material, the operating principles for unique SiC power MOSFETs, and GaN HEMT devices, the development of bipolar power devices from SiC to achieve ultra-high voltage performance and the performance of wide bandgap semiconductor power devices as compared to advanced silicon devices.
Prerequisite: ECE 553 or equivalent
Typically offered in Spring only

ECE 736  Power System Stability and Control  (3 credit hours)
Prerequisite: ECE 451 and ECE 750
Typically offered in Spring only

ECE 739  Integrated Circuits Technology and Fabrication Laboratory  (3 credit hours)
An integrated circuit laboratory to serve as a companion to ECE 538. Hands-on experience in semiconductor fabrication laboratory. Topics include: techniques used to fabricate and electrically test discrete semiconductor devices, the effects of process variations on measurable parameters.
Prerequisite: ECE 538
Typically offered in Spring only

ECE 745  ASIC Verification  (3 credit hours)
This course covers the verification process used in validating the functional correctness in today's complex ASICs (application specific integrated circuits). Topics include the fundamentals of simulation based functional verification, stimulus generation, results checking, coverage, debug, and formal verification. Provides the students with real world verification problems to allow them to apply what they learn.
Prerequisite: ECE 564
Typically offered in Spring only

ECE 748  Advanced Functional Verification with Universal Verification Methodology  (3 credit hours)
The Universal Verification Methodology is the industry standard for functional verification of today's complex ASICs and FPGAs. Students will learn the content and use of UVM to architect and implement complex test benches. The characteristics and architecture of reusable verification components is a major focus of the course. Students will learn and implement verification components which are reusable across projects, from block level simulation to chip level simulation, and from simulation to emulation. The course projects teach and demonstrate advanced verification methodologies that prepare students for careers in functional verification of digital semiconductors.
Prerequisite: ECE 745 or equivalent
Typically offered in Fall only

ECE 751  Detection and Estimation Theory  (3 credit hours)
Methods of detection and estimation theory as applied to communications, speech and image processing. Statistical description of signals and representation in time, spatial and frequency domains; Bayesian methods, including Wiener, Kalman and MAP filters; performance measures; applications to both continuous and discrete systems.
Prerequisite: ECE 514, ECE 421
Typically offered in Spring only

ECE 752  Information Theory  (3 credit hours)
An overview of Shannon's theory of information, which establishes fundamental limits on the performance of data compression and quantization algorithms, communication systems, and detection and estimation algorithms. Topics include information measures and their properties, information source models, lossless data compression, channel coding and capacity, information theory and statistics, and rate-distortion theory. Applications of information theory will also be discussed, including Lempel-Ziv data compression, vector quantization, error-correcting codes, satellite communications and high-speed modems.
Prerequisite: ECE 514: Random Processes
ECE 753 Computational Methods for Power Systems (3 credit hours)
This course is designed to introduce computational methods used for power grid operation and planning. The course will help students understand the various computational methods that form the basis of major commercial software packages used by grid analysts and operators. Students are expected to have some basic understanding of principles of power system analysis including power system models, power flow calculation, economic dispatch, reliable and stability analysis. The course covers the following computational methods commonly used in power grid operation and planning: Locational Marginal Pricing Schemes, Game Theory, Unconstrained Optimization, Linear Programming, Non-linear Constrained Optimization, and Forecasting Methods.
Prerequisite: ECE 451 or ECE 550
Typically offered in Spring only

ECE 755 Advanced Robotics (3 credit hours)
Advanced robotics at its highest level of abstraction; the level of synthesizing human reasoning and behavior. Advanced robotics deals with the intelligent connection of perception to action. At this level the subject requires knowledge of sensing (computer vision, tactile, sonar), and reasoning (artificial intelligence: machine learning, planning, world modeling). The advanced robotics course will be valuable for students who wish to work in the area.
Prerequisite: ECE 555; MAE 544
Typically offered in Fall only

ECE 756 Advanced Mechatronics (3 credit hours)
A project-oriented course focusing on the design, analysis, and implementation of advanced mechatronics technologies, including large-scale distributed sensors, distributed-actuators, and distributed-controllers connected via communication networks. Will use unmanned vehicles as the project platform, with applications from sensors, actuators, network-based controllers, cameras, and microcontrollers. ECE 516 is recommended.
Prerequisite: ECE 456 or ECE 556 with a Grade B+ and above
Typically offered in Spring only

ECE 759 Pattern Recognition (3 credit hours)
Image pattern recognition techniques and computer-based methods for scene analysis, including discriminate functions, fixture extraction, classification strategies, clustering and discriminant analysis. Coverage of applications and current research results.
Prerequisite: ECE(CSC) 514, ST 371, B average in ECE and MA
Typically offered in Spring only

ECE 762 Advanced Digital Communications Systems (3 credit hours)
An advanced graduate-level course in digital communications. Topics include signal design, equalization methods and synchronization techniques for realistic communication channels. Projects concentrate on literature review and computer simulations.
Prerequisite: ECE 515 or equivalent
Typically offered in Fall only

ECE 763 Computer Vision (3 credit hours)
Analysis of images by computers. Specific attention given to analysis of the geometric features of objects in images, such as region size, connectedness and topology. Topics include: segmentation, template matching, motion analysis, boundary detection, region growing, shape representation, 3-D object recognition including graph matching.
Prerequisite: ECE 558 and ECE 514
Typically offered in Spring only

ECE 765 Probabilistic Graphical Models for Signal Processing and Computer Vision (3 credit hours)
Techniques for machine learning using probabilistic graphical models. Emphasis on Bayesian and Markov networks with applications to signal processing and computer vision.
Prerequisites: Programming experience (MATLAB, C++ or other object oriented language such as Python), linear algebra (MA 405 or equivalent), and probability (ECE 514, equivalent or instructor permission)
Typically offered in Fall only

ECE 766 Signal Processing for Communications & Networking (3 credit hours)
This course deals with the signal processing principles underlying recent advances in communications and networking. Topics include: smart-antenna and multi-input multi-output (MIMO) techniques; multiuser communication techniques (multiple access, power control, multiuser detection, and interference management); signal processing in current and emerging network applications such as cognitive radio and social networks. Knowledge of linear algebra and stochastic analysis is required.
Prerequisite: Graduate standing
Typically offered in Fall only

ECE 767 Error-Control Coding (3 credit hours)
An introduction to the theory and practice of codes for detecting and correcting errors in digital data communication and storage systems. Topics include linear block codes, cyclic codes, cyclic redundancy checksums, BCH and Reed-Solomon codes, convolutional codes, trellis-coded modulation, LDPC and turbo codes, Viterbi and sequential decoding, and encoder and decoder architecture. Applications include the design of computer memories, local-area networks, compact disc digital audio, NASA’s deepspace network, high-speed modems, communication satellites, and cellular telephony.
Prerequisite: ECE 514 Random Processes; linear algebra at the undergraduate level is strongly recommended

ECE 773/CSC 773 Advanced Topics in Internet Protocols (3 credit hours)
Cutting-edge concepts and technologies to support internetworking in general and to optimize the performance of the TCP/IP protocol suite in particular. Challenges facing and likely evolution for next generation internetworking technologies. This course investigates topics that include, but may be not limited to: Internet traffic measurement, characterization and modeling, traffic engineering, network-aware applications, quality of service, peer-to-peer systems, content-distribution networks, sensor networks, reliable multicast, and congestion control.
Prerequisite: CSC/ECE 573
Typically offered in Spring only
ECE 774/CSC 774  **Advanced Network Security**  (3 credit hours)
A study of network security policies, models, and mechanisms. Topics include: network security models; review of cryptographic techniques; internet key management protocols; electronic payments protocols and systems; intrusion detection and correlation; broadcast authentication; group key management; security in mobile ad-hoc networks; security in sensor networks.

Prerequisite: CSC/ECE 570, CSC/ECE 574
Typically offered in Spring only

ECE 775/CSC 775  **Advanced Topics in Wireless Networking**  (3 credit hours)
Reviews the current state of research in wireless networks, network architectures, and applications of wireless technologies; students will design, organize, and implement or simulate systems in a full-semester research project. For students with background in networking and communications who wish to explore research and development topics.

Prerequisite: ECE/CSC 575
Typically offered in Fall only

ECE 776/CSC 776  **Design and Performance Evaluation of Network Systems and Services**  (3 credit hours)
Introduction to the design and performance evaluation of network services. Topics include top-down network design based on requirements, end-to-end services and network system architecture, service level agreements, quantitative performance evaluation techniques. Provides quantitative skills on network service traffic and workload modeling, as well as service applications such as triple play, internet (IPTV), Peer-to-peer (P2P), voice over IP (VoIP), storage, network management, and access services.

Prerequisite: CSC(ECE) 570 and CSC(ECE) 579
Typically offered in Fall only

ECE 777/CSC 777  **Telecommunications Network Design**  (3 credit hours)
Analytic modeling and topological design of telecommunications networks, including centralized polling networks, packet switched networks, T1 networks, concentrator location problems, routing strategies, teletraffic engineering and network reliability.

Prerequisite: CSC(ECE) 570
Typically offered in Spring only

ECE 785  **Topics in Advanced Computer Design**  (3 credit hours)
In depth study of topics in computer design; advantages and disadvantages of various designs and design methodologies; technology shifts, trends, and constraints; hardware/software tradeoffs and co-design methodologies.

Prerequisite: ECE 520, ECE 521
Typically offered in Spring only

ECE 786  **Advanced Computer Architecture: Data Parallel Processors**  (3 credit hours)
In-depth study of processor architectures to exploit data-level parallelism, including general computation on graphics processing units (GPGPU, aka GPU computing architecture) and vector processors; memory subsystems; advantages and disadvantages of various architectures; technology shifts, trends, and constraints.

P: ECE 463/563 and CSC/ECE 506
Typically offered in Spring only

ECE 791  **Special Topics In Electrical Engineering**  (3-6 credit hours)
Two-semester sequence to develop new courses and to allow qualified students to explore areas of special interest.

Prerequisite: B average in technical subjects
Typically offered in Fall and Spring

ECE 792  **Special Topics In Electrical Engineering**  (1-6 credit hours)
Two-semester sequence to develop new courses and to allow qualified students to explore areas of special interest.

Prerequisite: B average in technical subjects
Typically offered in Fall and Spring

ECE 801  **Seminar in Electrical and Computer Engineering**  (1-3 credit hours)
Typically offered in Fall and Spring

ECE 804  **Seminar in Comm/Sig PR**  (1-3 credit hours)
Typically offered in Fall and Spring

ECE 833  **Individual Topics In Electrical Engineering**  (1-3 credit hours)
Provision of opportunity for individual students to explore topics of special interest under direction of a member of faculty.

Prerequisite: B average in technical subjects
Typically offered in Fall and Spring

ECE 834  **Individual Studies In Electrical Engineering**  (1-3 credit hours)
The study of advanced topics of special interest to individual students under direction of faculty members.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

ECE 885  **Doctoral Supervised Teaching**  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall only

ECE 889  **Doctoral Preliminary Examination**  (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall only

ECE 890  **Doctoral Supervised Research**  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall only

ECE 893  **Doctoral Supervised Research**  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall only

ECE 895  **Doctoral Dissertation Research**  (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer
ECE 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course
work during a summer session and who will be devoting full time to thesis
research.
Prerequisite: Doctoral student
Typically offered in Summer only

ECE 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral
degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

Elementary Education (ELM)

ELM 250 Introduction to Elementary Education in a Global Society (3 credit hours)
Introduction to the major conceptual and intellectual foundations of the
teaching profession, the sociology and culture of elementary schools and
classrooms, and the world of work of elementary teachers. Fieldwork in
schools and related settings maybe required in lieu of lecture on
occasion. Students are responsible for transportation to and from their
school based experiences.
Prerequisite: Sophomore standing
Typically offered in Spring and Summer

ELM 310 Children’s Thinking and Additive Reasoning (3 credit hours)
Examination of mathematical reasoning processes in primary grade
children and the theory and practice of active teaching strategies
designed to motivate and engage children in mathematics learning in
grades K-3. Fieldwork in schools and related settings
Prerequisite: ELM 250, Junior standing, Elementary Education Majors
Typically offered in Fall only

ELM 320 Teaching Science in the Primary Grades (3 credit hours)
Examination of science knowledge and thinking in primary-age children.
Development and application of methods for teaching science in the
primary grades that leads to active learning of science as a process of
inquiry. Fieldwork in schools and related settings
Prerequisite: ELM 250, Junior standing, Elementary Education Majors
Typically offered in Fall only

ELM 330 Teaching Reading in Elementary School: K-2 (3 credit hours)
ELM 330 is designed to prepare preservice teachers to teach reading and
to lead to licensure in the elementary grades. Specific topics that relate
to the theory and practice of teaching reading for early and emergent
readers, including literature and struggling readers, will be examined.
Fieldwork in schools and related settings may be required in lieu of
lecture in occasion. Students are responsible for transportation to and
from their school based experiences.
Prerequisite: ELM 250, Junior standing, Elementary Education Majors
Typically offered in Fall only

ELM 335 Teaching Reading in the Elementary School: 3-5 (3 credit hours)
ELM 335 is designed to prepare preservice teachers to teach reading and
to lead to licensure in the elementary grades. Specific topics that relate
to the theory and practice of teaching reading for upper elementary grade
readers, including information and media literacy and literature, will be
examined. Fieldwork in schools and related settings may be required in
lieu of lecture on occasion. Students are responsible for transportation to
and from their school based experience.
Prerequisite: ELM 330, Junior standing, Elementary Education Majors
Typically offered in Spring only

ELM 340 Children Design, Create and Invent (3 credit hours)
An active hands-on class where prospective elementary school teachers
develop learning activities that children can use to stimulate their
imaginations and learn fundamental concepts in science, technology,
engineering, and mathematics. Part of a program leading to licensure in
Elementary Education.
Prerequisite: ELM 370, Junior standing, Elementary Education Majors
Typically offered in Spring only

ELM 350 Assessment of Learning and Behavior (3 credit hours)
Application of knowledge of pedagogy and development to develop
high-quality strategies for formative and summative assessment. Best
practices using developmentally-appropriate assessment strategies
including authentic assessment, portfolios and electronic portfolios,
real-time feedback, open- and closed-ended formal assessments, and
standardized testing. Particular attention to examining the rationale for
assessment and the implications of assessment.
Prerequisite: ELM 350, Junior standing, Elementary Education Majors
Typically offered in Fall only

ELM 370 Connections Seminar I The Elementary Classroom and
School Community (3 credit hours)
The purpose of this course is to introduce preservice teachers to the
world of public school classrooms and school communities and to the
tasks of teaching. Particular emphasis is placed on building a positive
classroom climate and implementing effective
Prerequisite: ELM 250, Junior standing, Elementary Education Majors
Typically offered in Fall only

ELM 375 Connections Seminar II Cultural Identity, Social Justice
and Diverse Learners (3 credit hours)
The purpose of the course is to help prospective elementary grades
teachers develop the competencies to provide equitable opportunities
to all of their future students. To do this, students will investigate issues
of systemic injustice and the role of the school in interrupting cycles
of inequality, and develop the capacity to engage in culturally relevant
pedagogy. Weekly fieldwork in schools and related settings is required
3 hours a week. Students are responsible for transportation to and from
their school based experiences.
Prerequisite: ELM 370; Junior standing, Elementary Education majors.
Typically offered in Fall only
ELM 400  Connections Seminar III Instructional Design and Assessment (3 credit hours)
In this course preservice elementary educators will examine research-verified practices in instructional design and assessment that are designed to meet the needs of diverse K-6 learners. This course will prepare candidates to plan appropriate units of study, learning experiences and assessment methods for use in the elementary classroom. Weekly fieldwork in schools and related settings is required. Students are responsible for transportation to and from their school based experiences.
Prerequisite: ELM 375, Senior standing, Elementary Education Majors
Typically offered in Fall only

ELM 410  Children's Thinking and Multiplicative Reasoning (3 credit hours)
This course is designed to prepare preservice teachers to teach math in the intermediate grades and to lead to licensure in the elementary grades. Specific methodologies that relate to the theory and practice of teaching of math will be examined. Fieldwork
Prerequisite: ELM 310, Junior standing, Elementary Education Majors
Typically offered in Spring only

ELM 420  Teaching Science in the Intermediate Grades (3 credit hours)
This course is designed to prepare preservice teachers to teach science in intermediate grades and to lead to licensure in the elementary grades. Specific methodologies that relate to the theory and practice of teaching science will be examined. Fieldwork
Prerequisite: ELM 320, Senior standing, Elementary Education Majors
Typically offered in Spring only

ELM 430  Teaching Language Arts in the Elementary School (3 credit hours)
This course is designed to prepare preservice teachers to teach language arts and to lead to licensure in the elementary grades. Specific methodologies that relate to the theory and practice of teaching language arts will be examined. Fieldwork in school
Prerequisite: ELM 335, Senior standing, Elementary Education Majors
Typically offered in Fall only

ELM 440  Teaching Children with Special Needs in the Elementary Classroom (3 credit hours)
This course is designed to prepare preservice teachers to teach students with special needs and to lead to licensure in the elementary grades. Specific methodologies that relate to the theory and practice of teaching students with special needs will be e
Prerequisite: ELM 350, ELM 375, Senior standing, Elementary Education Majors, Corequisite: ELM 420
Typically offered in Fall only

ELM 450  The Arts for Elementary Education (3 credit hours)
This course is designed to prepare preservice teachers to integrate the arts; visual music, dance and drama, into the content areas. Successful completion of this course leads to licensure in the elementary grades. Specific methodologies that relate to the theory and practice of teaching the arts will be examined.
Prerequisite: ELM 375, Senior standing, Elementary Education Majors
Typically offered in Fall only

ELM 460  Social Studies for the Young Learner (3 credit hours)
This course is designed to prepare preservice teachers to teach social studies and to lead to licensure in the elementary grades. The course is an examination of curriculum, instruction, and learning in K-6 social studies education. Emphases include development of the social studies; curricular principles and components; teaching strategies; and learner outcomes. Fieldwork in schools and related settings may be required in lieu of lecture on occasion. Students are responsible for transportation to and from their school based experiences.
Prerequisite: ELM 370, Junior standing, Elementary Education Majors
Typically offered in Fall only

ELM 480  Connections Seminar IV Linking Theory and Practice (3 credit hours)
ELM 480 Linking Theory and Practice is designed as the capstone course in the Elementary Education Program. Teacher candidates will meet regularly to analyze and discuss their student teaching experiences and connect new learning to previous university coursework. In addition, teacher candidates will complete their edTPA Tasks and other culminating activities required by the program.
Prerequisite: ELM 400, Elementary Education Majors, Admission to the Professional Semester, Corequisite: ELM 484
Typically offered in Spring only

ELM 484  Student Teaching in Elementary Education (9 credit hours)
Culminating experience for Elementary Education majors. A minimum of 10 weeks of supervised teaching in an elementary school classroom, demonstrating competent applications of standards-based practices and other required knowledge, skill, and dispositional outcomes. Taken concurrently with ELM 480. Students responsible for transportation to placement site.
Prerequisite: ELM 480, ELM 400, Elementary Education Majors, Admission to the Professional Semester
Typically offered in Spring only

ELM 515  Instructional Practice in Schools I (1 credit hours)
Prepares pre-service teachers to develop competencies in assessment, instructional design, and tutoring and leads to initial licensure in the elementary grades. Includes 15-20 hours of fieldwork; transportation to schools is the responsibility of the students.
Typically offered in Fall and Spring

ELM 516  Instructional Practice in Schools II (2 credit hours)
Prepares pre-service teachers to develop competencies in assessment, instructional design, and teaching in whole class settings and leads to initial licensure in the elementary grades. Includes 30 hours of fieldwork; transportation to the schools is the responsibility of the students.
Corequisite: ELM 572, ELM 573, ELM 575
Typically offered in Fall and Spring
ELM 520 Methods of Teaching Elementary School Science (3 credit hours)
This course is intended for teachers seeking to expand their knowledge and skills in teaching elementary school science. The course examines the purposes, scope, sequences, materials, and methodologies for teaching science in elementary schools to a diverse student body. It develops skill in planning, instructing, and assessing understanding of science content and processes. It links instruction and assessment and addresses relevant content topics in chemistry, biology, physics, and earth and space science.

Typically offered in Spring only

ELM 524 Issues in Elementary School Science Education (3 credit hours)
Analysis of contemporary elementary school environments specific to elementary science content areas: life, Earth/space, and physical science in elementary school as well as science practices of argumentation, discourse, learning progressions, and science for all.

Typically offered in Spring only

ELM 530 Social Studies In the Elementary School (3 credit hours)
Advanced professional training in teaching of social studies for middle grades and elementary teachers, including in-depth introduction to research-based teaching strategies, instructional resources and literature of the field.

ELM 533 Targeted Literacy Assessment and Instruction for Elementary School (3 credit hours)
Intended for teachers seeking to expand their knowledge and skills in assessing and teaching elementary reading, particularly to students with reading difficulties. Exploring the purposes, sequences, and materials for identifying students’ instructional strengths and learn methods for providing appropriate evidence-based reading instruction. Closely links reading assessment and reading instruction and addresses relevant content topics in elementary reading development, assessment, and instruction.

Typically offered in Spring only

ELM 537/ECI 537 Teaching Children’s Literature (3 credit hours)
Instructions for educators in quality children's literature, specific needs of young reader, genres of children's literature, strategies for instructing children's literature, ways to target reader's interests, and design of literature units.

Typically offered in Summer only

ELM 539 Special Problems in Elementary School Science (3 credit hours)
In this course teachers build their science content knowledge in life, physical, and Earth/space science, examine strategies for effective science instruction to provide students with 21st Century skills with applications to young children's cognitive and affective learning.

Typically offered in Spring only

ELM 540 Reading In the Elementary School (3 credit hours)
Theoretical foundations of reading instruction and current methods and materials for teaching reading, with emphasis on planning and implementing reading programs for children in kindergarten through grade six.

Typically offered in Fall and Spring

ELM 555 Number Systems and Operations: K-5 Mathematical Tasks (3 credit hours)
Analysis and construction of effective mathematical tasks in teaching number systems and operations at the K-5 level; attention is also given to the expansion of content knowledge.

Typically offered in Fall only

ELM 556 Rational Numbers and Operations: K-5 Learning Trajectories (3 credit hours)
Focus on rational number concepts through learning trajectories at the K-5 level; attention also given to problem solving and content knowledge.

Typically offered in Spring only

ELM 557 Data Analysis and Measurement: K-5 Classroom Interactions (3 credit hours)
Focus on statistical literacy of elementary teachers and the teaching of data analysis and measurement to K-5 students; attention is also given to learning methods which facilitate appropriate classroom interactions.

Typically offered in Summer only

ELM 558 Algebraic Reasoning: K-5 Discourse and Questioning (3 credit hours)
Focus on the early algebra concepts of functional thinking and generalized arithmetic in relationship to pedagogical practices centered on questioning in the mathematics classroom.

Typically offered in Summer only

ELM 559 Geometry and Spatial Visualization: K-5 Assessment (3 credit hours)
Formative and summative assessment strategies of students’ geometric thinking in elementary grades; Concept development of 2- and 3-dimensional Geometry. Attention also given to diagnosis of student errors.

Typically offered in Summer only

ELM 560 Mathematical Modeling: K-5 Leadership (3 credit hours)
Generating mathematical representations and making explicit connections between concepts; Pedagogy designed to equip elementary teachers to become mathematics teacher-leaders in school settings; Focus given to topics integrated within mathematical strands.

Typically offered in Summer only

ELM 571 Language Arts, New Literacies and Media for Initial License (3 credit hours)
Examine research-based processes for writing instruction, effects of and approaches for use of technology on literacy development, and effects of media and new literacies (non-print literacies, e.g. digital, visual, film) on literacy learning and development in elementary schools. Restricted to ELM MAT students.

Typically offered in Fall and Spring

ELM 572 Methods for Teaching Reading in the Elementary Classroom for Initial License (3 credit hours)
ELM 572 prepares pre-service teachers to teach reading and leads to licensure in the elementary grades. The course examines specific research-based methodology that relates to the theory and practice of teaching reading for elementary readers. Restricted to ELM, MAT students.

Typically offered in Fall and Spring
ELM 573  Methods for Teaching Elementary School Science for Initial License  (3 credit hours)
ELM 573 prepares preservice teachers to teach science and leads to licensure in the elementary grades. The course examines specific research verified methodologies that relate to the theory and practice of teaching science to elementary students. Restri

Typically offered in Fall and Spring

ELM 574  Methods for Teaching Mathematics in the Elementary Classroom for Initial License  (3 credit hours)
Prepares preservice teachers to teach mathematics and leads to licensure in the elementary grades. Examines specific research-based methodologies that relate to the theory and practice of teaching mathematics to elementary students. Limited to students

Typically offered in Fall and Spring

ELM 575  Social Studies in the Elementary School for Initial License  (3 credit hours)
Designed to prepare pre-service teachers to teach social studies and to lead to licensure in the elementary grades. The course is an examination of curriculum, instruction, and learning in K-6 social studies education. Emphasis include development of the social studies, curricular principles and components, research verified teaching strategies, and learner outcomes. Restricted to ELM MAT students.

Typically offered in Fall and Spring

ELM 590  Special Problems in Elementary Education  (1-6 credit hours)
In-depth study of topical problems in teaching and learning of current and special interest to elementary education practitioners.

Typically offered in Fall, Spring, and Summer

ELM 630  Independent Study in Elementary Education  (1-3 credit hours)
Detailed investigation of topics of particular interest to graduate students under faculty direction on a tutorial basis. Determination of credits and content by faculty member in consultation with department head.

Typically offered in Fall and Spring

ELM 644  Practicum in Elementary Education  (1-6 credit hours)
Supervised practical experiences in schools and area agencies concerned with education of elementary-age students.

Typically offered in Fall and Spring

ELM 654  Internship In Elementary Education  (1-6 credit hours)
Supervised opportunities for advanced professional development in contexts concerned with elementary grades education.

Typically offered in Fall and Spring

Engineering (E)

E 101  Introduction to Engineering & Problem Solving  (1 credit hours)
An introduction to the College of Engineering as a discipline and profession. Emphasis on engineering design, interdisciplinary teamwork, and problem solving from a general engineering perspective. Overview of academic policies affecting undergraduate engineering students. Exposure to College of Engineering and university-wide programs and services.

Prerequisite: Engineering Majors, Freshman standing

Typically offered in Fall only

E 102  Engineering in the 21st Century  (2 credit hours)
This interdisciplinary course will provide an overview of the fourteen engineering grand challenges of the 21st century and their relationships to all of the separate engineering disciplines in the College of Engineering. The lectures will incorporate examples, guest speakers, and specific readings on the challenges in sustainability, health, vulnerability, and the joy of living to advance civilization into the next century. Students will gain an appreciation for the methods in which engineers, in each discipline, acquire knowledge and design tools or interdisciplinary solutions essential to meet society's future needs. Course is available to 25% non-engineering students.

Restriction: Freshmen only with completion of a college introductory course, i.e. E101

E 115  Introduction to Computing Environments  (1 credit hours)
Introduction to the NC State computing system, and to student-owned computing resources. Includes topics such as maintaining your own computer, learning about campus-based computing resources and applications (how to access and use them), ethics and professionalism in the use of computing resources, introduction to web development and other campus resources.

Typically offered in Fall, Spring, and Summer

E 122  Engineering Academic Success  (1 credit hours)
This 8-week course is designed to teach students a variety of proven strategies for creating greater academic, professional, and personal success. Enrollment is required of students in the College of Engineering who were unsuccessful in completing E101 and/or have an earned GPA less than 2.0 after the first semester of the freshman year. Topics include: time management, goal setting, stress management, study skills, learning styles, and campus resources using a platform of lectures and guest speakers.

Typically offered in Spring only

E 144  Academic and Professional Preparation for Engineering I  (1 credit hours)
Assist new freshmen engineering students in the transition from high school to the collegiate environment. Cover critical-thinking; problem solving techniques; academic skills and time management.

Typically offered in Fall only

E 145  Academic and Professional Preparation for Engineering II  (1 credit hours)
Engineering as a field of study and profession. Career and professional development, goal setting, decision making and effective communication strategies.

Typically offered in Spring only
E 201 Engineering Transfer to Success (1 credit hours)
This 8-week course will provide an overview of the NC State University policies and procedures, organizations, and resources available for enhancing the academic success of new transfer students in the College of Engineering. Lectures and discussion from departmental representatives will focus on requirements and availability for financial aid, cooperative education, career services, and campus student organizations. Emphasis will be placed on acclimating student through teamwork and academic achievement within the first year of transfer.
Prerequisite: E101 or Introduction to College Course
Typically offered in Fall only

E 298 Special Topics Engineering (1-3 credit hours)
Typically offered in Spring only

E 304 Introduction to Nano Science and Technology (3 credit hours)
Fundamental concepts of Nano-Science and Technology including scaling, nano-scale physics, materials, mechanics, electronics, heat transfer, photonics, fluids and biology. Applications of nano-technology.
Prerequisite: MA 242 and PY 208 with grade of C- or higher
Typically offered in Fall and Spring

E 480 Namibia Wildlife Aerial Observatory (6 credit hours)
Namibia Wildlife Aerial Observatory (WAO) is restricted to junior-level and above students who participate in Namibia WAO study-abroad. The course is a purpose-driven educational experience of field work and research. The first 10 weeks take place in Namibia; of which during the first two weeks, the students receive lectures on such topics as African landscapes and wildlife, African culture, cross-cultural knowledge and skills, wildlife trade and poaching, data analysis for research, and are trained in the operation and maintenance of unmanned aerial vehicle systems (e.g. vehicles, cameras, communications) and in the following eight weeks are divided into field units that conduct aerial data collection for the purposes of meeting given wildlife missions. Upon returning to NC State, each field unit spends two-weeks (10 days) turning their findings into a research journal article for dissemination.
Junior standing or above
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall only

E 490 Fundamentals of Engineering (FE) Exam Preparation (1 credit hours)
Preparation for graduating seniors in engineering to take the Fundamentals of Engineering (FE) Examination. Information on how to register for the FE exam, exam strategy, and a review of selected science and engineering topics through active learning exercises directed at working sample examination problems. Credit may not be counted toward graduation.
Prerequisite: Engineering Majors, Senior standing, Graduate students, or PBS status
Typically offered in Fall and Spring

E 497 Engineering Research Projects (1-3 credit hours)
Projects in research, design or development in engineering or computer science. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.
Prerequisite: Junior standing in College of Engineering, Engineering Scholars Program or Engineering Research Center Scholars
Typically offered in Fall, Spring, and Summer

E 531/OR 531/MA 531 Dynamic Systems and Multivariable Control I (3 credit hours)
Introduction to modeling, analysis and control of linear discrete-time and continuous-time dynamical systems. State space representations and transfer methods. Controllability and observability. Realization. Applications to biological, chemical, economic, electrical, mechanical and sociological systems.
Prerequisite: MA 341, MA 405
Typically offered in Fall only

E 731/MA 731/OR 731 Dynamic Systems and Multivariable Control II (3 credit hours)
Prerequisite: OR(E,MA) 531
Typically offered in Spring only

English (ENG)

ENG 1GEP 100 Level English Composition (3 credit hours)
100 Level English Composition. Transfer students with 3 hours of ENG 1GEP credit may receive ENG 101 equivalency by completing ENG 105 with a C- or better.

ENG 100 Reading and Writing Rhetorically (4 credit hours)
Intensive practice in reading and writing critically and rhetorically, with attention to how those change according to purpose and situation. Introduction to rhetorical concepts and elements with application to a variety of academic, professional, or civic texts. Exploration of principles of argument and organization. Guidance in developing flexible, self-aware reading and composing processes. Practice in seeking, providing, and responding to constructive feedback. Practice with making choices about grammar, mechanics, and style appropriate to specific rhetorical situations. Extensive writing practice and individualized coaching to support ongoing development as a writer. Intended as preparation for ENG 101. Departmental consent required.
Typically offered in Fall, Spring, and Summer
ENG 101 Academic Writing and Research (4 credit hours)
Intensive instruction in academic writing and research. Basic principles of rhetoric and strategies for academic inquiry and argument. Instruction and practice in critical reading, including the generative and responsible use of print and electronic sources for academic research. Exploration of literate practices across a range of academic domains, laying the foundation for further writing development in college. Continued attention to grammar and conventions of standard written English. Successful completion of ENG 101 requires a C- or better. Credit for ENG 101 is not allowed if the student has already fulfilled the first-year writing requirement.

Prerequisite: Placement via English Department guidelines
Typically offered in Fall, Spring, and Summer

ENG 202 Disciplinary Perspectives in Writing (3 credit hours)
Examination of the uses of writing and research within academic disciplines; analysis, synthesis, and reflection on what makes effective academic arguments; development of an understanding of the rhetorical demands of disciplinary writing, including attention to audience, purpose, and context; instruction in critical research practices; engagement in reflective activities on writing and research processes to help students gain facility in academic writing across disciplines and within their own discipline. Restricted to transfer students with 3 hours of ENG1** or ENG1GEP transfer credit. Together with approved transfer credit hours, this course satisfies the Introduction to Writing component of the General Education Program. Course Pre-requisite: 3 credits of ENG1** or ENG1GEP transfer credit.

P: 3 hours transferring ENG1** or ENG1GEP transfer credit
Typically offered in Fall, Spring, and Summer

ENG 206 Studies In Drama (3 credit hours)
Selected drama from the classical period to the present. Emphasis on reading for enjoyment as well as understanding theory and development of tragedy, comedy, and other modes of dramatic expression. Writers such as Sophocles, Euripides, Shakespeare, Ibsen, and Shaw, and contemporary playwrights.

GEP Humanities
Typically offered in Fall and Spring

ENG 207 Studies In Poetry (3 credit hours)
Main features of poetry such as tone, voice, form, diction, figurative language, and sound patterns. Reading of poetry from different periods with the goal of learning how to understand, appreciate, and analyze different kinds of poems.

GEP Humanities
Typically offered in Fall, Spring, and Summer

ENG 208 Studies In Fiction (3 credit hours)
Representative examples of novels and short stories from different periods, emphasizing understanding and appreciation of fiction as a genre, a knowledge of the features and techniques of fiction, and a sense of the development of the genre.

GEP Humanities
Typically offered in Fall, Spring, and Summer

ENG 209 Introduction to Shakespeare (3 credit hours)
Shakespeare for non-English majors. Seven to ten major plays, including representative comedies, such as The Taming of the Shrew; histories, such as Richard III; tragedies, such as Hamlet; and romances, such as The Tempest. Does not satisfy requirements for English major.

GEP Humanities
Typically offered in Fall, Spring, and Summer

ENG 210 Introduction to Language and Linguistics (3 credit hours)
Linguistics theory and method. Topics include the English sound system, morphology, syntactic structure, semantics, and historical and contemporary dialect variation. Language acquisition, language and the brain, and computer processing and human language.

Prerequisite: ENG 101
Typically offered in Fall and Spring

ENG 214 Introduction to Editing (3 credit hours)
Basic editorial skills with a wide range of publications. Stylistic editing (conventions of written English, consistency, effectiveness of syntax, appropriateness of diction), substantive editing (accuracy, legal issues, ethics), and production editing (layout, typography, electronic publication processing). Introduction to resources such as standard reference works and professional organizations.

Prerequisite: ENG 101
Typically offered in Fall, Spring, and Summer

ENG 216 Technologies for Texts (3 credit hours)
Uses of computers for creating, designing, analyzing, and disseminating texts, both on desktops and on the Internet. Overview of technologies that facilitate reading, writing, and communication; development of skill with various applications and understanding of their capabilities, limitations, and historical analogues. Recommended for students in journalism and technical writing.

Prerequisite: ENG 101
Typically offered in Spring only

ENG 219/FL 219 Studies in Great Works of Non-Western Literature (3 credit hours)
Readings, in English translation, or non-Western literary masterpieces from the beginnings of literacy in the Middle East, Asia, and Africa to the modern period, including excerpts from texts such as the Upanishads, the Ramayana, the Sundiata, Gilgamesh, A Thousand and One Nights, and the Quran and such authors as Confucius, Oe Kenzaburo, Omar Khayyam, Rumi, and Amos Oz.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring
ENG 220/FL 220 Studies in Great Works of Western Literature (3 credit hours)
Readings, in English translation, of Western literary masterpieces, from the beginnings of literacy in the Middle East and Europe towards the present, including such authors as Homer, Sophocles, Virgil, Ovid, Augustine, Dante, Machiavelli, Shakespeare, Cervantes, Voltaire, Goethe, Austen, Flaubert, Dickinson, Tolstoy, Kafka, and Woolf. Credit will not be given for both ENG/FL 220 and either ENG/FL 221 or ENG/FL 222.

Restriction: Credit is not allowed for both ENG 220 and ENG 221 or ENG 222.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

ENG 221/FL 221 Literature of the Western World I (3 credit hours)
Readings from English translations of Biblical, Classical, Medieval, and Early Renaissance literature, including works by such authors as Homer, Plato, Virgil, Ovid, St. Paul, St. Augustine, Marie de France, and Dante. Credit is not allowed for both ENG 221 and ENG 220.

Restriction: Credit is not allowed for both ENG 221 and ENG 220.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

ENG 222/FL 222 Literature of the Western World II (3 credit hours)
Readings from English translations of Renaissance, Neo-Classical, Romantic, and Early Modern literature, emphasizing the cultures of continental Europe from the Renaissance to 1900, and including such authors as Petrarch, Erasmus, Rabelais, Machiavelli, Shakespeare, Voltaire, Rousseau, Goethe, Flaubert, and Tolstoy. Credit is not allowed for both ENG 220 and ENG 222.

Restriction: Credit is not allowed for both ENG 222 and ENG 220.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

ENG 223/FL 223 Contemporary World Literature I (3 credit hours)
Twentieth-century literature of some of the following cultures: Russian, Eastern European, Western European, Latin American, Canadian, Australian.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

ENG 224/FL 224 Contemporary World Literature II (3 credit hours)
Twentieth-century literature of some of the following cultures: Asian, Middle Eastern, African, Caribbean, Native-American.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

ENG 225 Literature and Medicine (3 credit hours)
Literary, cultural, and philosophical perspectives on medical science and practice, illness, epidemics, and related topics. Readings will include fiction, poetry, personal essays, film, and other media.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

ENG 246/FL 246 Literature of the Holocaust (3 credit hours)
Fictional and nonfictional versions of the Holocaust, focusing on themes of survival, justice, theology, and the limits of human endurance.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

ENG 248/AFS 248 Survey of African-American Literature (3 credit hours)
African-American writing and its relationships to American culture and history. Covers such writers as Wheatley, Douglass, Chesnutt, Dunbar, DuBois, Hughes, Hurston, Wright, and Morrison.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

ENG 249 Native American Literature (3 credit hours)
A survey of Native American literatures from before contact with Europeans to contemporary culture. Writers may include: Apsess (Pequot), Ridge (Cherokee), Silko (Laguna Pueblo), Momaday (Kiowa), Power (Sioux) Gunn Allen (Laguna-Siouxs), Harjo (Creek), and Erdrich (Anishinaabe).

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

ENG 251 Major British Writers (3 credit hours)
Significant British authors chosen from among such figures as Chaucer, Shakespeare, Milton, Swift, Austen, Wordsworth, Coleridge, Tennyson, Browning, Bronte, Dickens, Joyce, Eliot, Woolf, and Yeats. Credit will not be given for both ENG 251 and either ENG 261 or 262.

Credit is not allowed for both ENG 251 and ENG 261 or ENG 262.
GEP Humanities
Typically offered in Fall, Spring, and Summer

ENG 252 Major American Writers (3 credit hours)
Significant American authors chosen from among such figures as Franklin, Emerson, Thoreau, Hawthorne, Melville, Douglass, Stowe, Whitman, Dickinson, Twain, James, Frost, Faulkner, Hemingway, and Morrison. Credit will not be given for both ENG 252 and either ENG 265 or 266.

R: Credit will not be given for both ENG 252 and either ENG 265 or ENG 266.
GEP Humanities
Typically offered in Fall and Spring

ENG 255 Beyond Britain: Literature from Colonies of the British Empire (3 credit hours)
This course challenges students to understand the historical, political, and cultural circumstances that gave rise to literary production in 18th- and 19th-century colonial societies. The course will enable students to understand the value of reading 18th- and 19th-century literature from a global perspective, a critical component of literary studies in today's twenty-first-century world.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

ENG 260 Reading Literature and Exploring Textuality (3 credit hours)
Introduces fundamental questions in literary history and critical theory. Emphasizes critical reading skills and prepares students for the kinds of courses-surveys, genre courses, author courses, problem-based courses-that are part of the English major. Papers prepared using standard word processing programs.

Prerequisite: ENG 101
Typically offered in Fall and Spring
ENG 261  English Literature I  (3 credit hours)
A survey of English literature to 1660, including Old English, Middle
English, and Renaissance writing, focusing on such central authors as
Chaucer, Spenser, Marlowe, Shakespeare, Jonson, Donne, and Milton.
Credit will not be given for both ENG 261 and ENG 251.
Restriction: Credit is not allowed for both ENG 261 and ENG 251.
GEP Humanities
Typically offered in Fall, Spring, and Summer

ENG 262  English Literature II  (3 credit hours)
A survey of English literature from 1660 to the present. Poetry, fiction,
drama and intellectual prose by such central writers as Dryden, Pope,
Swift, Johnson, Wollstonecraft, Wordsworth, Keats, Shelley, Bronte,
Carlyle, Tennyson, Browning, Yeats, Woolf, Joyce and Eliot. Credit will
not be given for both ENG 262 and ENG 251.
Credit is not allowed for both ENG 262 and ENG 251.
GEP Humanities
Typically offered in Fall, Spring, and Summer

ENG 265  American Literature I  (3 credit hours)
A survey of American literature from the beginnings to the Civil War,
including such central authors as Edwards, Franklin, Irving, Emerson,
Hawthorne, Melville, Poe, Stowe, Douglass, Thoreau, and Whitman.
Credit will not be given for both ENG 265 and ENG 252.
Credit is not allowed for both ENG 265 and ENG 252.
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall and Spring

ENG 266  American Literature II  (3 credit hours)
A survey of American literature from the Civil War to the present,
including such central authors as Whitman, Dickinson, Twain, James,
Crane, Wharton, Frost, Eliot, Hemingway, Hurston, Faulkner, Wright,
O'Connor, and Morrison. Credit will not be given for both ENG 266 and
ENG 252.
Credit is not allowed for both ENG 266 and ENG 252.
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

ENG 267  LGBTQI Literature in the U.S.  (3 credit hours)
Chronological survey of works of literature by and about gay, lesbian,
bisexual, transgender, questioning, and intersex communities in the
U.S. Primary texts will be considered in historical, political, and literary
contexts. Brief consideration of early works from colonial period and 19th
century with primary focus on 20th and 21st century texts.
GEP Humanities
Typically offered in Fall, Spring, and Summer

ENG 275/FL 275  Literature and War  (3 credit hours)
A geographical and thematic examination of war and questions it raises,
as reflected in selected writings from, Homer, Sophocles, Japan's Tale of
the Heike, Shakespeare, The Bhagavad-Gita, Keegan, Kipling, Graham
Green, Mulden, Michael Herr, Dexter Filkins, Lucius Shepherd as well as
writers on Just War and Deterrence Theory, and military science.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

ENG 281  Introduction to Creative Nonfiction  (3 credit hours)
This is an introductory course that will instruct students in writing, editing
and appreciating the professional nonfiction one finds in magazines,
on issue-oriented websites, and in general interest publications, from
the New Yorker-style long article to the personal columns one finds on
online media outlets: writing about an issue or event in a personal, stylish
way while obtaining the rigor of journalism in scrupulous research and
clarity. In an ever-enlarging media universe, this is the most visible and
commercial of all the creative writing genres.
Prerequisite: ENG 101
Typically offered in Fall, Spring, and Summer

ENG 282  Introduction to Film  (3 credit hours)
Examination of basic film techniques and methods of film analysis.
Emphasis on understanding and appreciating film as a major US and
international art form and industry operating in various national, cultural,
and historical contexts.
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

ENG 287  Explorations in Creative Writing  (3 credit hours)
Introduction to the basic elements and principles of three genres of
creative writing: poetry, fiction and drama. Reading and class discussion
of student work. Recommended for students with no prior experience in
creative writing.
Prerequisite: ENG 101
Typically offered in Fall, Spring, and Summer

ENG 288  Fiction Writing  (3 credit hours)
Experience in writing short prose fiction. Class critiquing of student work
and instruction in techniques of fiction.
Prerequisite: ENG 101
Typically offered in Fall and Spring

ENG 289  Poetry Writing  (3 credit hours)
Experience in writing poetry. Class critiquing of student work and
instruction in techniques of poetry.
Prerequisite: ENG 101
Typically offered in Fall and Spring

ENG 292  Writing About Film  (3 credit hours)
Comprehensive study of various approaches to writing about film.
Primary focus is on the critical and evaluative practice involved in writing
film criticism for non-academic audiences. Film screenings, discussion
of assigned readings, and in-class writing workshops aid students in
preparing a portfolio of film writing that includes film reviews of various
lengths.
Prerequisite: ENG 101
GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

ENG 298  Special Projects in English  (1-3 credit hours)
Faculty-guided independent study, or courses on special topics
determined by departmental interest or need.
Typically offered in Fall, Spring, and Summer
ENG 305/WGS 305  Women and Literature  (3 credit hours)
Nineteenth through twenty-first century women's literature, as shaped by the intersecting and competing claims of gender, race, sexuality, and culture. Focus on fiction, accompanied by critical readings from American studies, feminist literary criticism, and postmodern theory.

Prerequisite: Sophomore standing and above
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall and Spring

ENG 308/WGS 308  Contemporary Issues in Ecofeminism  (3 credit hours)
Contemporary issues in ecofeminism provides a historical introduction to and global perspectives on women's sociopolitical, ethical, and economic contributions to the 20th and 21st century environmental movement. Theory and political action as they interweave issues of gender, race, and class in western and non-western contexts will be emphasized. Students will read works by and about female scientists/activists/writers and examine their own communities, analyzing the ways that individuals, community values, and dominant institutions impact women's relationships with the environment. Students will formulate questions, responses, and interpretations through critical reading practices, class discussion groups, self-reflective writing, and comparative analyses. Special attention will be paid to the role of literature—memoir, novel, short story, essay—in the dissemination of ecofeminist ideas.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

ENG 314  Technical Document Design and Editing  (3 credit hours)
Layout and design principles for written documents; desktop building; legibility, readability testing; conventions of proposals, instructions, and reports; basics of technical editing: usage, vocabulary, style manuals, editing mathematical equations, graphs, tables.

Prerequisite: ENG 214
Typically offered in Fall only

ENG 315  Phonetics  (3 credit hours)
This course is an introduction to phonetics: how spoken language is produced and perceived, and the physical properties of speech. An understanding of phonetics is fundamental to scientific and clinical approaches to speech and language. This course is meant to build both skills and knowledge.

Typically offered in Fall only

ENG 316  Introduction to News and Article Writing  (3 credit hours)

Prerequisite: ENG 101
Typically offered in Fall and Spring

ENG 317  Designing Networked Communications  (3 credit hours)
A course in the layout, design, and composition of digitally-networked communication. Students will learn to analyze audiences and themselves for their uses of information in order to plan, compose, and critically evaluate digitally networked ecologies including web pages, mobile applications, and social media platforms. Students will acquire theories and skills with HTML/CSS coding, rhetorically-centered design, accessibility, and user experience and will apply those skills to the composition of a variety of digital texts. Course work will require students to become proficient with commercially-available and open source content platforms.

Prerequisite: ENG 101
Typically offered in Spring only

ENG 320  Anatomy and Physiology of Speech  (3 credit hours)
Students will learn about the anatomy and physiology of the speech mechanism including the muscular, skeletal, and nervous system structures involved in respiration, phonation, and articulation. This knowledge may be applied in clinical fields such as speech-language pathology or serve as the basis for the study of linguistic phonetics.

Typically offered in Fall only

ENG 321/COM 321  Survey of Rhetorical Theory  (3 credit hours)
Principles of rhetorical theory from its classical origins through the modern period to the present time. Key concepts and theories that provide a critical understanding of the processes of persuasive symbol use.

Prerequisite: Sophomore standing and above

ENG 323  Writing in the Rhetorical Tradition  (3 credit hours)
A writing course based on the study of rhetoric. Readings on the principles of invention, arrangement, and style; analysis of written texts; writing of persuasive texts for a variety of audiences and purposes.

Prerequisite: ENG 101
Typically offered in Fall, Spring, and Summer

ENG 324  Modern English Syntax  (3 credit hours)
Study of Modern English at the sentence level. Analysis of grammatical structure. Consideration of language variation in English.

Prerequisite: ENG 101
Typically offered in Fall only

ENG 325  Spoken and Written Traditions of American English Dialects  (3 credit hours)
Basic issues in the study of language: linguistic terminology and categories; grammatical traditions and topics such as prescriptivism and descriptivism, standard and non-standard, orality and literacy; language acquisition and awareness; language aesthetics and ethics.

Prerequisite: ENG 101
Typically offered in Fall only

ENG 326  History of the English Language  (3 credit hours)
Development of the English language from its Indo-European origins to the present. Emphasis on historical and comparative linguistic methodology and on changes in sound, syntax, and meaning.

P: ENG 101
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only
ENG 327/WGS 327  Language and Gender  (3 credit hours)
Introduction to the use of language by men and women. Research in Linguistics and Women's Studies addressing issues such as the acquisition of gender-differentiated language, gender and conversational interaction, sexism in language, gender issues in society, and the relationship between language, gender, and other social constructs (e.g., class, culture, and ethnicity).

Prerequisite: ENG 101
Typically offered in Fall only

ENG 328  Language and Writing  (3 credit hours)
Study of language structure; specific attention to differences between spoken and written language; print conventions; error analysis; and the application of linguistics to rhetoric and composition. Analysis of a variety of grammatical approaches; how

Prerequisite: ENG 101
Typically offered in Fall only

ENG 329  Language and Globalization  (3 credit hours)
Introduction to the sociolinguistics of globalization. Through linguistic-semiotic practices, examine how mobility, migration, and the global circulation of information and ideologies impact people, places, and practices. Study of the interplay between global flows, (trans)local contexts, and the consequences of intense contact with linguistic and cultural otherness. Topics include: English as a global language; mobility, migration, multilingualism; youth language in mobility; multilingual hip-hop; globalization and social media; multilingual signs and linguistic landscapes in urban settings.

GEP Global Knowledge, GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

ENG 330  Screenwriting  (3 credit hours)
Writing for films, story planning, character development, communicating information, building scenes, relationships between script and cinematic dimensions, working with studios and editors.

Prerequisite: 6 credit hours from courses in writing for media, creative writing, or Film Studies
Typically offered in Fall and Spring

ENG 331  Communication for Engineering and Technology  (3 credit hours)
Written communication in industrial and technical organizations, emphasizing internal communication with managers and technical personnel and including external communication with regulators, vendors, and clients. Intensive practice in writing; relationship of writing to oral and visual communication. For students in engineering and other primarily technological curricula. Credit is not allowed for more than one of ENG 331, ENG 332, and ENG 333.

Prerequisite: Junior standing. Credit is not allowed for both ENG 331 and ENG 332 or ENG 333.
Typically offered in Fall, Spring, and Summer

ENG 332  Communication for Business and Management  (3 credit hours)
Written communication in business and public organizations, including both internal communication (such as instructions, policies, management reports) and external communication with clients, vendors, and publics. Intensive practice in writing; relationship of writing to oral and visual communication. For students in business and management-related programs. Credit is not allowed for more than one of ENG 331, ENG 332, and ENG 333.

Prerequisite: Junior standing. Credit is not allowed for both ENG 332 and ENG 331 or ENG 333.
Typically offered in Fall, Spring, and Summer

ENG 333  Communication for Science and Research  (3 credit hours)
Written communication in scientific and research contexts, emphasizing relationship between research and writing in problem formulation, interpretation of results, and support and acceptance of research. Intensive practice in writing; relationship of writing to oral and visual communication. For students who plan careers in scientific research. Credit is not allowed for more than one of ENG 331, 332, and 333.

Prerequisite: Junior standing. Credit is not allowed for both ENG 333 and ENG 331 or ENG 332.
Typically offered in Fall, Spring, and Summer

ENG 335  Language Development  (3 credit hours)
This course addresses syntactic, semantic, morphologic, and pragmatic development from birth through adolescence, explores the influence of cognitive and social development on language development, and contrasts first language acquisition with second language learning.

Typically offered in Spring only

ENG 338  Speech Science  (3 credit hours)
Learn about the acoustic properties of speech sounds and the dynamics of speech sound production. Become familiar with and practice the use of basic clinical instrumentation used to measure respiratory, phonatory, and articulatory movements and the acoustic events that result from these movements. Complete assignments requiring the use of basic instrumentation and computer software.

Prerequisite: ENG 320
Typically offered in Spring only

ENG 339  Literature and Technology  (3 credit hours)
Introduction to how the interactions among technologies, media, and literature shape the cultural past. The course pursues studies of fictional and non-fictional texts through several disciplinary perspectives including literary criticism, communications, media theory, and history. Technologies and literary and historical eras considered will vary.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring
ENG 340 Literature, Art, and Society (3 credit hours)
This course explores the intersection of literature and the arts, including the visual and/or performing arts, and their role as social commentary. It will consider the expressive power of the medium in the arts, whether that of an individual artist working across mediums or a collaboration between artists, and will examine the rich relations that have existed between literature, the arts, and important social movements of the day. Disciplinary perspectives include literary criticism, history, art history, performance studies, and museum studies.

Requisite: Sophomore Standing or Above
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

ENG 341 Literature and Science (3 credit hours)
This course tracks the imaginative potentials, social repercussions, and interdisciplinary mixing of literature and science since the emergence of empiricism in the sixteenth century. Well before literature and science divided into "two cultures," they supplied a fruitful crossover for ideas about how and why the world works and how we gain new knowledge. Even with the development of modern disciplines, literature plays an important role in cultural assessments of scientific discovery and education. Students will read a selection of works from literary as well as scientific writers, analyzing texts and historical contexts and producing written arguments within an interdisciplinary framework.

Requisite: Sophomore Standing or Above
GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

ENG 342 Literature of Space and Place (3 credit hours)
This course investigates how various spatial categories (for example, the city, the pastoral, wilderness, region, nation, or the globe) work in and are constructed by literary texts. Humanities fields have increasingly noted the importance of space and place in shaping our lives and as key mechanisms through which ideas of gender, sexuality, race, class, national identity, or nature are shaped. Our spatial analysis of literature will borrow from an interdisciplinary range of methods: cultural and historical geography, cartography, urban studies, and/or environmental studies. The course also addresses the historical and cultural contexts that have shaped ideas of space.

Requisite: Sophomore Standing or Above
GEP Humanities, GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Fall and Spring

ENG 349/AFS 349 African Literature in English (3 credit hours)
Anglophone literature in Africa. Emphasis on the relationship between the African world-view and literary production and the persistent trend by African writers to connect literature with politics. Writers such as Achebe, Ngugi, Soyinka, and Serote.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ENG 350 Professional Internships (3 credit hours)
Directed work for CHASS majors including work-site mentoring and evaluation. Department supervision includes a course work directed toward designing employment application materials, developing a portfolio of professional work or relevant research paper, considering a variety of career options, and reading literature on workplace socialization. Students must provide their own transportation to the internship site. Modest liability insurance fee required. Students must have at least a 2.5 overall GPA and at least a 3.0 GPA in the major, be a junior or senior CHASS major or minor, and must complete the application process outlined on the Internship Program Website or provide the internship coordinator with contact information for your supervisor at an internship you obtained independently.

Typically offered in Fall and Spring

ENG 359 Topics in Film Studies (3 credit hours)
Critical approaches to focused film topics involving film genres, directorial styles, or trends within a national cinema. Topics will vary from semester to semester.

Typically offered in Spring only

ENG 360 Studies in British Poetry (3 credit hours)
An examination of selected British poetry within its historical and cultural contexts. The course will focus on poetry of the Victorian period. Poets studied include Matthew Arnold, Robert and Elizabeth Barrett Browning, Rudyard Kipling, Christina and Dante Gabriel Rossetti, Alfred, Lord Tennyson, and Oscar Wilde. Class discussion will focus on analysis of literary texts within the larger cultural contexts of debates over art and aesthetics, science and industrialization, gender roles, religion, and imperial expansion.

Requisite: Sophomore Standing or Above
GEP Humanities
Typically offered in Fall and Spring

ENG 361 Studies in the British Novel (3 credit hours)
Emphasizes major novelists such as Behn, Fielding, Defoe, Richardson, Swift, Austen, Dickens, the Brontës, Eliot, Carroll, Hardy, Stevenson, Wilde, Stoker, James, Woolf, Forster, Joyce, Orwell, Lawrence, Lessing, Murdoch, Burgess, McEwan, Ishiguro, Byatt, Mantel, Zadie Smith.

Requisite: Sophomore Standing or Above
GEP Humanities
Typically offered in Fall and Spring

ENG 362 Studies in the British Novel (3 credit hours)
Emphasizes major novelists such as Behn, Fielding, Defoe, Richardson, Swift, Austen, Dickens, the Brontës, Eliot, Carroll, Hardy, Stevenson, Wilde, Stoker, James, Woolf, Forster, Joyce, Orwell, Lawrence, Lessing, Murdoch, Burgess, McEwan, Ishiguro, Byatt, Mantel, Zadie Smith.

Requisite: Sophomore Standing or Above
GEP Humanities
Typically offered in Fall and Spring

ENG 364/COM 364 History of Film to 1940 (3 credit hours)
Technological developments and aesthetic movements that shaped international cinema production from the beginning of the industry to 1940. Formal evolution in camera movement, editing, sound, narrative form, and the documentary. The rise to prominence of Hollywood and international cinemas in historical, economic, and cultural contexts.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

ENG 369 The American Novel of the 19th Century (3 credit hours)
Major novels illustrating the development of American fiction from Romanticism to Realism and Naturalism. Works by such writers as Brown, Cooper, Hawthorne, Stowe, Melville, Twain, Howells, James, Norris, Crane, Chopin, and Dreiser.

Prerequisite: Sophomore standing and above
Typically offered in Fall only
ENG 370  American Fiction, Twentieth Century and Beyond  (3 credit hours)
Study of narrative fiction written in the twentieth-century and after by American writers. This course will examine major developments in narrative form and technique, based on developments in important literary traditions such as realism, modernism or postmodernism. The course will situate the fiction in key contexts, whether literary or cultural. Representative writers: Ernest Hemingway, Gertrude Stein, William Faulkner, Toni Morrison and Cormac McCarthy.

Prerequisite: Sophomore standing and above
GEP Humanities
Typically offered in Fall and Spring

ENG 372  American Poetry, Twentieth Century and Beyond  (3 credit hours)
Study of poetry written in the twentieth-century and after by American poets. This course will examine major developments in form and technique by poets influenced by transformative movements such as Imagism, Modernism, the Objectivists, Black Mountain poets, New York School and subsequent developments. The course will situate poetry in key contexts, whether literary or cultural. Representative poets: T.S. Eliot, H.D., Langston Hughes, Frank O’Hara, C.D. Wright and Yusef Komunyakaa.

Prerequisite: Sophomore standing and above
GEP Humanities
Typically offered in Fall and Spring

ENG 374/COM 374  History of Film From 1940  (3 credit hours)
Technological developments and aesthetic movements that have shaped international cinema production from 1940 to the present. Evolution in camera movement, editing, sound, narrative form, and the documentary. Post-war Hollywood cinema and international film industries (both established and emerging) in historical, economic and cultural context.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Spring only

ENG 375/AFS 375  African American Cinema  (3 credit hours)
Survey and analysis of African American film culture from 1900-present. Examination of pre-Hollywood, classical Hollywood, and Independent filmmaking. Particular focus on independent filmmakers’ response to dominant industry representations and the work of filmmakers who seek to create a specifically African American cinematic style.

GEP U.S. Diversity
Typically offered in Spring only

ENG 376  Science Fiction  (3 credit hours)
Representative works of science fiction. Emphasis on works written in the twentieth century, with some attention to the history and development of the genre.

Prerequisite: Sophomore standing and above
GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

ENG 377  Fantasy  (3 credit hours)
Representative works in the genre of fantasy. Emphasis on works of 19th and 20th centuries. Authors such as Carroll, Lewis, Tolkien, Borges, LeGuin, and Gardner.

Prerequisite: Sophomore standing and above
GEP Humanities
Typically offered in Spring only

ENG 378  Women & Film  (3 credit hours)
This course will introduce students to women’s participation, as well as their representation, in the history of film and other audiovisual media, including television, music videos, and performance art. The course includes screenings and addresses issues such as: the gendered nature of the gaze; film form and genre; nation and postcoloniality; spectatorship; race, class, and sexuality.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

ENG 380  Modern Drama  (3 credit hours)
Major plays and playwrights from Ibsen to Churchill, including at least some of the following: Ibsen, Shaw, Chekhov, Glaspell, O’Neill, Brecht, Hughes, Hellman, Beckett, Williams, Miller, Albee, Hansberry, Walcott, Soyinka, Churchill, Kushner, and Parks.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

ENG 381  Creative Nonfiction Writing Workshop  (3 credit hours)
A workshop in creative nonfiction (literary or magazine journalism) for the student with demonstrated understanding of the basic techniques of creative writing and journalism.

Prerequisite: ENG 215, 287, 288, or 289
Typically offered in Fall and Spring

ENG 382  Film and Literature  (3 credit hours)
Ways of adapting literary works to film form. Similarities and differences between these two media. Emphasis on the practical art of transforming literature into film. Attention to the impact of film upon literature.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

ENG 384  Introduction to Film Theory  (3 credit hours)
Survey of critical approaches to film art. Application of theoretical paradigms--formalist, realist, psychoanalytic, feminist, poststructuralist--to individual films, genres, national cinemas and directors.

Prerequisite: ENG 282
Typically offered in Spring only

ENG 385  Biblical Backgrounds of English Literature  (3 credit hours)
Influences of the Bible--principal forms, genres, and texts--on major English and American writers such as Milton, Spenser, Melville, Eliot, and Faulkner.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only
ENG 388  Intermediate Fiction Writing Workshop  (3 credit hours)
An intermediate workshop in creative writing for students with demonstrated understanding of the basic techniques of writing prose fiction.

P: ENG 288; R: Students must have earned a B or better in ENG 288. Typically offered in Fall and Spring

ENG 389  Intermediate Poetry Writing Workshop  (3 credit hours)
An intermediate workshop in creative writing for students with demonstrated understanding of the basic techniques of writing poetry.

Prerequisite: ENG 289; Students must have earned a B or better in ENG 289. Typically offered in Fall and Spring

ENG 390  Classical Backgrounds of English Literature  (3 credit hours)
Literature of the ancient Western world and its influence on English and American writing. Emphasis on the connections between the two bodies of literature. Covers such writers as Plato, Horace, Virgil, and St. Augustine.

Prerequisite: Sophomore standing and above GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ENG 391  Special Topics in Modern Drama  (3 credit hours)
Various topics in modern drama covering different cultures, issues, and theatrical practices within the last 100 years. Modern American drama, modern British drama, modern World Drama, and European theatre from World War II to the present.

Prerequisite: Sophomore standing and above GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ENG 392/FL 392  Major World Author  (3 credit hours)
Intensive study in English, of the writings of one (or two) author(s) from outside the English and American traditions. Sample subjects: Homer, Virgil and Ovid, Lady Murasaki, Marie de France and Christine de Pizan, Dante, Cervantes, Goethe, Balzac and Flaubert, Kafka, Proust, Lessing and Gordimer, Borges and Marquez, Neruda, Achebe, Soyinka, Calvino, Walcott and Naipaul. Topics will vary from semester to semester. May be repeated for credit with new topic.

Prerequisite: Sophomore standing and above GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

ENG 393/FL 393  Studies in Literary Genre  (3 credit hours)
Concentrated treatment of one literary genre, such as the epic, the lyric, the drama, satire, romance, autobiography, the essay, the novel, or the short story. Treatment of materials from several national or ethnic cultures and several periods. All readings in English. Course may be taken three times for credit. Course may be taken 3 times in different genres.

Prerequisite: Sophomore standing and above GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

ENG 394/FL 394  Studies in World Literature  (3 credit hours)
Study of a subject in world literature: for example, African literature, Asian literature, Hispanic literature, East European literature, Comedy, the Epic, the Lyric, Autobiography, the Faust legend, or Metamorphosis. Subjects vary according to availability of faculty. Readings in English translation.

Restriction: Sophomore Standing and Above GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

ENG 395/COM 395  Studies in Rhetoric and Digital Media  (3 credit hours)
Study of the influence of emerging technologies on rhetorical theory and practice. Rhetorical analysis of texts, including visual and audio texts. Invention and construction of digital media texts as a means of engaging rhetorical theory and analysis. Topics vary to adapt to emerging technologies and changing vernacular practices.

Prerequisite: ENG 101 GEP Humanities
Typically offered in Fall and Spring

ENG 399  Contemporary Literature  (3 credit hours)
Literature from the twentieth-century and twenty-first century. Readings may be from various genres including fiction, non-fiction, drama, and poetry. Writers will be from the English-speaking world, but also reading may include writers outside it, that is, writers whose work has been translated into English. This course will track important developments, whether literary or cultural, in contemporary literature. Representative writers: Jean Rhys, James Baldwin, W.G. Sebald, Leslie Marmon Silko, August Wilson, Salman Rushdie and Wislawa Szymborska.

Prerequisite: Sophomore standing and above GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

ENG 400  Applied Criticism  (3 credit hours)
Types and methods of literary criticism designed specifically for students intending to teach English in high school.

Prerequisite: TED Majors, Senior standing.
Typically offered in Fall only

ENG 405/ECI 405  Literature for Adolescents  (3 credit hours)
The history, types, and characteristics of literature for adolescents. Emphasizes reading and analyzing the literature by exploring the themes, literary elements, and rationale for teaching literature for adolescents. Addresses ways in which this literature can be integrated and implemented in English/Language Arts curriculum.

Prerequisite: Junior standing.
Typically offered in Spring only

ENG 406/FL 406  Modernism  (3 credit hours)
Review and discuss the International Modernist movement in literature, from its nineteenth-century origins to its culmination in the early twentieth century. Identify and discuss definitions of modernity, as embodied in a variety of genres. Discuss Modernist texts within a variety of cultures that produced them.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only
ENG 407/FL 407  Postmodernism  (3 credit hours)
Study literary expressions of postmodernism, from its origins in the
Modernist movement through its culmination in the later decades of the
twentieth century and after. Examine post modernity, as embodied in a
variety of genres. Situate postmodernist texts within a variety of cultures
that have produced them.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ENG 410/WGS 410  Studies in Gender and Genre  (3 credit hours)
This course examines the ways in which women writers from diverse
backgrounds have revised the literary genres to include the varied
experiences of women. It will focus on a different generic area, such as
poetry, fiction, drama or autobiography, depending on its instructor.

Prerequisite: Sophomore Standing or Above
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

ENG 411/COM 411  Rhetorical Criticism  (3 credit hours)
Rhetorical analysis of public speeches, social movements, political
campaigns, popular music, advertising, and religious communication.
Neo-Aristotelian criticism, movement studies, genre criticism, dramatic
analysis, content analysis, fantasy theme analysis.

Prerequisite: Junior standing

ENG 416  Advanced News and Article Writing  (3 credit hours)
Advanced work in writing news stories, profiles, features, and
investigative stories. Includes analysis and critical reading of print media.
Assumes thorough knowledge of AP style and rudiments of news and
feature writing.

Prerequisite: ENG 316
Typically offered in Fall and Spring

ENG 417  Editorial and Opinion Writing  (3 credit hours)
Discussing and writing newspaper and magazine editorials, with added
attention to other forms of opinion in print, such as columns and books
and music reviews.

Prerequisite: ENG 214, ENG 316
Typically offered in Fall and Spring

ENG 420  Major American Author  (3 credit hours)
Intensive study of the writings of one (or two) American author(s).
Developments across the career, relationships between the writing and
the life, the writer’s participation in a culture and an historical moment.
Sample subjects: Emerson and Thoreau, Melville, Whitman, Stowe
and Douglass, Dickinson, Twain, James and Wharton, Frost, O’Neill,
Fitzgerald and Hemingway, Faulkner, Hurston and Wright, O’Conner,
Morrison.

Prerequisite: Sophomore standing and above
GEP Humanities
Typically offered in Fall only

ENG 421  Computer Documentation Design  (3 credit hours)
Theory and design of documentation for computer hardware and
software, including user guides, reference manuals, quick reference
guides, tutorials, online documentation, and CD-based media delivery.
Training in alternative documentation testing procedures, usability testing,
and collaborative revision.

Prerequisite: ENG 214 or ENG 331 or ENG 332 or ENG 333
Typically offered in Spring only

ENG 422  Writing Theory and the Writing Process  (3 credit hours)
Theory and research on the processes and contexts of written discourse;
cognitive, socio-cultural, educational perspectives; reflective and
research-based accounts of the writing process; analysis of discourse
contexts and communities.

Prerequisite: ENG 101
Typically offered in Fall only

ENG 425  Analysis of Scientific and Technical Writing  (3 credit hours)
The role of communication in the creation of scientific knowledge and
technical designs and artifacts; methods of analyzing texts and of
studying their creation and use; relationships between writing and other
forms of communication. Field research in a

Typically offered in Spring only

ENG 426  Analyzing Style  (3 credit hours)
Development of a greater understanding of and facility with style in
written discourse. Theories of style, stylistic features; methods of
analysis, imitation.

Prerequisite: ENG 101
Typically offered in Fall and Spring

ENG 430  Advanced Screenwriting  (3 credit hours)
Advanced Screenwriting students will complete ready-to-sell screenplays
over the course of the semester. Workload includes taking home two
100-page scripts each week and giving a thorough critique both in writing
and in class discussion. Course included pitch sessions, opening scene
workshops, intensive reading and writing.

Prerequisite: ENG 330
Typically offered in Spring only

ENG 439  Studies in English Renaissance Literature  (3 credit hours)
Works of non-dramatic literature written in English or circulated in
England from the sixteenth and seventeenth centuries. The course
puts the English Renaissance in both a European and colonial context.
Genres include, but are not limited to: poetry, political and fictional
prose, masques, travel writing, proto-ethnographies, and popular writing
(conduct books, ballads, emblems, polemical texts). Authors may
include Thomas Wyatt, Henry Howard, Isabella Whitney, Philip Sidney,
Edmund Spenser, Louise Labe, Gaspara Stampa, Sor Juana Della Cruz,
Castiglione, Mary Sidney, Ben Jonson, Mary Wroth, Aemilia Lanyer, John
Donne, George Herbert, Margaret Cavendish, and Aphra Behn.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ENG 448/AFS 448/ENG 548/AFS 548  African-American Literature  (3 credit hours)
Survey of African-American literature and its relationships to American
culture, with an emphasis on fiction and poetry since 1945. Writers such
as Bontemps, Morrison, Hurston, Baldwin, Hayden, Brooks, Naylor,
Harper, and Dove.

Prerequisite: Junior standing.
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring and Summer
ENG 451/ENG 551  Chaucer  (3 credit hours)
Introduction to the study of Chaucer through an intensive reading of The Canterbury Tales.
R: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ENG 452  Medieval British Literature  (3 credit hours)
Readings in the rich poetic, thematic, and generic diversity of Medieval British literature. Representative selections from romance, dream-vision, allegory, fabliau, lyric, chronicle, saint's life, satire, in historical and cultural contexts. Prior knowledge of Middle English unnecessary.
Prerequisite: Sophomore standing and above
Typically offered in Spring only

ENG 453  The Romantic Period  (3 credit hours)
Emphasis on the major poetry of Blake, Wordsworth, Coleridge, Byron, Shelley, and Keats, with selected readings from other poets, prose writers, and dramatists of the period.
Prerequisite: Sophomore standing and above
Typically offered in Spring only

ENG 455  Literacy in the U.S.  (3 credit hours)
Academic study of the nature, functions, acquisition, institutionalization, and present state of literacy in the U.S., with special focus on issues of cultural diversity and social inequity. Three contexts for literacy - personal, academic, and home/community - provide a range of readings, investigations, and opportunities for reflection and further study.
Prerequisite: ENG 101; Junior or senior standing.
Typically offered in Fall only

ENG 460  Major British Author  (3 credit hours)
In-depth study of the works of one (or two) British author(s) within their historical and literary-historical context. Sample authors might include: Spencer and Sidney, Swift and Pope, Austen, Wordsworth and Coleridge, Keats and Shelley, the Brontes, the Brownings, Dickens, George Eliot, Hardy, Joyce, Woolf.
Prerequisite: Sophomore standing and above
GEP Humanities
Typically offered in Spring only

ENG 462  18th-Century English Literature  (3 credit hours)
Major figures in English literature between 1660 and 1790. Works studied in relation to social, cultural, political, and religious developments. Emphasis on writers such as Dryden, Swift, Pope, Johnson.
Prerequisite: Sophomore standing and above
Typically offered in Fall only

ENG 463  The Victorian Period  (3 credit hours)
Significant British poets, writers of prose non-fiction, and novelists studied in the social, economic, scientific, intellectual, and theological contexts of the Victorian era.
Prerequisite: Sophomore standing and above
Typically offered in Spring only

ENG 464  British Literature and the Founding of Empire  (3 credit hours)
This course uses literature to understand rapid shifts in making and breaking empire. Reading novels, newspapers, essays, and autobiographies, we will study liberty in colonial North America, the orientalism of British India, and adventure writing of nineteenth-century Africa. In 1773, George McCartney, a British imperial officer, looked out from India and saw a "vast empire on which the sun never sets." Ten years later the thirteen American colonies that had founded that empire were gone. We will use this sentiment to determine how empire shaped the world and to consider how it contributed to Britain's literary and cultural traditions.
Requisite: Sophomore Standing or Above
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ENG 465  British Literature and the Dissolution of Empire  (3 credit hours)
This course examines the role of British literature in the dissolution of empire and the reshaping of Britain as a multicultural society. As poet Louise Bennett wryly comments, the 20th century British experience is one of "colonization in reverse." From the departure of the colonies, to the impact of American expatriates and Caribbean, African and South Asian immigrants, to the Scottish nationalist critique, this period is one of radical change in British national identity. At the center of that change are the global writers who create a heterogeneous literature that represents both a "new" British literature and a post-empire reality.
Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

ENG 466  Transatlantic Literatures  (3 credit hours)
This course will investigate notable literary exchanges in the literatures of the Atlantic Rim, long linked by trade (including slavery) as well as by commerce of many other kinds. Examples of these exchanges include Great Britain and the U.S., the U.S. and the Caribbean, and very importantly, between African cultures on the Atlantic and Atlantic cultures in the U.S. The course will explore the literary and cultural hybridity brought about by these exchanges. Representative writers: William Shakespeare and Aimee Cesaire, Joseph Conrad and Chinua Achebe; Charlotte Bronte and Jean Rhys; William Faulkner and Edouard Glissant.
Requisite: Sophomore Standing or Above
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall and Spring

ENG 467  American Colonial Literature  (3 credit hours)
Survey of American literature and thought from its beginnings to the adoption of the Constitution. Representative works such as travel and exploration reports, Indian captivity narratives, diaries, journals, autobiographies, sermons, and poetry.
R: Sophomore standing and above
GEP Humanities
Typically offered in Spring only
ENG 468 Studies in Nineteenth-Century American Literature (3 credit hours)
Topics in nineteenth-century American literature, such as Romanticism, the nineteenth-century novel, Realism & Naturalism, etc. Focus on special areas of interest, which will vary from year to year, with attention to cultural and historical contexts.

Restriction: Sophomore Standing and Above
GEP Humanities
Typically offered in Fall only

ENG 470 American Literature, Twentieth Century and Beyond (3 credit hours)
American Literature from the twentieth century until the present day. Readings from various genres such as fiction, non-fiction, drama and poetry. Emphasis will be on key literary developments in relation to important critical/cultural contexts. Representative writers: F. Scott Fitzgerald, Gwendolyn Brooks, Zora Neale Hurston, James Baldwin, David Mamet, and Maxine Hong Kingston.

Requisite: Sophomore Standing or Above
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall and Spring

ENG 476 Southern Literature (3 credit hours)
 Literary traditions of the Southeastern United States from colonization through the present, including study of such major writers as Byrd, Jefferson, Simms, Poe, Douglass, Twain, Chesnutt, Glasgow, Hurston, Tate, Wolfe, Faulkner, Warren, Wright, Welty, Williams, O'Connor, Percy, and Lee Smith.

Prerequisite: Sophomore standing and above
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

ENG 480 Modern Drama (3 credit hours)

ENG 481 History of the Book (3 credit hours)
This course provides an overview of book history from the invention of the hand-written codex through the printing press and current digital manifestations, including electronic texts and Google Books. Students will examine rare materials in hands-on settings and during field trips to special collections libraries; try out historical techniques of writing, printing, and manufacture; and investigate the many social roles involved in creating and using books, including those of author, editor, printer, publisher, reader, and seller.

Restriction: Junior standing or above
Typically offered in Fall and Spring

ENG 482 Reading in the Digital Age (3 credit hours)
This capstone questions how textual, reading, and interpretive practices are changing in a digital age. Using a diverse sample of literature, the course explores the consequences of digital remediation for texts and literary studies. Students will learn concepts in mediation, analyze works of literature on different reading platforms, and experiment with computational methods for literary curation, quantitative analysis, and data visualization. Students of all technical levels are welcomed; no special skills are required beyond basic familiarity with a computer.

Junior standing or above
Typically offered in Fall and Spring

ENG 483 Literature and Media (3 credit hours)
This course will explore how shifts in media technologies have influenced the creation, transmission, and reception of literature. Topics might include: investigations of how the spread of printing presses led to the first newspapers in eighteenth-century London, with comparison to how newspapers look today; study of the importance of serial publication in magazines for nineteenth-century authors like Charles Dickens; and examinations of spy novels, detective fiction, and the rise of the paperback in the twentieth century before turning to the explosion of graphic novels in the twenty-first century.

Restriction: Junior standing or above
Typically offered in Fall and Spring

ENG 485 Shakespeare: Revisions and Resources (3 credit hours)
A study in the plays of Shakespeare and ways to teach them, using multi-media presentations and textual exegesis, concentrating on each performance as an unique interpretation. The play choices are chosen by examining the plays that students in the English Ed program will likely find themselves teaching in area high schools.

P: 6 credit hours of English above the 100-level
GEP Humanities
Typically offered in Fall only

ENG 486 Shakespeare, The Earlier Plays (3 credit hours)
Study a selection of Shakespeare's major works before 1603 with an emphasis on his cultural context and development as a playwright.

Restriction: Sophomore Standing and Above
GEP Humanities
Typically offered in Fall only

ENG 487 Shakespeare, The Later Plays (3 credit hours)
Study a selection of Shakespeare's major works after 1603 with an emphasis on his cultural context and development as a playwright.

R: Sophomore standing and above
GEP Humanities
Typically offered in Spring and Summer

ENG 488 Advanced Fiction Writing Workshop (3 credit hours)
An advanced workshop in creative writing for students with demonstrated understanding and accomplishment in the techniques of writing prose fiction. This course is restricted to juniors and seniors. Departmental approval required.

Prerequisite: ENG 388
Typically offered in Fall and Spring

ENG 489 Advanced Poetry Writing Workshop (3 credit hours)
An advanced workshop in creative writing for the students with demonstrated understanding and accomplishment in the techniques of writing poetry. This course is restricted to juniors and seniors. Departmental approval required.

Prerequisite: ENG 389
Typically offered in Fall and Spring
ENG 490 Studies in Medieval Literature (3 credit hours)
Topics (in rotation) in medieval English and continental literature, such as Arthurian legend and literature; women in medieval society and literature; the self in the late Middle Ages. Focus on special areas of interest, with attention to cultural and historical backgrounds and contemporary scholarship. Some texts in Middle English, some in translation; no prior knowledge of Middle English needed.
Prerequisite: Sophomore standing and above
Typically offered in Fall only

ENG 491 Honors in English (3 credit hours)
Intensive course or independent study project designed as one portion of the Honors Program in English. Subject varies.
Requisite: English Majors Only
Typically offered in Fall and Spring

ENG 492 Special Topics in Film Styles and Genres (3 credit hours)
Critical approaches to focused film topics involving film genres, directorial styles, or trends within a national cinema. Topics will vary from semester to semester.
Typically offered in Fall and Spring

ENG 494 Special Topics in Linguistics (3 credit hours)
(May be repeated for credit with new topic.) Methodology and analysis within various branches of linguistics, e.g. syntax, semantics, computational linguistics, phonology, dialectology, historical linguistics, discourse analysis. Examination of topic's basic methods, controversial issues, analysis of linguistic data. Projects may include novel analyses of English constructions, parsing programs, field work reports.
Prerequisite: ENG 101
Typically offered in Spring only

ENG 495 Studies in Literature (3 credit hours)
Intensive exploration of selected topics or issues in the area of literature/English studies with a wide variation in content that sometimes includes materials from several national or ethnic cultures and periods. Course may be used to meet the capstone
Junior standing or above
Typically offered in Fall and Spring

ENG 496 Seminar in Literary Criticism (3 credit hours)
Introduction to theoretical and applied criticism of literature, primarily for English majors and minors. May include traditional theory from Plato and Aristotle to New Criticism, as well as contemporary psychoanalytical, social, historical, and linguistic approaches to literature.
Prerequisite: 9 hours of literature at the 300 level or above
Typically offered in Fall and Spring

ENG 498 Special Topics in English (1-6 credit hours)
Directed individual study or experimental course offerings in language or literature. Individual study arranged through consultation with faculty member and Director of Undergraduate Studies.
Prerequisite: Six hours in ENG above the 100 level
Typically offered in Fall, Spring, and Summer

ENG 499 Special Topics in Creative Writing (3 credit hours)
Techniques and practice in writing a particular form within the traditional genres of poetry, prose, or drama, such as "Creative Non-Fiction," "Science Fiction," "The Novella," or "The Satirical Poem." Topics vary from semester to semester.
Prerequisite: ENG 288 or ENG 289; Students must have earned a grade of B or better in 288 or 289 or they must have demonstrated competence in creative writing as determined by instructor.
Typically offered in Fall and Spring

ENG 505 Writing Program Administration: Theory, Practice, and Research (3 credit hours)
Seminar designed to focus on current theories, research, and practices of writing program administration, including curricular design and assessment, faculty development, assessment of student achievement, budget oversight, the politics of administration in higher education, and historical studies of writing program administration. Designed for all interested MA, MFA and PhD students, but particularly valuable for those considering administrative work in first-year writing programs, writing centers, or WAC/WID/CAC programs at a range of institutions (community colleges, small liberal arts colleges, and large research universities). Course involves the study of an existing program through contact with its director(s).
Prerequisite: Graduate standing
Typically offered in Fall and Spring

ENG 506/COM 506 Verbal Data Analysis (3 credit hours)
Research strategies for understanding how spoken and written language shapes activities (e.g., design, instruction, counseling, gaming interactions, e-commerce, etc.). Tracking patterned uses of language as verbal data (e.g., grammatically topical, thematically), formulating research questions, and designing studies to answer those questions through quantitative descriptive means. Sampling, collecting and managing data, developing coding schemes, achieving reliability, using descriptive statistical measures, and reporting the results.
Typically offered in Fall only

ENG 507 Writing for Health and Environmental Sciences (3 credit hours)
Readings, on-site research, document gathering, and analysis of writing in health and environmental science fields. Students study, practice, and present major forms of writing in their profession. Professional portfolio due at the end of the semester. Intended for students interested in exploring or pursuing writing careers in medicine, pharmaceuticals, nutrition, agriculture, ecology, or other health and environmental science-related industries, or professionals who wish to improve knowledge and skills.
Prerequisite: Graduate standing, Doctoral student, Master's student
Typically offered in Fall only
ENG 508  Usability Studies for Technical Communication  (3 credit hours)
Advanced study of usability inspection, inquiry, and testing theories and practices related to instrumental and instructive texts (i.e., computer-related, legal, medical, pharmaceutical, financial, etc.). Practical experience testing a variety of texts using several testing methods, including completion of a substantial, lab-based usability test. For students planning careers in technical communication, human factors, software design, and multimedia design.
Prerequisite: ENG 517
Typically offered in Fall only

ENG 509  Old English Literature  (3 credit hours)
Study of Old English language with selections from important poems including Beowulf. Examination of the poetry in the light of various modern critical approaches.
Typically offered in Spring only

ENG 510  Middle English Literature  (3 credit hours)
Study of major works of medieval English literature (exclusive of Chaucer's Canterbury Tales) in historical context, as reflections of and influences on social and cultural change. Includes works such as Sir Gawain and the Green Knight, Pearl, Langland's Piers Plowman and Malory's Morte d'Arthur.
Typically offered in Spring only

ENG 511  Theory and Research In Composition  (3 credit hours)
Research and scholarship in composition and the teaching of writing. Major theoretical perspectives (such as expressive, social, cognitive, feminist), current issues (such as audience, invention, revision, evaluation) and various research methods.
Typically offered in Fall and Spring

ENG 512  Theory and Research In Professional Writing  (3 credit hours)
Introduction to research and scholarship in professional writing and writing in the workplace. Major theoretical perspectives for studying writing; current issues (such as usability, readability, collaboration, gender, authorship); and various research methods.
Corequisite: ENG 666
Typically offered in Fall only

ENG 513  Empirical Research In Composition  (3 credit hours)
Reading and evaluation of empirical research in written composition; guided practice in qualitative and quantitative methods. Basic principles of research; problem definition, research design and statistical analysis, description and assessment of written products and processes.
Typically offered in Spring only

ENG 514/COM 514  History Of Rhetoric  (3 credit hours)
Historical development of rhetorical theory with attention to contemporaneous rhetorical practice and philosophical trends. Major focus on the classical period with briefer coverage of medieval, Renaissance, 18th-century, and 19th-century developments. Implications for contemporary theory and practice, including pedagogical practice.
Typically offered in Fall only

ENG 515  Rhetoric Of Science and Technology  (3 credit hours)
The relationships among rhetoric, scientific knowledge and technological development and of changes in how these relationships understood historically. Practice in critical analysis of scientific and technical discourse. Consideration of scientific and technical language and of public controversy concerning science and technology.
Typically offered in Fall only

ENG 516/COM 516  Rhetorical Criticism: Theory and Practice  (3 credit hours)
Development, achievements, limitation of major critical methods in the 20th century, including neo-Aristotelian, generic, metaphoric, dramatistic, feminist, social-movement, fantasy-theme and postmodern approaches. Criticism of political discourse, institutional discourse, discourses of law, medicine, religion, education, science, the media. Relations between rhetorical and literary criticism and other forms of cultural analysis.
Prerequisite: Graduate Standing or the equivalent of COM/ENG 321 or COM/ENG 411
Typically offered in Spring only

ENG 517  Advanced Technical Writing, Editing and Document Design  (3 credit hours)
Advanced study of technical communication practice, including content management, document design, and technical editing and usability. For students planning careers as technical communicators.
P: ENG 314 or graduate standing
Typically offered in Fall only

ENG 518  Publication Management for Technical Communicators  (3 credit hours)
Advanced study of publication and team management issues such as staffing, scheduling, cost-reduction and subcontracting. For students planning careers as technical communicators.
Prerequisite: ENG 517
Typically offered in Spring only

ENG 519  Online Information Design and Evaluation  (3 credit hours)
Concepts and practices related to multimedia information design, information architectures, human-computer interaction, and genre for complex websites.
Prerequisite: ENG 517
Typically offered in Spring only

ENG 520  Science Writing for the Media  (3 credit hours)
Coverage of three areas: how to write science articles for a variety of mass media, how to think critically about how mass media cover science, and how to think critically about science itself. Preparation for careers not only in mass media, but also in scientific and technological organizations.
Typically offered in Fall only

ENG 522  Writing in Nonacademic Settings  (3 credit hours)
Directed work experience for English Department graduate students including work-site mentoring and evaluation and concurrent academic assignments. Academic component includes reading and discussing articles relevant to the day-to-day practice of writing.
Typically offered in Spring only
ENG 523 Language Variation Research Seminar (3 credit hours)
Field-initiated research. Group and individual research topics focused on current sociolinguistic issues related to language variation and changes. Ethnographic and quantitative methods of analysis.
Prerequisite: ENG 525
Typically offered in Fall only

ENG 524 Introduction to Linguistics (3 credit hours)
Introduction to theoretical linguistics, especially for students in language, writing and literature curricula. Phonology, syntax, semantics, history of linguistics; relation of linguistics to philosophy, sociology and psychology; application of theory to analysis of texts.
Prerequisite: Graduate standing or 12 hrs. in ENG
Typically offered in Fall only

ENG 525 Variety In Language (3 credit hours)
Language variation description, theory, method and application; focus on regional, social, ethnic and gender varieties; sociolinguistic analysis, basic discourse analysis.
Prerequisite: Graduate standing or 12 hrs. in ENG
Typically offered in Fall only

ENG 527/ENG 727 Discourse Analysis (3 credit hours)
Overview of major issues, theories, and research methods in contemporary discourse analysis. It explores how language as a form of social practice regulates social actions, relations and identities; how ways of speaking construct and are constructed by social order, cultural practice, and individual agency. Texts/discourses are analyzed to examine how speakers create meaning through formal linguistic choices; what the micro-organization of talk reveals about social order; how critical understanding of discourse helps to interpret complex processes of social life.
Prerequisite: Graduate standing
Typically offered in Fall only

ENG 528 Sociophonetics (3 credit hours)
A survey of sociophonetics: the study of language variation using modern phonetic techniques. Acoustic analysis of consonants, vowels, prosody, voice quality. Speech perception experiments and how they can be applied to a variety of issues. Applications to theoretical issues in sound change, sociolinguistics, phonetics and phonology, and cognition of language. Graduate standing required.
Typically offered in Fall only

ENG 529 16th-Century Non-Dramatic English Literature (3 credit hours)
Prose and poetry of the English Renaissance, excluding drama. Special attention to major authors, including Spenser and Sidney, and to intellectual, cultural and literary backgrounds and developments. Introduction to pertinent methods and issues of scholarly inquiry and critical interpretation.
Typically offered in Fall only

ENG 530 17th-Century English Literature (3 credit hours)
A close examination of the literature of England from 1600 to 1660 with emphasis on major literary figures and movements, development of important literary forms and genres and relationship between literary texts of this period and their philosophical, political and theological contexts. Some bibliographical and textural assignments. Content and focus varies according to instructor's emphasis, but writers covered usually include Donne, Herbert, Crashaw, Marvell and Browne.
Typically offered in Spring only

ENG 531 American Colonial Literature (3 credit hours)
Survey of American literature and thought from the beginning to adoption of the constitution. Representative works such as travel and exploration reports, Indian captivity narratives, diaries, journals, auto biographies, sermons and poetry.
Typically offered in Spring only

ENG 532 Narrative Analysis (3 credit hours)
Introduction to theories concerning the structure, use, and interpretation of narratively organized discourse; application of methods of narrative analysis to both spoken and written narratives.
Prerequisite: Graduate standing
Typically offered in Fall only

ENG 533 Bilingualism and Language Contact (3 credit hours)
Linguistic, cultural and socio-political aspects of bi- and multilingualism in a global context. Issues and implications of bilingualism from both theoretical and practical perspectives. Topics include: language maintenance and shift; child and adult bilingualism; relationship between language, culture and identity in bi- and multilingual situations; psycholinguistic aspects and linguistic outcomes of bilingual contact, such as code-switching, convergence and language attrition; language ideology, the politics of language choice and language policy; globalization and intercultural communication. Must hold graduate standing or get consent of instructor for advanced undergraduate students.
Typically offered in Spring only

ENG 534 Quantitative Analysis in Sociolinguistics (3 credit hours)
The quantitative methods specific to sociolinguistic variation are examined in detail, focusing both on gaining experience using quantitative analysis software and on understanding fundamental concepts underlying the quantitative analysis of language variation. This course takes students beyond the basic familiarity with quantitative analysis gained in ENG 523, both in depth of investigation and in attention to the link between method and theory.
Prerequisite: ENG 523
Typically offered in Fall only

ENG 536 Research Methods in Phonology (3 credit hours)
This course explores laboratory and computational tools for investigating linguistic sound systems (e.g., speech perception experiments, speech production tools such as ultrasound imaging, and computational tools such as automated transcription and acoustic measurement). Requires enrollment in the Sociolinguistics MA or PhD program or permission of instructor.
Requisite: Enrollment in the Sociolinguistics concentrations of the MA English or PhD Sociology programs or permission of instructor.
Typically offered in Fall only
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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
<th>Description</th>
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<tbody>
<tr>
<td>ENG 539/FL 539</td>
<td>Seminar in World Literature</td>
<td>(3 credit hours)</td>
<td>Rotating topics in world literature, including treatment of the subject's theoretical or methodological framework. Possible subjects: colonialism and literature; orality and literature; the Renaissance; the Enlightenment; translation; comparison of North and South American literatures; African literary traditions; post-modernism and gender. Readings in English (original languages encouraged but not required). Typically offered in Spring only</td>
</tr>
<tr>
<td>ENG 540</td>
<td>History of Literary Criticism</td>
<td>(3 credit hours)</td>
<td>Survey of the history of literary criticism from Antiquity to early Modern period. Introduction to major theoretical definitions of literature and modes of practical criticism. Close study of Aristotle's Poetics, Sidney's Apology for Poetry, Pope's Essay On Criticism, Coleridge's Biographia Literaria, Eliot's essays and other landmark works in development of literary criticism. Prerequisite: Graduate standing or PBS status Typically offered in Fall only</td>
</tr>
<tr>
<td>ENG 541/FL 541</td>
<td>Literary and Cultural Theory</td>
<td>(3 credit hours)</td>
<td>A survey of literary theory in the 20th century from New Criticism to postmodernism. Examines the virtues and pitfalls of these approaches to the study of culture and literature. A course on issues, concepts, theorists and the sociohistorical and political context in which the theorists are writing. Taught in English. No formal pre-requisites. However, students who have not had advanced literature will be disadvantaged. Typically offered in Fall only</td>
</tr>
<tr>
<td>ENG 543</td>
<td>Introduction to Digital Humanities</td>
<td>(3 credit hours)</td>
<td>This course invites students of all technical abilities to explore the ongoing digital transformation of resources, tools, and methods in the humanities. As an introduction, this course is a gateway into a variety of representative subfields in digital humanities. It is designed to generate curiosity about how this emerging arena of scholarly activity might intersect with students' own disciplines, research interests, and pedagogies. It aims to provide a working knowledge of: 1) backgrounds of new media and humanities computing, 2) debates and outlooks for the digital humanities today, as well as 3) hands-on experience collaborating on, creating, and critiquing digital humanities projects. Prerequisite: Graduate standing Typically offered in Fall only</td>
</tr>
<tr>
<td>ENG 548/AFS 548/ENG 448/AFS 448</td>
<td>African-American Literature</td>
<td>(3 credit hours)</td>
<td>Survey of African-American literature and its relationships to American culture, with an emphasis on fiction and poetry since 1945. Writers such as Bontemps, Morrison, Hurston, Baldwin, Hayden, Brooks, Naylor, Harper, and Dove. Prerequisite: Junior standing GEP Humanities, GEP U.S. Diversity Typically offered in Spring and Summer</td>
</tr>
<tr>
<td>ENG 549</td>
<td>Modern African Literature</td>
<td>(3 credit hours)</td>
<td>The works of the most important writers shaping modern African literature in English (and English translation). Selections from East, West, North and South Africa, spanning colonial through post-colonial Africa--from literature of protest and culture conflict to that of disillusionment, reappraisal and feminism. Typically offered in Fall only</td>
</tr>
<tr>
<td>ENG 550</td>
<td>English Romantic Period</td>
<td>(3 credit hours)</td>
<td>A detailed study of the six major romantic poets--Blake, Wordsworth, Coleridge, Byron, Shelley, and Keats; some attention as well to the political, social and literary background and to a few minor writers and critics. Typically offered in Fall only</td>
</tr>
<tr>
<td>ENG 551/ENG 451</td>
<td>Chaucer</td>
<td>(3 credit hours)</td>
<td>Introduction to the study of Chaucer through an intensive reading of The Canterbury Tales. R: Sophomore standing and above GEP Global Knowledge, GEP Humanities Typically offered in Spring only</td>
</tr>
<tr>
<td>ENG 554/COM 554</td>
<td>Contemporary Rhetorical Theory</td>
<td>(3 credit hours)</td>
<td>Contemporary rhetorical theory covering the 20th and 21st centuries. Conceptual connections with and disruptions of the classical tradition and its successors; relationship between rhetorical theory and philosophical trends, institutional histories, socioeconomic circumstances, and pedagogical needs. Attention to current issues such as the revival of invention, rhetorical agency, and ethics. Typically offered in Spring only</td>
</tr>
<tr>
<td>ENG 555</td>
<td>American Romantic Period</td>
<td>(3 credit hours)</td>
<td>The literary culture of the United States from 1820s through 1860s, settling works of transcendentalists and other romantic writers within sociohistorical contexts. Consideration of writing by women, slave narratives and popular fiction as well as such major figures as Emerson, Hawthorne, Thoreau and Melville. Typically offered in Fall only</td>
</tr>
<tr>
<td>ENG 558</td>
<td>Studies in Shakespeare</td>
<td>(3 credit hours)</td>
<td>An intensive study of a particular phase of the Shakespeare canon. Emphasis will normally be on one dramatic genre (tragedy, comedy, history), but occasionally the focus may be more limited. Typically offered in Fall and Summer</td>
</tr>
<tr>
<td>ENG 560</td>
<td>Victorian Poetry and Critical Prose</td>
<td>(3 credit hours)</td>
<td>The literature of Victorian England: 1837-1901; the major poets and essayists, movements and questions in their historical contexts, religious, political and aesthetic. Typically offered in Spring only</td>
</tr>
<tr>
<td>ENG 561</td>
<td>Milton</td>
<td>(3 credit hours)</td>
<td>An intensive reading of Milton with attention to background materials in history and culture of seventeenth-century England. Typically offered in Spring only</td>
</tr>
<tr>
<td>ENG 562</td>
<td>18TH-Century English Literature</td>
<td>(3 credit hours)</td>
<td>British writers of the period 1600-1790 studied in historical and cultural contexts. Usually includes works by Dryden, Swift, Pope, Defoe, Mandeville, Boswell and Johnson, but addition of other significant writers possible. Typically offered in Fall only</td>
</tr>
</tbody>
</table>
ENG 563 18TH-Century English Novel (3 credit hours)
Selected British novels of the Restoration and eighteenth century from a
variety of contemporary critical perspectives. Such writers as Fielding,
Richardson, Sterne, Burney, Smollett and Austen.

Typically offered in Spring only

ENG 564 Victorian Novel (3 credit hours)
Study of selected British novels published between 1837 and 1901 in
contexts of the development of the genre, historical period and current
literary theory. Such writers as Dickens, Thackeray, Bronte, Trollope,
Eliot, Meredith and Hardy.

Typically offered in Spring only

ENG 565 American Realism and Naturalism (3 credit hours)
Study of literary culture of United States from 1860s to early 1900s with
emphasis on fiction by such realists and naturalists as Twain, Howells,
Chesnutt, James, Crane, Wharton, Dreiser and Norris. Inclusion of prose
of writers such as Adams and DuBois possible.

Typically offered in Spring only

ENG 570 20TH-Century British Prose (3 credit hours)
Examination of British fiction of this century and relationship of significant
intellectual, historical and political issues. Inclusion of such writers as
Joyce, Conrad, Woolf, Lawrence, Beckett and Murdoch possible but also
post-colonial novelists as well.

Typically offered in Fall only

ENG 571 20TH-Century British Poetry (3 credit hours)
Development of English poetry from its late Victorian phase through
Modernism to present post-war scene. Inclusion of such writers as Hardy,
Yeats, Eliot, Smith, Auden, Larkin, Heaney, Wolcott and Hill possible.

Typically offered in Spring only

ENG 572 Modern British Drama (3 credit hours)
Survey of modern British drama from its beginnings at turn of the century
to present.

Typically offered in Fall only

ENG 573 Modern American Drama (3 credit hours)
A survey of modern American drama centering on major figures.

Typically offered in Fall only

ENG 575 Southern Writers (3 credit hours)
Introduction to literary culture of "the South," tracing the roots of the
twentieth-century "Southern Renaissance" in such antebellum genres
as plantation fiction, Southwestern humor, fugitive-slave narration and
pastoral elegy. Examination of persistence of "Southern" writing within
increasingly standardized culture of the United States.

Typically offered in Spring only

ENG 576 20TH-Century American Poetry (3 credit hours)
Development of modern American poetry from rebellion against the
romantic and genteel verse of the 1890's; special attention to Robinson,
Frost, Pound, Williams, Stevens and Ransom.

Typically offered in Spring only

ENG 577 20TH-Century American Prose (3 credit hours)
An examination of representative American writers of novel and short
fiction.

Typically offered in Spring only

ENG 578 English Drama To 1642 (3 credit hours)
Elizabethan and Jacobean drama from 1580 to 1642, excluding
Shakespeare. Coverage of such writers as Marlowe, Jonson, Webster,
Beaumont and Fletcher, Heywood, Tourneur and Ford.

Prerequisite: ENG 261 and upper division or Graduate standing

Typically offered in Fall only

ENG 579 Restoration and 18th-Century Drama (3 credit hours)
Representative British plays of the period 1660-1780 studied in cultural,
social and ethical contexts. Usually includes works by Etherege,
Wycherley, Behn, Dryden, Otway, Vanburgh, Farquhar, Congreve, Lillo,
Gay, Goldsmith and Sheridan.

Typically offered in Spring only

ENG 580 Literary Postmodernism (3 credit hours)
Post-1945 literary theory in relationship with representative avant-garde
writers. Theoretical and argumentative essays in such areas as chaos
theory, deconstruction, feminism and the limits of fiction. Fiction readings
by Calvino, Pynchon, Barthelme, Cortazar and others.

Prerequisite: Graduate standing

Typically offered in Spring only

ENG 581/COM 581 Visual Rhetoric: Theory and Criticism (3 credit hours)
Application of visual theory to rhetoric and of rhetorical theory to
visual forms of communication. Discussion and analysis may include
advertising, photography, news and informational media, political
communication, instructional material, scientific visualization, visual arts,
public commemorative artifacts, internet and other digital media.

R: Graduate Students Only

Typically offered in Spring only

ENG 582 Studies in Literature (3 credit hours)
Variation in content. Selected problems and issues in literature.

Prerequisite: Graduate standing

Typically offered in Fall and Spring

ENG 583 Studies in Rhetoric and Writing (3 credit hours)
Variation in content. Selected problems and issues in rhetoric and writing.

Prerequisite: Graduate standing

Typically offered in Fall and Spring

ENG 584 Studies in Linguistics (3 credit hours)
Variation in content. Selected problems and issues in linguistics.

Prerequisite: Graduate standing

Typically offered in Fall and Spring

ENG 585 Studies in Film (3 credit hours)
Variation in content. Selected problems and issues in film.

Prerequisite: Graduate standing

Typically offered in Fall and Spring

ENG 586 Studies in Theory (3 credit hours)
Variation in content. Selected problems and issues in theory.

Prerequisite: Graduate standing

Typically offered in Fall and Spring
ENG 587  Interdisciplinary Studies in English  (3 credit hours)
Content varies. Selected topics and issues that cross disciplinary boundaries in English Studies. May be repeated for credit with different topics. Graduate standing is required.

Typically offered in Fall and Spring

ENG 588  Fiction Writing Workshop  (3 credit hours)
Advanced work in techniques of writing fiction for students with substantial experience in writing. Workshop sessions with students commenting on each other’s work.
Prerequisite: ENG 488 or ENG 489
Typically offered in Fall and Spring

ENG 589  Poetry Writing Workshop  (3 credit hours)
Advanced work in techniques of writing poetry for students with substantial experience in writing. Workshop sessions with students commenting on each other’s work.
Prerequisite: ENG 488 or ENG 489
Typically offered in Fall and Spring

ENG 590  Studies In Creative Writing  (3 credit hours)
Techniques special to a particular kind of writing within the traditional genres of prose, poetry or drama, such as “Speculative Fiction” or “The Long Poem or Poetic Sequence.” Various subjects.
Prerequisite: ENG 588 or 589
Typically offered in Spring only

ENG 591  Studies in National Cinemas  (3 credit hours)
Aesthetic developments and historical importance of national cinema traditions in specific cultural contexts. Focus on the relation between cinema and linguistic, literary and artistic developments within a national setting or in regional or international contexts. Topics, which change each year, may include Italian Neorealism, French New Wave, and British Social Realism.

Typically offered in Spring only

ENG 592  Special Topics in Film Styles and Genres  (1-6 credit hours)
Critical approaches to focused film topics involving film genres, directorial styles, or trends within a national cinema. Topics will vary from semester to semester. Students cannot obtain credit for both ENG 492 and 592.

Typically offered in Fall and Spring

ENG 610  Special Topics English  (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

ENG 624  Teaching College Composition  (3 credit hours)
Preparation for teaching college composition. Introduction to pedagogical principles and practices. Practice in setting course goals, designing writing assignments to meet those goals, developing instructional activities to support assignments, and evaluating student writing. The course is scheduled as a 5-day workshop before classes begin, followed by weekly meetings and mentoring during the fall semester.
Prerequisite: ENG 511 and mentored assistantship in ENG 101
Typically offered in Fall only

ENG 626  Advanced Writing for Empirical Research  (3 credit hours)
A seminar and workshop for graduate students in empirical research fields working on grant proposals, theses and dissertations, papers for professional journals, conference proposals, and other significant research texts. Intensive practice and feedback on writing, grounded in an introduction to theory and research on writing processes, products, and contexts. Requirements include three major writing projects designed by the student, review and discussion of drafts written by other workshop members, analysis and presentation of discipline-specific communication patterns and practices.
Prerequisite: Graduate standing
Typically offered in Fall only

ENG 636  Directed Readings  (1-6 credit hours)
Intensive study of a specific topic from various specializations of the English faculty. Negotiation between the student and the director for variable credit and approved by Director of Graduate Studies.
Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

ENG 669  Literature, Methods, and the Profession  (3 credit hours)
This course initiates students into ways of thinking and practicing in English literary studies. We will explore critical traditions, research methods, and emerging approaches, including literary criticism and theory, globalization, transnationalism, and postcolonialism in literature, together with introductions to cultural studies, rhetoric, composition, film studies, and media studies as they influenced literary criticism and theories. The course also prepares students to begin formulating their own academic and professional pathways with attention to practical considerations of how to become a professional in graduate school. You will become familiar with faculty from the department, develop research plans, and discover resources to start trajectories that include careers in writing, media, and teaching.

Typically offered in Fall only

ENG 675  Projects in Technical Communication  (3 credit hours)
Capstone course for M.S. in Technical Communication. Students engage in major semester-long individual project under direction of instructor.
Prerequisite: ENG 518
Typically offered in Spring only

ENG 676  Master's Project in English  (3 credit hours)
Individual capstone project in English Studies. Topic and mode of study determined in consultation with faculty project advisor. For students in the final semester of the English MA program.
Typically offered in Fall and Spring

ENG 685  Master's Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall and Spring
ENG 688  Non-Thesis Masters Continuous Registration - Half Time Registration  (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall only

ENG 690  Master's Examination  (1-9 credit hours)
For students in non-thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ENG 693  Master's Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

ENG 695  Master's Thesis Research  (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Summer only

ENG 696  Summer Thesis Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

ENG 699  Master's Thesis Preparation  (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ENG 722  Linguistics and Literacy  (3 credit hours)
Focus on two-way relationship between linguistic theory and literacy. Metalinguistic awareness and acquisition of literacy, orthography and phonology, oral vs. written language, oral vs. literate cultures, and metalinguistic assumptions in linguistic theory.

Prerequisite: ENG 525
Typically offered in Spring only

ENG 727/ENG 527  Discourse Analysis  (3 credit hours)
Overview of major issues, theories, and research methods in contemporary discourse analysis. It explores how language as a form of social practice regulates social actions, relations and identities; how ways of speaking construct and are constructed by social order, cultural practice, and individual agency. Texts/discourses are analyzed to examine how speakers create meaning through formal linguistic choices; what the micro-organization of talk reveals about social order; how critical understanding of discourse helps to interpret complex processes of social life.

Prerequisite: Graduate standing
Typically offered in Spring only

ENG 729  Language Variation and Social Theory  (3 credit hours)
Although the field of sociolinguistic variation has developed its own body of theory, its central questions continue to call for engagement with theory in related socio-cultural disciplines. This course examines sociolinguists' explicit and implicit incorporation of social theory into the analysis of language variation; it also explores the many ways in which social theory could yet enrich, and be enriched by, empirical sociolinguistic analysis.

Prerequisite: ENG 523
Typically offered in Spring only

ENG 730  Ethnolinguistic Variation  (3 credit hours)
This course examines the nature of ethnolinguistic variation in the English-speaking diaspora, with particular attention to the ethnic varieties in the United States, including African American English, Hispanic English, and Native American English.

Prerequisite: ENG 525
Typically offered in Spring only

ENG 731  Applied Sociolinguistics  (3 credit hours)
This course will introduce the main research concentrations and methods in Applied Sociolinguistics, including first language acquisition and teaching, second language learning, bilingualism, and clinical assessment and treatment of communication disorders. Students will be introduced to the basic foundations of language variation from linguistic and sociocultural/historical perspectives and learn how sociolinguistic variation affects clinical and educational processes and organizations.

Prerequisite: ENG 525
Typically offered in Spring only

ENG 798  Special Topics in English Studies  (3-6 credit hours)
Intensive exploration of specialized or emerging topics in an area of language, literature, rhetoric, film, or other aspect of English studies. Emphasis on student research and writing. May be used to test and develop new courses. May be repeated for credit.

Typically offered in Fall and Spring

ENG 810  Directed Readings in English Studies  (1-6 credit hours)
Intensive study of a specific topic from various specializations of the English faculty. Negotiation between the student and the director for the variable credit and approved by the director of Graduate Studies. May be repeated for credit.

Typically offered in Fall and Spring

ENG 896  Summer Dissert Res  (1 credit hours)
Entomology (ENT)

ENT 110 General Entomology (3 credit hours)  
Considers how insects live, their internal and external structures and their functions, classification and identification and control when desirable. Recognition of economically important beneficial and destructive insects and mites occurring in North Carolina and neighboring states, stressing information on their life histories, damage and control.

Requisite: Agricultural Institute Only  
Typically offered in Fall only

ENT 121 Pesticides and Their Utilization (3 credit hours)  
Basic characterization, classification, chemical and physical properties of pesticides. Use of pesticides including environmental effects; Federal and State laws and regulations relating to their manufacture, distribution and use; safety procedures including handling and storage; and application equipment including types, calibration, use and maintenance. TOTH

Requisite: Agricultural Institute Only  
Typically offered in Fall only

ENT 132 Urban Pest Management (3 credit hours)  
Insects and related arthropods found in residential and industrial buildings, nature of damage, and their control. Identification and life history of the different pest species, methods to detect their presence, and integrated pest management strategies. Hands-on learning of species in laboratory with emphasis on current control techniques. Field trips required. Agricultural Institute Students only.

Requisite: Agricultural Institute Only  
Typically offered in Fall only

ENT 190 Insects and People (3 credit hours)  
An introduction to the fascinating world of insects and how they interact with people. Included is a brief survey of insect history, diversity, structure and function, and behavior. This is followed by examples of beneficial and harmful insects in a variety of human activities including some sampling of the profound impacts insects have had on history, society and culture.

GEP Interdisciplinary Perspectives, GEP Natural Sciences  
Typically offered in Fall, Spring, and Summer

ENT 203 An Introduction to the Honey Bee and Beekeeping (3 credit hours)  
Introduction to honey bee biology and a fundamental understanding of beekeeping management including crop pollination by bees. Examination of the relationships between honey bees and humans from prehistoric through modern times and the behavior and sociology of beekeeping.

GEP Natural Sciences  
Typically offered in Fall only

ENT 207 Insects and Human Disease (3 credit hours)  
This course is an introduction to the many interactions between insects, other arthropods and humans that result in disease, ranging from simple anxiety, phobias, discomfort and pain, to transmission of pathogenic organisms causing sickness and even death. Included will be an understanding of the special physical and chemical adaptations of insects that enable them to cause us harm. The major groups of insects, mites, ticks and related arthropods associated with human suffering and disease as well as an introduction to the diseases transmitted by them will be presented. Finally, the course will present information on how major outbreaks of disease transmitted by the insects have influenced human populations, demographics, warfare, religion, and societal structure throughout recorded history.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Natural Sciences  
Typically offered in Spring only

ENT 212 Basic Entomology (1 credit hours)  
This course offers a brief and basic introduction to the world of insects and the discipline of entomology. It is intended as a primer for several other more specialized entomology classes such as forensic entomology and forest entomology.

Typically offered in Fall and Spring

ENT 305 Introduction to Forensic Entomology (3 credit hours)  
This course provides a broad overview of forensic entomology - a specialized field of entomology employed in medicocriminal investigations. Forensic entomology relies on knowledge of insect ecology, biology, taxonomy, physiology and development to elucidate the circumstances surrounding death. The role of arthropods associated with decomposed human remains is one of several valued disciplines in forensic sciences. Understanding the general principles of forensic entomology and their application will be the focus of this course.

GEP Natural Sciences  
Typically offered in Fall only

ENT 401 Honey Bee Biology and Management (3 credit hours)  
A hands-on course in honey bee management including bee pollination of selected crops based on an understanding of bee biology, bee behavior, bee pathology, and bee botany. Students must be able to provide their transportation to field sites or arrange to work with a beekeeping mentor. Students may choose, but are not required, to purchase their own beekeeping equipment and hive.

Prerequisite: (ENT 201, ENT 203, ENT 425, BIO 105 or PB 200)  
Typically offered in Spring only
ENT 402/FOR 402  Forest Entomology  (3 credit hours)
Fundamentals of morphology, classification, biology, ecology and control of insects attacking trees, with emphasis on silvicultural practices.
Prerequisite: Junior standing.
GEP Natural Sciences
Typically offered in Spring only

ENT 425  General Entomology  (3 credit hours)
This course explores the science of entomology by focusing on the basic principles of systematics, morphology, physiology, development, behavior, ecology, and management of insects. Field trips provide opportunities to collect insects and study their adaptations to a wide variety of natural environments.
Prerequisite: BIO 181 or BIO 140 or BIO 350
GEP Natural Sciences
Typically offered in Fall only

ENT 470/PP 470/CS 470  Advanced Turfgrass Pest Management  (2 credit hours)
Characteristics and ecology of turfgrass weed, insect, and disease pests; identification and diagnosis of turfgrass pests, strategies for managing pests including cultural, mechanical, biological, and chemical methods; development of integrated pest management programs, characteristics and modes of action for herbicides, insecticides, fungicides, and plant growth regulators; behavior and fate of pesticides in soil; and the development and management of pesticide resistant pest populations.
Prerequisite: C- or better in CS 200
Typically offered in Spring only

ENT 492  External Learning Experience  (1-6 credit hours)
A learning experience within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.
Prerequisite: Sophomore standing
Typically offered in Fall and Spring

ENT 493  Special Problems in Entomology  (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes campus facilities and resources. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.
Prerequisite: Sophomore standing
Typically offered in Fall and Spring

ENT 495  Special Topics in Entomology  (1-3 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.
Typically offered in Fall, Spring, and Summer

ENT 502  Insect Diversity  (4 credit hours)
Diversity of insect biology and structure with emphasis upon identification of adults; includes speciation, evolutionary relationships, approaches to classification, nomenclature, zoogeography and techniques of collection.
Prerequisite: ENT 425 or Graduate Standing
Typically offered in Fall only

ENT 503  Insect Morphology and Physiology  (3 credit hours)
The objectives are to acquaint students with the internal morphology, histology, and ultra-structure and system functions of insects. The laboratory will assist in recognizing the internal anatomy and associated external structure of insects and provide practical experience in the study of insect function.
Prerequisite: (CH 221 or CH 225) and (CH 223 or CH 227) and ENT 425 or Graduate Standing
Typically offered in Spring only

ENT 504  Professional Development for Entomologists  (2 credit hours)
A successful professional career in entomology is not limited to understanding just the science of Entomology. Also required is an understanding of career paths, professional ethics, written and verbal communication, safety, how to work with animals and human subjects, personal interactions, vita preparation, networking, and future directions of the discipline. These skills are essential to taking the knowledge obtained in entomology and applying them to a career in the discipline. Graduate Standing required.
Typically offered in Fall only

ENT 506/GES 506  Principles of Genetic Pest Management  (3 credit hours)
Introduction to the biological aspects of genetic pest management (GPM). Genetic techniques for GPM, including historical uses (such as the sterile insect technique) and approaches that are currently in development. Practical issues relating to the deployment of GPM, including ecological and economic considerations.
Typically offered in Fall only

ENT 509/AEC 509  Biology of Aquatic Insects  (3 credit hours)
Life history descriptions and identification of aquatic insects. Emphasis on behavioral and physiological adaptations to diverse habitats and the role of insects in aquatic ecosystem function and as indicators of water quality. The course includes 3-4 Saturday collecting trips to a local pond and streams in the mountains, piedmont and coastal plain. Collecting trips are not required, but are strongly encouraged.
Typically offered in Spring only

ENT 510  Writing Proposals in Agriculture, Biology, and Ecology  (2 credit hours)
Participants will be guided through the process of writing, with the intention to submit, a fellowship or grant proposal to an appropriate program of their selection and effective peer review of grant or fellowship proposals. The course includes a combination of lectures, in class activities, and direct practice. Students will also interact with a wide variety of experts in grant writing and evaluation who serve as weekly guest reviewers.
Typically offered in Fall only

ENT 520  Insect Behavior  (3 credit hours)
This course stresses comprehensive coverage of the principles of animal behavior using insects as models and examples. Physiology, genetics, mechanisms, behavioral ecology, and evolution of insect behavior will be covered.
Typically offered in Spring only
ENT 526 Organic Agriculture: Principles and Practices (3 credit hours)
This is a multidisciplinary class, and lectures cover many aspects of organic production given by a number of experts from both on and off campus. Classes also include discussions of issues and controversies surrounding organic production, as well as field trips to selected farms. This course is restricted to upper level undergraduate, graduate, or post-baccalaureate continuing education students.

Typically offered in Spring only

ENT 550 Fundamentals of Arthropod Management (3 credit hours)
The principles underlying modern methods for protecting food, clothing, shelter and health from insect attack.

Prerequisite: ENT 425 or Graduate Standing
Typically offered in Fall only

ENT 560 Techniques in Molecular Ecology and Evolution (3 credit hours)
Laboratory-intensive course providing hands-on experience in application of several commonly used techniques in molecular ecology and evolution. Lectures cover theory and application of specific techniques in the context of case studies from the primary literature. By end of course, students should be comfortable with theory and application of molecular markers in studies of ecology and evolution, and should be able to incorporate one or more techniques into their thesis research. Graduate standing or permission of the instructors required.

Typically offered in Spring only

ENT 582/ZO 582 Medical and Veterinary Entomology (3 credit hours)
The morphology, taxonomy, biology and control of the arthropod parasites and disease vectors of man and animals. The ecology and behavior of vectors in relation to disease transmission and control.

Prerequisite: ENT 425 and ZO 315
Typically offered in Spring only

ENT 591 Special Topics in Entomology (1-6 credit hours)
A variable credit lecture and laboratory series offering topics such as advanced beekeeping, morphology, physiology, systematics, behavior, biological control, nursery and ornamental pests, host plant resistance, information retrieval, biological monitoring and sampling, population modeling, extension entomology, computer methods and urban, forest and stored product pests.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ENT 601 Seminar (1 credit hours)
Discussion of entomological topics selected and assigned by seminar chair.

Prerequisite: Graduate standing in ENT or closely allied fields
Typically offered in Fall and Spring

ENT 604 Insect Natural History and Field Ecology (1 credit hours)
Diversity of ecological roles and lifestyles of insects and related arthropods using techniques in field ecology. Two week-long field trips to Coastal Plain and Mountains with orientation walks, evening lectures, and field projects. Taught during the two weeks prior to the Fall semester.

Prerequisite: Graduate standing in Entomology
Typically offered in Fall only

ENT 620 Special Problems (1-6 credit hours)
Original research on special problems in entomology not related to a thesis problem. Provides experience and training in research. Credits arranged.

Typically offered in Spring only

ENT 641 Agricultural Entomology Practicum (3 credit hours)
Practical experience in research, extension and commercial aspects of insect pest management on a broad range of agricultural crops under actual field conditions. Class meets 9 hours each Friday for 10 weeks from early June to mid-August. Students should register for Fall term.

Prerequisite: Economic entomology (ENT 762 recommended)
Typically offered in Fall only

ENT 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Spring only

ENT 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Spring only

ENT 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ENT 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ENT 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

ENT 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer
ENT 726 Biological Control of Insects and Weeds (3 credit hours)
Overview of the field of biological control and its role in Integrated Pest Management programs. Emphasis on the diversity and sometimes unusual interactions of insect parasitoids and predators with their hosts/prey, controversies in biological control, critical analysis of selected projects, and basic conceptual and "hands-on" tools for approaching biological control research and implementing projects.

Prerequisite: ENT 425 or Graduate Standing
Typically offered in Fall only

ENT 727/PP 727 Ecology of Soil Ecosystems (3 credit hours)
This course will focus on the interactions between soil organisms and their environment, and the ecological consequences of these diverse complex interactions. In particular, it will explore the scientific evidence that illustrates links between soil organisms, ecosystem functioning and the quality of air and water systems, and examine why and how the related research was conducted. This course will bring together theory and research trends from distinct subject areas: soil microbiology, entomology and ecosystem ecology.

Prerequisite: One course in: (SSC 332, SSC 511, SSC 521, or SSC 532), or ecology (BO 360 or CS 430), or microbiology (MB 351), or consent of instructor.
Typically offered in Spring only

ENT 731 Insect Ecology (3 credit hours)
The interrelationships among insects and components of their effective environments which result in dynamic spatial and temporal patterns of particular species. Also, the diverse roles of insects in structure and function of communities and ecosystems.

Prerequisite: ENT 425 or Graduate standing
Typically offered in Spring only

ENT 762 Insect Pest Management In Agricultural Crops (3 credit hours)
Critical review of the biology and ecology of representative beneficial and injurious insects and arachnids of agricultural crops and the advantages and limitations of advanced concepts of their management in selected agroecosystems.

Prerequisite: Graduate Standing
Typically offered in Spring only

ENT 791 Special Topics In Entomology (1-6 credit hours)
A variable credit lecture and laboratory series offering topics such as advanced beekeeping, morphology, physiology, systematics, behavior, advanced biological control, nursery and ornamental pests, host plant resistance, information retrieval, biological monitoring and sampling, population modelling, extension entomology, computer methods and urban, forest and stored product pests.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ENT 801 Seminar (1 credit hours)
Discussion of entomological topics selected and assigned by seminar chair.

Prerequisite: Graduate standing in ENT or closely allied fields
Typically offered in Fall and Spring

ENT 804 Insect Natural History and Field Ecology (1 credit hours)
Diversity of ecological roles and lifestyles of insects and related arthropods using techniques in field ecology. Two week-long field trips to Coastal Plain and Mountains with orientation walks, evening lectures, and field projects. Taught during the two weeks prior to the Fall semester.

Prerequisite: Graduate standing in Entomology
Typically offered in Fall only

ENT 820 Special Problems (1-6 credit hours)
Original research on special problems in entomology not related to a thesis problem. Provides experience and training in research.

Typically offered in Spring only

ENT 841 Agricultural Entomology Practicum (3 credit hours)
Practical experience in research, extension and commercial aspects of insect pest management on a broad range of agricultural crops under actual field conditions. Class meets 9 hours each Friday for 10 weeks from early June to mid-August. Students should register for fall semester.

Prerequisite: Economic entomology (ENT 762 recommended)
Typically offered in Fall only

ENT 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

ENT 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Summer only

ENT 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ENT 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ENT 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

ENT 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer
Entrepreneurship in Music and the Arts (EMA)

EMA 110 Introduction to Arts Entrepreneurship (3 credit hours)
This course introduces students to the basic components of an entrepreneurial lifestyle in the arts for those interested in starting an arts business. Students explore fundamental issues arts entrepreneurs encounter and how they can be addressed before

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

EMA 293 Independent Study in Arts Entrepreneurship (1-3 credit hours)
Independent study offering under the direction of a faculty member. Requirements for the independent study will be determined by the student and faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Stu

Typically offered in Fall, Spring, and Summer

EMA 295 Special Topics in Arts Entrepreneurship (1-3 credit hours)
Timely topical courses or experimental course offerings in Arts Entrepreneurship.

Typically offered in Fall and Spring

EMA 365 Foundations in Arts Entrepreneurship (3 credit hours)
This course will introduce and outline the role, purpose, and perception of "art" in various marketplaces and contexts for the emerging arts entrepreneur. Topics include: issues in marketing aesthetic products, consumer identification through art, models of consumer behavior, art and technology, macro-economic issues that affect the arts industries, arts policy and access.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

EMA 370 Practical Arts Entrepreneurship (3 credit hours)
This course will introduce and outline the cultural and economic environment of the arts in the United States. Topics include: the start-up process of for- and non-profit entities, economic and social impact of art and artists in communities, public and private arts support, non-profit culture and basic grantmanship, arts policy, creative economy efforts, the role of geography, demand and infrastructure considerations in entrepreneurial decision-making, competition analysis and marketing.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

EMA 375 Understanding the Arts Economies (3 credit hours)
This course explores arts and arts-related economies of critical importance to the emerging arts entrepreneur. Topics include: creative, experimental and hybrid economies, Arts infrastructure in urban and rural areas, arts clusters, patronage, broader economic conditions effecting arts economies, the relationship of "art" to segmented technology economies.

Prerequisite: EMA 370
Typically offered in Fall only

EMA 430 Capstone Experience in Arts Entrepreneurship (3 credit hours)
Students analyze arts and arts-related businesses through the use of case studies in addition to executing an entrepreneurial project concerning the arts in a Raleigh community. This class introduces students to the decision-making skills necessary to

Prerequisite: EMA 375
Typically offered in Spring only

EMA 493 Advanced Independent Study in Arts Entrepreneurship (1-3 credit hours)
Advanced Independent Study offering under the direction of a faculty member. Requirements for the independent study will be determined by the student and faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Stu

Typically offered in Fall, Spring, and Summer

Entrepreneurship Initiative (EI)

EI 100 Entrepreneurial Thinking in the Albright Entrepreneurs Village (1 credit hours)
Course involves active discussion about current events, case studies and assigned reading to evaluate strategies needed to think like an entrepreneur. Our students will think critically and apply basic skills needed when joining or forming teams to launch ideas or ventures. This course will host only residents of the Albright Entrepreneurs Village to discuss these ideas and build upon the living and learning community's learning outcomes.

R: Albright Entrepreneurs Village
Typically offered in Fall only

EI 201 Exploring Interdisciplinary Entrepreneurial Thinking (3 credit hours)
Course covers the perspectives of entrepreneurial thinking from an interdisciplinary perspective including: expectations and understanding of successful entrepreneurs as well as entrepreneurial opportunities in a variety of disciplines and entities including sciences, technology, humanities and social sciences. Primary focus will be on developing the student's entrepreneurial mindset.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

EI 331 Interdisciplinary Entrepreneurial Thinking I: Skills and Planning Basics (3 credit hours)
Course covers the development and application of critical skills in entrepreneurship as well as the fundamentals of entrepreneurial planning including interdisciplinary opportunity identification and feasibility analysis. Some individual off campus trav

Prerequisite: EI 201
GEP Interdisciplinary Perspectives
Typically offered in Spring only
EI 495 Independent Study in Entrepreneurship (3 credit hours)
The Independent Study in Entrepreneurship (EI 495) is designed to give students the opportunity to create their own experiential learning activity within the scope of an academic environment. EI 495 projects should be designed to meet the criteria for a 3 credit hour course. Before moving forward with the request to enroll in EI 495, the student should first work with their Independent Study sponsor to define the Independent Study contract. This course is restricted to students who have obtained faculty permission to enroll.

Typically offered in Fall, Spring, and Summer

Environmental Assessment (EA)

EA 501 Environmental Stressors (3 credit hours)
Introduces students to how organisms are affected by and respond to changes or stressors - both natural and human-induced - in the environment. With a focus on the concepts most significant to the field of environmental assessment, the course emphasizes the fundamental processes and effects of pollutants and naturally-occurring substances in the environment, including emerging issues and historically significant cases.

Prerequisite: Graduate standing

Typically offered in Fall only

EA 502 Environmental Risk Assessment (3 credit hours)
This course provides students with an appreciation and understanding of the principles of environmental risk assessment including: Hazard Identification, Toxicity Assessment, Exposure Assessment, and Risk Characterization. Emphasis is placed on contemporary problems in human health and the environment, and it will be based on the most current methodologies described in the "Risk Assessment Guidance for Superfund." Enrollment in the course requires graduate standing or consent of the instructor. Two semester sequence of college biology & college chemistry.

Prerequisite: Two semester sequence of college biology & college chemistry.

Typically offered in Spring only

EA 503 Environmental Exposure Assessment (3 credit hours)
Provides students with an appreciation and understanding of the principles of environmental exposure assessment including the sources, transport and fate of chemicals in the environment. Emphasis is on contemporary problems in human health and the environment, covering topics such as: transformation and degradation processes, classes of contaminants a well as predicting environmental fate and exposure. Enrollment in the course requires graduate standing or consent of the instructor. Two semester sequence of college biology & college chemistry.

Prerequisite: Two semester sequence of college biology & college chemistry.

Typically offered in Fall only

EA 504 Environmental Monitoring and Analysis (3 credit hours)
Monitoring and analysis of chemical and biological impacts to the environment. Theory of chemical, physical, biological, and ecological monitoring. Planning and conducting environmental sampling and monitoring programs. Management, analysis, and quality assurance and control. Enrollment in the course requires graduate standing or consent of the instructor.

Prerequisite: One Year College Biology and One Year College Chemistry

Typically offered in Summer only

EA 505 Environmental Assessment Law & Policy (3 credit hours)
This course provides students with an appreciation and understanding of the principles of environmental law and policy. Emphasis is on the US legal system and litigation process relevant to environmental law, covering topics such as: the National Environmental Policy Act (NEPA), the Pollution Prevention Act (PPA), the Clean Water Act, and the Clean Air Act. Throughout the course, a case study is integrated into the conceptual lecture material with the intent of providing practical examples to conceptual material.

Graduate standing and EA 501 and EA 502 or EA 503

Typically offered in Spring only

EA 506 Water Quality Assessment (3 credit hours)
Introduces students to topics fundamental to the understanding of aquatic systems and the processes that influence water quality. Covered topics include the hydrologic cycle, water chemistry, aquatic ecology, aquatic toxicology, water quality laws and standards, water quality assessment and techniques, and water pollution control and treatment. Emphasis is on contemporary water quality issues such as nutrient enrichment, introduced species, contaminants, and climate change.

Prerequisite: Graduate standing

Typically offered in Spring only

EA 520 Renewable Energy Policy and Economics (3 credit hours)
This course will cover global frameworks, as well as local, utility, state and federal policy and incentives that foster renewable energy implementation. It will also cover fundamental concepts of finance and economics to build a renewable energy project model that show how these policies affect the economics of a renewable energy project.

Prerequisite: Graduate standing

Typically offered in Fall only

EA 521 Fundamentals of Renewable Energy Site Assessment (3 credit hours)
This course will cover solar site assessment, wind assessment, and bioenergy with required exercises using current industry tools to assess the viability of the resource. Overview of the historical and current role of wind, solar, and bioenergy power technologies globally and the direction of each sector's evolution for the future, particularly in the USA. The course emphasizes the technology behind power generation for wind, solar, and bioenergy sectors. Students will evaluate policy and permitting issues and, consequently, determine if a site is appropriate for implementation of either or all of these technologies.

Prerequisite: Graduate Standing

Typically offered in Spring only
EA 522 Photovoltaic Design and Assessment  (3 credit hours)
This course covers fundamental principles of the application, design, installation, and operation & maintenance of Photovoltaic (PV) systems in order to properly assess the best system options for a specific project or application. The course will begin with some background on electric energy and its use and delivery. In addition, the course will cover economic implications of the site and PV system considerations. Building on this foundation we will then take an in-depth look at solar photovoltaic function and design to aide students in assessing the environmental, and financial, sustainability of the project. This interdisciplinary approach allows the student to gain a comprehensive understanding of photovoltaics beyond the technical, and caters to individuals across a range of experience and expertise.

Prerequisite: Graduate Standing
Typically offered in Fall only

EA 523 Assessment of Renewable Energy Storage Systems  (3 credit hours)
Energy Storage and operations and maintenance have become two areas in clean energy, particularly in the PV industry that have been rapidly evolving. This course will offer the basics of battery technology, as well as current market trends and incentives, to provide students timeless tools to assess the best possible option for a specific renewable energy + storage project. Meanwhile, the operations and maintenance portion will go through industry best practices that not only deal with technical management of a solar asset, but also understanding financial implications of the project. This interdisciplinary approach allows students of diverse STEM and non-STEM professional experience and expertise to gain a comprehensive understanding of this aspect of the solar industry.

Prerequisite: Graduate Standing and EA 522
Typically offered in Spring only

EA 590 Special Topics in Environmental Assessment  (1-6 credit hours)

EA 665 Professional Project  (1-6 credit hours)
Environmental assessment project conducted under the mentorship of a member of the graduate faculty.

Prerequisite: EA 502, EA 503, and EA 504
Typically offered in Fall, Spring, and Summer

Environmental Science (ES)

ES 100 Introduction to Environmental Sciences  (3 credit hours)
Interrelationships between human populations and the natural environment. Human population trends, agriculture, air and water pollution, biological diversity, forest and land use, energy and mineral resources, and toxic substances. Consideration of related economic factors, laws, politics, political behavior, and ethical questions.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

ES 111 Applications of Environmental Sciences  (1 credit hours)
Applications of Environmental Sciences provides Environmental Sciences majors deeper exploration of topics presented in Introduction to Environmental Sciences (ES 100) through hands-on activities, small-group discussion, and interaction with environmental professionals. Students build skills in data analysis, collaboration, and communication; learn more about Environmental Sciences focal areas and how to select theirs; and begin developing peer networks and mentor relationships with others in the field. Course is restricted to Environmental Sciences majors.

Corequisite: ES 100 or student has received transfer or AP credit for ES100; Environmental Sciences majors only
Typically offered in Spring only

ES 113 Earth from Space  (3 credit hours)
This course takes an orbital perspective on Earth and its natural resources. Particular attention is paid to how humans are changing Earth, challenges to sustainably managing natural resources, and how satellite Earth observation has enabled these discoveries. Students will gain a fundamental understanding of how satellite sensor systems work, how they enable us to understand the dynamic Earth, and the role that remote sensing plays in natural resource challenges.

GEP Global Knowledge, GEP Natural Sciences
Typically offered in Fall only

ES 150 Water and the Environment  (3 credit hours)
This interdisciplinary course focuses on the essential role of water in supporting all life on earth, and the expected impacts of rapidly changing water resources. Aspects of water issues will include physical sciences and engineering, life sciences, and social sciences. Case studies outline the importance of water in the global context and in specific settings, including North Carolina. The course will help prepare students for living in a rapidly changing world.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Spring only

ES 200 Climate Change and Sustainability  (3 credit hours)
This course explores the relationships between humans and the environment with interdisciplinary content. Focus is on past impacts of climate change on human activities and future prospects. Course content is based on lectures with students also respons

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

ES 295 Special Topics in Environmental Science  (1-4 credit hours)
Provides instruction on rapidly emerging curriculum. Also provides courses on an experimental basis before incorporation into the curriculum. See specific course offering for course details.

Typically offered in Fall and Spring

ES 300 Energy and Environment  (3 credit hours)
This course explores relationships between humans, energy, and the environment with interdisciplinary context. Themes include environmental impacts of energy production, distribution and use with discussion of new technologies. Half of the course content is from subject lectures and half from self-selected student projects. Student projects emphasize analytical approaches to solving environmental problems, and enhance skills in writing, seminars, and team work.

Prerequisite: CH 101 or PY 212 or PY 208
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring
ES 400 Analysis of Environmental Issues (3 credit hours)
A capstone course for students in environmental sciences or related majors. The course teaches use of analytical approaches for solving environmental problems, and for communicating results. The course emphasizes development of student projects that lead to environmental decision-making, such as devising a resource management plan, developing a predictive model, prioritizing risk, identifying tipping points, designing new software or technologies, or predicting outcomes of environmental policies. Individual student projects fit within a team framework to simulate a work environment. Students enhance writing and seminar skills. Student may incur extra expenses with projects for this course.

Prerequisite: ES 100, ES 200, ES 300 and Senior standing

Typically offered in Fall and Spring

ES 449/ES 450 Human Dimensions of Natural Resources in Australia/New Zealand (3 credit hours)
This 3.5 week study abroad program examines human dimensions of natural and environmental conservation in Australia. The course will involve an orientation and lectures from faculty at James Cook University. Students will explore the natural environments in Australia including Great Barrier Reef, Tropical Rainforest and Outback and be introduced to Australian culture and history through interactions with communities. Educational travel, active participation, lectures, seminars, and reflective exercises facilitate learning to improve understanding of relationships between human societies and the natural environment. Students must pay program fees, airfare, some meals, and incidentals.

Corequisite: PRT 450
GEP Global Knowledge, GEP Interdisciplinary Perspectives

Typically offered in Summer only

ES 450/PRT 450 Sustaining Natural Resources in Australia/New Zealand (3 credit hours)
This 3.5 week study abroad program will examine issues related to natural history and environmental conservation in Australia. The course will involve an orientation and lectures from Australian university faculty. Students will explore natural environments in Australia including the Great Barrier Reef, Tropical Rainforest and Outback; learn about sustainable development and protection of the natural environment through educational travel, field trips, active participation, lecture presentations and seminars, written assignments, research projects and reflective exercises. Students must apply through NCSU Study Abroad Office. Students must pay program fees, airfare, some meals and incidentals.

Corequisite: PRT 449
GEP Global Knowledge, GEP Interdisciplinary Perspectives

Typically offered in Summer only

ES 495 Special Topics in Environmental Science (1-6 credit hours)
This course provides instruction on rapidly emerging environmental themes not currently covered in the undergraduate curriculum. Also provides courses on an experimental basis. See specific course offering for course detail.

Prerequisite: Junior standing

Typically offered in Fall and Spring

ES 496 Environmental Science Internship (1-3 credit hours)
Students can earn 1-3 credits for completing internships in the public or private sectors. Emphasis is placed on gaining work experience needed to explore and plan careers in the environmental field. Students must prepare an internship proposal. Student

Typically offered in Fall, Spring, and Summer

ES 497 Professional Development in Environmental Science (1-3 credit hours)
The course provides 1-3 credits for students who develop skills necessary to organize, promote, and participate in an event such as a workshop, conference or a seminar. Examples of acceptable events include organizing a panel of speakers on a specific topic. A speaker series, a career fair, or a workshop. The formats and topics of events are determined by the organizing student(s). Each student prepares an event proposal before the student can register for ED 497. Students must provide own transportation for professional development in environmental sciences. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

ES 498 Research in Environmental Science (1-3 credit hours)
Students can earn 1 credit in ES 498 for every 50 hours of research during a semester up to a total of 3 credits for 150 of research in a semester. A student cannot complete more than 3 credits of ES 498 research in a single semester, or more than 6 credits in their program of study. Research can be traditional laboratory and/or fieldwork, or other creative activity. The student must produce a final report, seminar, or product that can be evaluated. Typically, the work for 1-3 credit of ES 498 research will be completed in one semester. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

ES 499 Thesis in Environmental Science (3 credit hours)
ES 499 thesis provides academic credit for students who participate in original, inquiry-based learning and discovery in environmental sciences. Students present the thesis to a community of peers and experts for evaluation. ES 499 thesis requires a thesis proposal signed by the student, ES faculty advisor, a thesis host, and a supporting faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

Environmental Technology (ET)

ET 105 Introduction to Environmental Regulations (1 credit hours)
ET 105 is a 1 hour lecture/discussion class, required of all environmental technology majors. The course reviews all the major federal and state regulations and laws addressing, water air and soil pollution; solid, toxic and hazardous waste, occupational safety/health and environmental management systems. For ET majors only.

Typically offered in Spring only
ET 120 Introduction to Renewable Energy Technologies and Assessments (3 credit hours)
Overview of the various renewable energy assessment technologies. Students will learn what assessments and measurements can be taken to determine if renewable energy technologies will be effective in a particular location. Topics include biomass and biofuels, geothermal systems, solar thermal systems, photovoltaics, wind energy, and hydroelectric.

Typically offered in Spring only

ET 201 Environmental Technology Laboratory I (1 credit hours)
Use of field and laboratory instrumentation for monitoring water quantity and quality. Management, analysis, interpretation, and oral and written reporting of complex environmental data sets. Hands-on, real-world experience in water quality monitoring and maintenance. Required field trips may extend beyond class time.

Typically offered in Fall only

ET 202 Environmental Technology Laboratory II (1 credit hours)
Use of field and laboratory instrumentation for monitoring plants, soils, and natural systems. Management, analysis, interpretation, and oral and written reporting of complex environmental datasets. Hands-on, real-world experience in plant and soil quality monitoring and maintenance. Required field trips may extend beyond class time.

Typically offered in Spring only

ET 203 Pollution Prevention (1 credit hours)
This course studies the prevention of the pollution of air, water, and terrestrial ecosystems. State of the art technological solutions are discussed. The social, economic, legal and ethical dimensions of pollution prevention are integrated into the scientific and technological challenges facing developed and developing economies.

Prerequisite: ES 100

Typically offered in Fall only

ET 220 Solar Photovoltaics Assessment (3 credit hours)
This course introduces specific elements in photovoltaic (PV) systems technologies including efficiency, modules, inverters, charge controllers, batteries, and system installation. Topics include National Electric Code (NEC), electrical specifications, photovoltaic system components, array design and power integration requirements that combine to form a unified structure. Upon completion, students should be able to demonstrate an understanding of various photovoltaic designs and proper installation of NEC compliant solar electric power systems.

Prerequisite: ET 120

Typically offered in Fall only

ET 255 Hydro, Wind, and Bioenergy Assessment (3 credit hours)
Overview of the historical and current role of wind, hydro-electric, and bioenergy power technologies globally and the direction of each sector's evolution for the future particularly in the USA. The course emphasizes the technology behind power generation for wind, hydro, and bioenergy sectors. Students will evaluate policy and permitting issues and, consequently, determine if a site is appropriate for implementation of either or all of these technologies.

Prerequisite: ET 120

Typically offered in Spring only

ET 262 Renewable Energy Adoption: Barriers and Incentives (3 credit hours)
The understanding of the economic, social, and legal barriers and incentives to renewable energy adoption is an important facet to helping renewable energies reach their potential. This course explores mechanisms that can be used and that have been used successfully in the US and in other parts of the world to remove those barriers and to promote greater use of renewable resources, particularly in rural areas and on agricultural and forested lands.

Typically offered in Fall only

ET 293 Independent Study in Environmental Technology & Management (1-6 credit hours)
Independent Study for Environmental Technology & Management students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students

Typically offered in Fall, Spring, and Summer

ET 294 Independent Study in Environmental Technology & Management (1-6 credit hours)
Independent Study for Environmental Technology & Management students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students

Typically offered in Fall, Spring, and Summer

ET 295 Special Topics in Environmental Technology & Management (1-6 credit hours)
Special Topics in Environmental Technology & Management at the 200 Level for offering courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

ET 301 Environmental Technology Laboratory III (1 credit hours)
Assessment of and response to environmental hazards caused by hazardous materials releases. Regulatory requirements associated with hazardous materials releases. Utilization of chemical protective clothing and respiratory protection. Students passing th

Typically offered in Fall and Summer

ET 302 Environmental Technology Laboratory IV (1 credit hours)
Use of field and laboratory instrumentation for monitoring outdoor and indoor air quality. Management, analysis, interpretation, and oral and written reporting of complex environmental data sets. Hands-on, real-world experience in air quality monitoring and maintenance. Required field trips may extend beyond class time.

Typically offered in Spring only

ET 303 Laboratory Safety Systems and Management (1 credit hours)
Theory and practice of regulation, management, and auditing of laboratory safety. Laboratory field trips may extend beyond class time.

Typically offered in Spring only
ET 310 Environmental Monitoring and Analysis (3 credit hours)
Monitoring and analysis of chemical, biological, and radiation impacts to the environment. Theory of chemical, physical, biological, and ecological monitoring. Planning and conducting environmental sampling and monitoring programs. Management, analysis, and quality assurance and control. Risk assessment in environmental technology. Laboratory practice and safety.
Prerequisites: CH 101 or 100; BIO 181; ET students only
Typically offered in Spring only

ET 320/MEA 320 Fundamentals of Air Pollution (3 credit hours)
Air pollution sources, and the influence of natural and anthropogenic processes on the atmosphere. Roles of local, state and federal governments in air pollution control and importance of the Clean Air Act and its amendments.
Prerequisite: (MA 121, MA 131, or MA 141) and (PY 131 or PY 201 or PY 205 or PY 211)
Typically offered in Spring only

ET 330 Environmental Technology Practicum (3 credit hours)
Preparation for practicum, including resume writing, interviewing skills, cover letters, and practicum search techniques and resources. Professional practice as an environmental technologist. Written and oral communications of the practicum experience.
Typically offered in Fall, Spring, and Summer

ET 401 Environmental Technology Laboratory V (1 credit hours)
Scientific and legal definitions of brownfield and EPA Superfund sites. Physical, chemical, and biological methods for remediating contaminated sites. Impacts of hazardous waste management on public and private sector organizations. Field trips to public and private brownfield and Superfund remediation sites to examine real-world applications of principles. Required field trips may extend beyond class time.
Typically offered in Fall only

ET 455 Adaptive Management and Governance (3 credit hours)
Some environmental and natural resource problems are more difficult to resolve than others. The purpose of this course is to understand the factors that condition intractable or "wicked" environmental and natural resources conflicts. These factors include narrow conceptions of science, rigid bureaucratic structures and narrow policy targets. We also explore some of the alternatives for addressing intractable environmental and natural resource problems- including adaptive management and governance.
Junior standing or above
Typically offered in Fall only

ET 460 Practice of Environmental Technology (3 credit hours)
This capstone course will provide the opportunity to actively learn and apply the theory and practice of environmental project management and monitoring in order to perform a baseline Environmental Management System (EMS) assessment. EMS requires data collection, data analysis, report preparation, and professional recommendations to organizations on how to structure an EMS that conforms to internationally recognized guidelines and standards. Environmental Management Systems are proven tools specifically designed to help organizations manage their activities to meet their environmental policies and goals. Project management and EMS work skills are transferable across private industry, government, and not-for-profit organizations. This course will provide participants opportunities to advance work skills in project planning, stakeholder engagement, budgeting, and resource management when developing EMS initiatives. Course participants, as teams, will create and execute an EMS project work plan through practical hands-on experiences, local field-site visits, class exercises, and relevant case studies.
Prerequisite: ET 310 or SSC 442; and ET Senior Only
Typically offered in Spring only

ET 493 Independent Study in Environmental Technology & Management (1-6 credit hours)
Independent Study for Environmental Technology & Management students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in No
Typically offered in Fall, Spring, and Summer

ET 494 Independent Study in Environmental Technology & Management (1-6 credit hours)
Independent Study for Environmental Technology & Management students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in No
Typically offered in Fall, Spring, and Summer

ET 495 Special Topics in Environmental Technology & Management (1-6 credit hours)
Special Topics in Environmental Technology & Management at the 400 level for offering courses on an experimental basis.
Typically offered in Fall, Spring, and Summer

Fashion and Textile Design (FTD)

FTD 104 Fashion and Textile Design First Year Studio I (6 credit hours)
This course provides Fashion and Textile Design freshman with a comprehensive introduction to foundational design concepts and methods representative of the creative thought and processes of fashion and textile design disciplines. The coursework encourages entering freshmen to think creatively through design and art, and the world around them, as they secure a skillful level of craftsmanship in the design and making of textile products. Design language, design elements and principles, and design communication and theory will be studied through readings and applications and will be experienced in person through field trips. Additional costs may be incurred for field trips.
Co-requisite: D 100
Typically offered in Fall only
FTD 105  Fashion and Textile Design First Year Studio II  (6 credit hours)
This course is the continuation of the comprehensive introduction to foundational design concepts and methods representative of creative thought and activity across design and artistic disciplines, started in FTD FY Studio I. The course work encourages first year students to think critically and in depth about concept, context, material, and design process, for textile and fashion product development. There will be readings and applications in advanced design theory, including processes, methods, philosophies and related concepts. The class will involve field trips to experience these advanced design principles in person. Additional costs may be incurred.
Prerequisites: D 100 and FTD 104; Co-requisites: D 101 and FTD 200
Typically offered in Spring only

FTD 200  Design Skills Workshop  (3 credit hours)
First course in developing student's use of design tools for the production of prototype products from textile materials, beginning with the selection of appropriate fabric and other raw materials and extending through critiquing the product. Concepts of ethical and sustainable design are built into the analysis and design of the product. A variety of techniques for designing sewn textile products are explored, as well as methods and safe practices for using equipment in the studio. FTD Majors Only.
Prerequisite: TT 105 and Corequisite: D 105
Typically offered in Spring only

FTD 218  Fashion Illustration  (3 credit hours)
Concepts and practices for the fashion figure and fashion illustration, including the analysis of fashion figure structure details, proportion, and fashion figures clothed with different apparel and materials. The training of effective drawing of different fashion styles, wearing status and occasions, and the study of applying multiple illustration approaches to enhance fashion design and presentation. Additional costs may be incurred for course materials/equipment. FTD and FTM majors only.
Prerequisite: ADN 281
Typically offered in Spring only

FTD 374  Surface Design and Texture  (3 credit hours)
Exploration of innovative surface design and texture techniques for commercial and art applications. Embroidery, applique, stitching, fabric manipulation and aesthetic finishing processes for creative and functional design will be taught in state of the art facilities including digital printing, screen printing, cad embroidery, and industrial cad software for print design. Additional costs may be incurred for course materials/equipment. FTD majors only.
Prerequisite: TT 105 and a grade of C or better in FTD 200
Typically offered in Spring only

FTD 375  Woven Textile Design Studio I  (3 credit hours)
Design and sample production of woven fabrics. Exploration of basic structures, color and textural effects. Development of design abilities through creative projects executed using hand production methods, including an introduction to computer-integrated woven textile design systems and industrial processes. Study of actual fabrics and digital images, presentations will be made. Studio experience will be augmented, when possible, through outside speakers and field trips to mills. Additional costs may be incurred for course materials/equipment. FTD majors only.
Prerequisite: Grade of C or better in both TT252 and FTD 373
Typically offered in Fall only
FTD 376 Knitted Textile Design Studio I (3 credit hours)
Design and sample production of hand and machine knit textiles. Exploration of basic structures, terms, and definitions, including knitting notation and terminology. Development of creative knit products utilizing design abilities and appropriate yarns through hand and machine production methods. Introduction to computer integrated knit design system and industrial knitting products and processes. Additional costs may be incurred for course material/equipment. FTD majors only.
Prerequisite: Grade of C or better in both TT252 and FTD 373
Typically offered in Fall only

FTD 419 Fashion Design 2 (3 credit hours)
Studio course which poses fashion problems to be solved with an emphasis on elements of design. Explores use of experimentation and development of "studies" as an aid in developing design ideas. Uses combination of flat pattern and CAD. Introduction to grading, marker making, and computer-controlled cutting. Additional costs may be incurred for course materials/equipment. FTD majors only.
Prerequisite: Grade of C or better in FTD 215, FTD 216, FTM 317, and FTD 321
Typically offered in Fall only

FTD 420 Fashion Collection Preparation (3 credit hours)
Studio course exploring sources of inspiration requiring students to research, develop and translate ideas into a line plan for a collection of garments. Stresses the extension and elaboration of ideas within a specific market. Integrates knowledge across the curriculum. Student may work with a firm, contest, or current theme to develop a fashion design statement. Additional costs may be incurred for course materials/equipment. FTD and FTM majors: Fashion Design and Fashion Development concentrations only.
Prerequisite: Grade of C or better in FTM 318 or (FTD 321 and co-requisite of FTD 419)
Typically offered in Fall only

FTD 475 Woven Textile Design Studio II (3 credit hours)
Design and sample production of specialized jacquard woven structures. Jacquard design for diverse end uses is addressed from art fabrics to unique specialty products. Exploration of advanced structures, color and textural effects. Development of design abilities through electronic production methods, including expanded use of computer-integrated design systems and exposure to industrial processes. Students will be required to complete creative design projects from concept to sample production and proposed finishing. Study of actual fabrics, digital images and presentations. Studio experiences will be augmented, when possible, through outside speakers and field trips to museum, markets, and mills. Additional costs may be incurred for course materials/equipment. FTD majors only.
Prerequisite: Grade of C or better in FTD 375
Typically offered in Fall only

FTD 476 Knitted Textile Design Studio II (3 credit hours)
Further development of knit design beyond basic design concepts and knit structures to product application. Development of creative knit products utilizing design abilities through hand and machine production methods, including advanced methods of utilizing computer-integrated design system for both technical structures of knits and designing of garments and shaped panels. Exploration in yarn, color, and pattern design using electronic jacquard, fully fashion and seamless knitting equipment and cad systems. Consideration of other knit technologies such as warp knitting, terry, and crochet. Students will develop specifications for knitted products, and enhance understanding of industrial products and processes. Additional costs may be incurred for course material/equipment. FTD majors only.
Prerequisite: Grade of C or better in FTD 376
Typically offered in Fall only

FTD 479 Senior Textile Design Studio (6 credit hours)
Design and execution of creative projects integrating learning within curriculum, solution of textile design problems through synthesis of knowledge and skills gained through previous courses, preparation of work for portfolio, exhibition and participation in industry focused design competitions. Professional textile design practices and methods including advanced portfolio development concepts and presentation, development of textile collections suited to specified end use with emphasis on ideation, refinement, and design development, presentation and visual communication. The student will be expected to work with design, science, engineering, technology, and management disciplines. Additional costs may be incurred for course materials/equipment. Senior Standing, BS Fashion and Textile Design, Textile Design majors ONLY.
Prerequisite: FTD 374, FTD 475, FTD 476
Typically offered in Spring only

Fashion and Textile Management (FTM)

FTM 217 The Textile Industry (3 credit hours)
Study of the structure and organization of the integrated textile complex and its strategic functions. Critical stages involved in the manufacture of textile and apparel products. Fundamental aspects of cost management and finance as related to the industry
Prerequisite: TT 105
Typically offered in Fall, Spring, and Summer

FTM 219 Fashion Product Analysis (3 credit hours)
Concepts and practices for the production and evaluation of fashion goods, beginning with selection of fabric and other raw materials and extending through quality analysis of the final product. Provide techniques for production of a variety of garment applications, as well as methods for evaluation.
Typically offered in Fall and Spring
FTM 220  Principles of Retailing and Supply Chain Management in Textiles  (3 credit hours)
Introduction to theories and principles in fashion and textiles retailing and supply chain management including: the framework of textile retailing, textile retail strategies, textile supply chains and investigation of the strategic planning process. Emphasis placed on conducting an environmental scan, identifying and targeting the consumer, analyzing the trade area, site selection and textile product merchandise planning.
Prerequisite: FTM 217
Typically offered in Fall, Spring, and Summer

FTM 271  Computer-Aided Textile Design  (3 credit hours)
Introduction to the operation of design software for woven, knitted and printed textiles. Adobe Photoshop, Pointcarre' and Monarch programs will be taught. Peripheral equipment essential to the design process will be included. Field trips to atextile design centers. Credit not allowed for students enrolled in TT curriculum with the exception of the dual degree in the Bachelor of Art and Design and BS in Textile Technology.
Typically offered in Fall and Spring

FTM 282  Introduction to Textile Brand Management and Marketing  (3 credit hours)
An introduction to the essential elements of brand management and marketing with specific reference to the marketing of textile and apparel goods with the integrated textile complex (from fiber to retail). The course covers both the principles and practice of marketing, in general, and provides an introduction of major concepts of brand management and marketing with a focus on branding activities used in by major textile and apparel firms within the integrated textile supply chain.
Typically offered in Fall and Spring

FTM 310  Entrepreneurship & New Product Development in Textiles  (3 credit hours)
Academic dimensions of the entrepreneurship body of knowledge. Integration of new product development (NPD) process and entrepreneurship in textiles. Critical thinking skills for the textile entrepreneurial mindset. Teams exercise entrepreneurial skills
Prerequisite: Junior standing
Typically offered in Fall and Spring

FTM 315  Fashion Product Design  (3 credit hours)
Concepts and practices for the design and development of fashion apparel items, beginning with selection of fabric and other raw materials and extending through flat pattern development, pattern engineering, and generation of final garments. Provide techniques for development of styled patterns, which address issues of body measurements, body shape, comfort and fit.
Prerequisite: FTM 217 and FTM 219
Typically offered in Fall and Spring

FTM 317  Computer-Aided-Design for Apparel  (3 credit hours)
Introduction to the operation of industry design software for apparel & other sewn products. Euphoria and/or Artworks visual design programs, Gerber Accumark or Lectra pattern design programs, and other programs used by the industry to create, market and/or visualize products will be taught. Peripheral equipment essential to the design process will be included.
Prerequisite: FTD 215 or Corequisite: FTM 315
Typically offered in Fall and Spring

FTM 318  Fashion Development Processes  (3 credit hours)
The principles of apparel manufacturing including computerization of the design; marker making and production areas; spreading and cutting technology; apparel assembly systems; production systems evaluations; fusing and pressing; production capacity; an
Prerequisite: FTM 317
Typically offered in Fall and Spring

FTM 320  Retail Merchandising in Fashion and Textiles  (3 credit hours)
An in-depth study of textile product merchandising and its functions, focusing on a comprehensive approach to textile product merchandising that links manufacturing and retailing to the consumer through the merchandising process. Textile merchandising as a process is studied in newly restructured consumer-centric businesses and textile product strategy needed for employees to function successfully in today's global, integrated world of merchandising.
Prerequisite: FTM 220
Typically offered in Fall only

FTM 382  Intermediate Textile Brand Management and Marketing  (3 credit hours)
This course builds on the introduction of the basic concepts introduced in TAM 282 by providing an in-depth examination of the major theories and concepts associated with brand management and brand marketing. Included is the identification and analysis
Prerequisite: FTM 282 and (EC 201 or ARE 201)
Typically offered in Fall, Spring, and Summer

FTM 384  Visual Merchandising Principles and Management  (3 credit hours)
Study and application of techniques in the effective display of merchandise, from fiber to finished product. The focus of the course placed on the integration of textile and apparel product characteristics, target market characteristics and the latest merchandising technology and concepts.
Prerequisite: Junior standing or higher, FTM 217, Corequisite: FTM 382
Typically offered in Spring only

FTM 385  Fashion and the Consumer  (3 credit hours)
This course focuses on consumer decision process for textile products, including the study of environmental, individual, psychological and marketing influences on behavior of consumers in the textile consumption process. Further examination will include influences on the process, including fashion theories, the mass media, demographics and psychographics, and societal trends. Current development and research in the textile consumer decision process are reviewed.
Prerequisite: FTM 217, FTM 282
Typically offered in Fall, Spring, and Summer
FTM 387  Textile Brand Communications & Promotions  (3 credit hours)
Examines the utilization of textile brand marketing communication and promotion tools to build, maintain or expand a brand's value in the textile complex marketplace. Includes examination of principles and theories for Integrated Brand Marketing (IBM) and how these strategies and tactics are used within the textile complex advance brand positioning. Knowledge of IBM will be demonstrated via case studies, examination and textile industry-related application projects. FTM Majors Only
Prerequisite: FTM 382
Typically offered in Fall and Spring

FTM 400  Major Fashion Designers  (3 credit hours)
Study of fashion designers from the early 1800s to the present. Emphasis will be placed on historical and cultural events that may have influenced the work of fashion designers during the time and trends that have emerged. Of specific interest will be m

GEP Visual and Performing Arts
Typically offered in Spring and Summer

FTM 415  Fashion Product Development  (3 credit hours)
Fashion product development for specific target markets. Line production using various methods of generating patterns for mass-produced apparel with emphasis on "flat pattern" design techniques. Relationship of body configuration to pattern shape, specifications to garment size and fit, standards for judging fit, distinctions between ease and style fullness, and design analysis procedures are included.
Prerequisite: FTM 318
Typically offered in Fall and Spring

FTM 416  The Fashion Industry  (3 credit hours)
Planning and sourcing of fashion apparel products to meet the needs of the consumer. Emphasis is placed on the role of the merchandiser and merchandising function together with the measures of performance required by the fashion businesses. The interactions of the merchandiser with the functions of marketing, design, development and sourcing during pre-production are studied with respect to successful sourcing. Sourcing is studied from the requirements of compliance, product quality, cost, and manufacturing capability.
Prerequisite: Senior standing
Typically offered in Fall and Spring

FTM 420  Retail Buying in Fashion and Textiles  (3 credit hours)
Overview and analysis of the components of buying and selling products at he retail level. Management of profit factors to improve performance in textile merchandising driven organizations. Analysis of the practices, procedures and systems that track textile merchandising decisions and aid in meeting profit goals. The course consists of an integrated framework that applies merchandising theory and mathematical processes to textile retail problems.
Prerequisite: FTM 320
Typically offered in Spring only

FTM 431  Quality Management and Control in Textile Manufacturing  (3 credit hours)
Principles of quality and process management and control in textile/apparel manufacturing with emphases in quality management systems, quality costs, statistical control chart procedures, process capability, acceptance sampling, and optimal process and product design and improvement methods.
Prerequisite: TT 221, TT 252, TT 331, and ST 361 or BUS 350

FTM 460  Textile Market Research  (3 credit hours)
Data from textile and apparel industry firms are utilized to explore the role of marketing research in managerial decision-making within the textile and apparel industry, and allow students to develop basic skills in the market research process (problem identification to final reporting). Topics included are problem formulation, research design, data collection (instruments and sampling), and data analysis techniques (qualitative and quantitative).
Prerequisites: FTM 382 and (ST 311, ST 361, or ST 370)
Typically offered in Spring only

FTM 480/TT 480  Operations Management Decisions for Textiles  (3 credit hours)
Quantitative techniques for decision making and management in the textile complex. Applications include vendor selection, plant location, retail inventory management, forecasting demand, project management, and logistics planning. Techniques covered include simulation, PERT/CPM, mathematical modeling.
Prerequisite: TT/FTM 380 and ACC 210 and ST 311 or ST 370 and (MA 131 and 132) or MA 141
Typically offered in Fall only

FTM 481  Product Costing in the Textile and Apparel Industry  (3 credit hours)
Capstone course covering cost issues in yarn manufacturing, fabric formation, finishing, apparel production and retail operations. Traditional and activity-based costing systems will be addressed. Relevance of costing to managerial decisions as well as cost reduction strategies will be emphasized.
Typically offered in Spring and Summer

FTM 482  Advanced Textile Brand Management and Marketing  (3 credit hours)
An applied textile marketing course that integrates textile product development, brand management, and global marketing. This course provides an overview of the global textile and apparel industries, their distribution channels and markets—with positioning the US textile, apparel, and retail industries in the global competitive environment. The course includes diverse textile end uses, including apparel, nonwovens, home textiles, transportation textiles and medical textiles. Development and implementation strategies of launching textile products in the global marketplace are analyzed.
Prerequisite: FTM 382
Typically offered in Fall, Spring, and Summer
FTM 483 Global Trade & Sourcing  (3 credit hours)  
This course provides students with an understanding and appreciation of the global textile and apparel market. Included is the explanation and guidance in understanding the uniqueness of textile and apparel regulations in global trade. Students will learn global sourcing strategies and the identification and analysis of major strategic decisions used in global sourcing, as impacted by global trade dynamics. Students will be assigned practical application projects that require utilization of academic knowledge with industry application.

Prerequisite: FTM 282 and EC 201 or ARE 201 or EC 205  
Typically offered in Fall and Spring

FTM 484 Strategic Planning and Decision Making in the Textile and Fashion Industries  (3 credit hours)  
The course provides a framework for understanding and analyzing strategic planning and decision making in the textile and apparel supply chain, from fiber through retail. It integrates theory and practice through lectures, case studies, and exercises to provide students an understanding of the competitive dynamics in the textile industry, including structural and behavioral components and the role of entrepreneurship.

Prerequisite: BUS 320 or FTM/TT 380, and TT 221 or equivalent  
Typically offered in Fall and Summer

FTM 485/TT 485 Textile Computer Integrated Enterprise  (3 credit hours)  
Survey of information technology in textile and apparel industries. Topics discussed include: computer aided design (CAD); computer aided manufacturing (CAM); computer aided engineering (CAE); material handling systems; automation and robotics; logistics and warehousing systems; retail product tracking, and Internet resources.

Prerequisite: TT/FTM 380  
Typically offered in Fall only

FTM 486/TT 486 Supply Chain Management in the Textile Industry  (3 credit hours)  
Study of the operations necessary to produce and distribute a product, starting with the procurement of the raw material used in making the goods and ending with the delivery of the finished product. Topics covered include approaches to solving problems in manufacturing, sourcing, transportation logistics, and retail operations within the Integrated Textile Complex. Credit cannot be given for both TAM486 and MT386.

Prerequisite: TT/FTM 380  
Typically offered in Spring only

FTM 487 Textile and Apparel Labor Management  (3 credit hours)  
Labor management problems. Emphasis directed toward role of production supervision in textile and apparel plants. Study of NLRB decisions and court opinions involving textile and apparel corporations.

Prerequisite: Senior standing  
Typically offered in Fall and Spring

FTM 490 Development Projects in Textile and Apparel Management  (1-3 credit hours)  
Directed research in Textile and Apparel Management through experimental, theoretical and literature studies in textile and apparel-related problems. Courses may be taken twice provided projects are different subject matter.

Prerequisite: Junior standing and 2.75 GPA  
Typically offered in Fall and Spring

FTM 491 Special Topics in Textile and Apparel Management  (1-4 credit hours)  
Special topics related to textile and apparel management.

Prerequisite: Senior standing

FTM 494 International Industrial Internship in Textile Management  (3 credit hours)  
Professional level work experience in textile management abroad, relating academic training, international textile management and technology to industrial practice under professional guidance. Grading based on written report and oral presentation. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: At least FL 202 for internships in non-English speaking countries, Minimum GPA 2.5, Junior standing  
Typically offered in Fall and Summer

FTM 497 Senior Fashion Collection Studio  (6 credit hours)  
Advanced fashion product design. Design and production of a "collection" using various methods of generating patterns for garments, such as flat pattern, draping, and CAD techniques. Relationships of body configuration and fabrication to garment design. Emphasis on ideation, creativity, communication, theme development, fit, quality, and exhibition of a fashion collection. Work culminates in a Fashion show or Static exhibition format.

Prerequisite: FTM 318  
Typically offered in Fall and Spring

FTM 499 Textile Senior Project  (4 credit hours)  
This is a project based course to be taken in the last semester of the Senior year. In this capstone course the students work in cross-functional teams to research and solve applied problems in textile related fields. The results of the projects will

Prerequisite: Senior standing

Feed Mill (FM)

FM 272 Swine Feed Mill Management  (1 credit hours)  
Principles of feed manufacturing, equipment operation, feed and ingredient quality assurance and regulatory compliance in a modern feed milling operation. Overview of feed mill regulations and safety.

“Restriction: Restricted to non-ANS (Animal Science) students. ANS students cannot take the course for credit.”  
Typically offered in Fall only

FTM 490 Development Projects in Textile and Apparel Management  (1-3 credit hours)  
Directed research in Textile and Apparel Management through experimental, theoretical and literature studies in textile and apparel-related problems. Courses may be taken twice provided projects are different subject matter.

Prerequisite: Junior standing and 2.75 GPA  
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Typically offered in Fall only
**FM 425/PO 425/FM 525/ANS 525/PO 525/NTR 425/ANS 425** Feed Manufacturing Technology (3 credit hours)
Feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture.

Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225
Typically offered in Fall and Spring

**FM 426/PO 426** Feed Manufacturing Technology Laboratory (1 credit hours)
Laboratory associated with feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture. PO/ANS/FM 425 is a required course for the Poultry Science Technology Concentration (TPS); the Feed Milling Minor (FEM); and the Feed Mill Certificate.

Corequisite: PO 425 or ANS 425 or FM 425 and FEM minor or 11PLTRYBS
Typically offered in Spring only

**FM 460** Feed Mill Operations and Leadership (3 credit hours)
Principles and current practices of modern feed mill operations. Topics include managing employees, team building, safety, budgets, regulations, and key performance indicators.

Prerequisite: ANS 425 or FM 425 or PO 425
Typically offered in Spring only

**FM 480** Feed Quality Assurance & Formulation (3 credit hours)
Introduction to the principles of ingredient and feed quality assurance and how to develop a comprehensive quality assurance program. The course will include the development of approved suppliers, ingredient specifications, feed manufacturing procedures, and formulation based on dynamic ingredient matrices.

Prerequisite: PO(ANS) 425
Typically offered in Fall only

**FM 490** Feed Science Seminar (1 credit hours)
Exploration of topics related with current and future potential to influence the feed industry. Guest lectures from feed industry leaders and university representatives will include: vertically integrated and commercial feed production, current research topics, government regulations, trade organizations, and quality assurance.

Typically offered in Fall only

**FM 494** Feed Mill Learning Experience (1 credit hours)
Hands-on laboratory teaching students how to safely operate feed mill equipment and manufacture feed using a computer system.

Prerequisite: PO(ANS) 425
Typically offered in Fall, Spring, and Summer

**FM 525/ANS 525/PO 525/NTR 425/ANS 425/FM 425/PO 425/NTR 525** Feed Manufacturing Technology (3 credit hours)
Feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture.

Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225
Typically offered in Fall and Spring

**FM 580/PO 580** Feed and Ingredient Quality Assurance (3 credit hours)
The course will teach students the principles of feeding and ingredient quality assurance and how to develop a comprehensive quality assurance program. The course will include the development of an approved supplier list, ingredient specifications, feed manufacturing quality assurance procedures, and risk based feed safety programs.

Prerequisite: NTR(FM) 525
Typically offered in Fall only

**FM 594** Advanced Feed Mill Practicum (1 credit hours)
This course will teach students the principles of operating a modern feed mill. Students will receive ingredients, grind grain, manufacture feed, and perform quality checks on finished feed products. Students will complete safety, quality assurance, and feed processing training units as part of their training.

Prerequisite: NTR(FM) 525
Typically offered in Fall and Spring

**FM 706/NTR 706** Vitamin Metabolism (3 credit hours)
Structures, chemical and physical properties, functions, distribution, absorption, transport, metabolism, storage, excretion, deficiencies, and toxicity of vitamins in humans and domestic animals. Interactions between vitamins and other factors affecting vitamin metabolism or bioavailability as well as the nutritional significance of essential fatty acids and metabolism of prostaglandins, prostacyclins and leukotrienes. Application of knowledge will include critical review of scientific literature, experimental design, and formulation of vitamin supplements.

Prerequisite: ANS(NTR,PO) 415 and BCH 453
Typically offered in Fall only

**FM 790/NTR 790** Advanced Feed Formulation (3 credit hours)
Principles of feed and ingredient quality assurance and how to develop a comprehensive quality assurance program. The course will include the development of an approved supplier list, ingredient specifications, feed manufacturing quality assurance procedures, and risk based feed safety programs.

Prerequisite: NTR(FM) 525
Typically offered in Fall only

**Fiber and Polymer Science (FPS)**

**FPS 696** Summer Thesis Res (1 credit hours)
FPS 710/TC 710 Science of Dye Chemistry, Dyeing, Printing and Finishing (3 credit hours)
The primary course purpose is to gain a strong fundamental understanding of the chemistry and technology of preparation, dyes, dyeing and finishes. Emphasis will be on the chemistry of different bleach activators, surfactants, photophysics and photochemistry of FWA's, modulations of dyes structures to influence color, tenctorial strength, light fastness, wash fastness and aggregation. Chemistry of different dye classes will be studied with emphasis on structure-property relationships and dye-fiber interactions. Dyeing isotherms (Nernst and Langmuir), kinetics of dyeing with emphasis on derivation of Nernst and Langmuir based on thermodynamics and kinetics principles will be covered with practical examples of dyeing at different temperature and how to calculate thermodynamic parameters of dyeing (entropy, standard affinity and isotherm constants of Nernst and Langmuir). Chemistry of different finishes, including soil release, chemistry of flame retardants and mechanisms of flame retardancy, antimicrobial and water and oil repellency, will be covered with emphasis on structure-property relationships.
Prerequisite: Graduate Standing and C or better in CH221 or CH225 and CH223 or CH227
Typically offered in Fall and Spring

FPS 750/TTM 750 Advances in Fabric Formation, Structure, and Properties (3 credit hours)
The course covers different aspects of the processing of yarns to products (braided, knitted, woven, and their composites) and the interrelation between the production mechanics and structure, geometry and properties of fiber assembly. Topics in the field are assigned and each student is expected to thoroughly study the topics and write critical papers based on structured assignments and specific questions. Conduct projects from concept to fabric formation, analyses, and evaluation.
Prerequisite: TT 550 or TT 551 (or TT 451) or equivalent
Typically offered in Spring only

FPS 770 Advances in Polymer Science (3 credit hours)
This course provides an overview of the unique features of polymer materials that distinguish them from those composed of small-molecules or atoms (Polymer Physics) and the connections between their detailed molecular structures and their properties
Restriction: Graduate Standing in Fiber and Polymer Science, Textile Chemistry, Textile Engineering, Material Science and Engineering, Chemical Engineering, Chemistry and Physics, or by permission of the instructor.
Typically offered in Fall only

FPS 792 Special Topics in Fiber Science (1-6 credit hours)

FPS 801 Seminar (1 credit hours)
Typically offered in Fall and Spring

FPS 830 Independent Study (1-3 credit hours)
Typically offered in Fall and Spring

FPS 876 Special Project in Fiber and Polymer Sciences (1-12 credit hours)
Typically offered in Fall only

FPS 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

FPS 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

FPS 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

FPS 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

FPS 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Summer only

FPS 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

Financial Mathematics (FIM)

FIM 500 Career Development for Quants (3 credit hours)
Enhance your professional and career development skills while you are in the Financial Math program with seminar topics on networking, LinkedIn, resumes, interviews, presentations and business writing tips. Learn about workplace etiquette and business ethics. You will also gain resources and important industry information from guest speakers and alumni. Become Base SAS Certified and Bloomberg Certified, and gain hands-on experience with these tools by participating in group and individual projects. Course includes one or more projects that expose students to applications in the area of financial mathematics. Students that wish to develop SAS programming skills are encouraged to take ST 555/556.
Must be in the Masters of Financial Mathematics program.
Typically offered in Fall only
**FIM 528/MA 528/ECG 528/MBA 528 Options and Derivatives Pricing** (3 credit hours)
The course covers (i) structure and operation of derivative markets, (ii) valuation of derivatives, (iii) hedging of derivatives, and (iv) applications of derivatives in areas of risk management and financial engineering. Models and pricing techniques include Black-Scholes model, binomial trees, Monte Carlo simulation. Specific topics include simple no-arbitrage pricing relations for futures/forward contracts; put-call parity relationship; delta, gamma, and vega hedging; implied volatility and statistical properties; dynamic hedging strategies; interest-rate risk, pricing of fixed-income product; credit risk, pricing of defaultable securities.

Prerequisites: MA 341 and MA 405 and MA 421
Typically offered in Fall only

**FIM 548/MA 548 Monte Carlo Methods for Financial Math** (3 credit hours)
Monte Carlo (MC) methods for accurate option pricing, hedging and risk management. Modeling using stochastic asset models (e.g. geometric Brownian motion) and parameter estimation. Stochastic models, including use of random number generators, random paths and discretization methods (e.g. Euler-Maruyama method), and variance reduction. Implementation using Matlab. Incorporation of the latest developments regarding MC methods and their uses in Finance.

Prerequisites: (MA 421 or ST 421), MA 341, and MA 405
Typically offered in Spring only

**FIM 549/MA 549 Financial Risk Analysis** (3 credit hours)
This course focuses on mathematical methods to analyze and manage risks associated with financial derivatives. Topics covered include aggregate loss distributions, extreme value theory, default probabilities, Value-at-Risk and expected shortfall, coherent risk measures, correlation and copula, applications of principle component analysis and Monte Carlo simulations in financial risk management, how to use stochastic differential equations to price financial risk derivatives, and how to back-test and stress-test models.

Prerequisites: MA 405 and (MA 421 or ST 421) and (MA/ST 412 or MA/ ST 413)
Typically offered in Spring only

**FIM 590 Special Topics in FIM** (1-6 credit hours)
Special Topics in FIM

**FIM 601 Seminar in Financial Mathematics** (1 credit hours)
 Seminar in Financial Mathematics

Prerequisite: FIM 500
Typically offered in Fall and Spring

**FIM 610 Special Topics in Financial Mathematics** (1-6 credit hours)
Special Topics in Financial Mathematics

**FIM 620 Special Problems in FIM** (1-6 credit hours)
Special Problems in FIM

**FIM 650 Internship in Financial Mathematics** (1-9 credit hours)
The internship experience provides the students the opportunity to use quantitative financial mathematics in a workplace under the supervision of a practitioner. Links academic theory to practice. Develop a heightened awareness of workplace issues as th

Must be a student registered in the Masters of Financial Mathematics program.
Typically offered in Fall, Spring, and Summer

**FIM 675 Project in Financial Mathematics** (1-3 credit hours)
The project provides the students the opportunity to apply quantitative financial mathematics to a problem of practical interest under the supervision of faculty and/or practitioners. Links academic theory to applications. Examine a practical problem fr

Must be a student registered in the Masters of Financial Mathematics program.
Typically offered in Fall, Spring, and Summer

**FIM 688 Non-Thesis Masters Continuous Registration - Half Time Registration** (1 credit hours)
Non-Thesis Masters Continuous Registration - Half Time Registration
Typically offered in Spring only

**FIM 689 Non-Thesis Masters Continuous Registration - Full Time Registration** (3 credit hours)
Non-Thesis Masters Continuous Registration - Full Time Registration
Typically offered in Fall and Spring

**FIM 693 Master's Supervised Research** (1-9 credit hours)
Master's Supervised Research
Typically offered in Fall, Spring, and Summer

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**Fisheries & Wildlife Sciences (FW)**

**FW 221 Conservation of Natural Resources** (3 credit hours)
This course examines the importance of natural resources and their role in the progress of human civilization. Physical, biological and ecological principles are described that underlie sustainability of natural resources, particularly as these relate to the consequence of human impacts as resources are used to meet societal needs. The course emphasizes renewable natural resources, the importance of habitat, and a broadly-international context. The course has an optimistic perspective that life on Earth can and will be better in the future if we learn and practice good resource management today.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

**FW 293 Independent Study in Fisheries, Wildlife, and Conservation Biology** (1-6 credit hours)
Independent Study for Fisheries, Wildlife, and Conservation Biology students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

**FW 294 Independent Study in Fisheries, Wildlife, and Conservation Biology** (1-6 credit hours)
Independent Study for Fisheries, Wildlife, and Conservation Biology students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer
FW 311  Piedmont Wildlife Ecology and Management  (3 credit hours)
This 3-week course will involve relationships of wildlife and habitat, the use of GIS and GPS, use of new technology (PIT tags, radio telemetry), and field identification of habitats and animals. This course is taught off-campus at Hill Forest. It is a 3 week residential camps with side trips and overnight trips. Class meets all day for 3 weeks. Additional charge for room and board. Students must provide their own transportation to Hill Forest. Junior standing in one of the following: FOM, NRE, SFW, SFF, SZO, ESC.

Typically offered in Summer only

FW 312  Fisheries Techniques and Management  (1 credit hours)
Field exercises in aquatic environments emphasizing assessment of habitat, fish, invertebrates, plants, and ecological relationships to form the basis of describing and solving management dilemmas. Taught off-campus at Hill Forest. 5 day residential camp. Local travel required to various aquatic ecosystems. Additional charges for room and board.

Corequisite: FW 311 and FW 313
Typically offered in Summer only

FW 313  Mountain Wildlife Ecology and Management  (1 credit hours)
Visit different mountain communities along an elevation gradient from 2,000 to 6,000 feet and observe changes in plant and animal communities. Discuss wildlife and fisheries management issues, interact with agency personnel responsible for managing mountain fisheries and wildlife. One-week field trip to the North Carolina mountains. Additional charges for room and board.

Corequisite: FW 311 and FW 312
Typically offered in Summer only

FW 314  Coastal Ecology and Management  (1 credit hours)
Hands-on study of the fishery and wildlife resources associated with North Carolina coastal plain habitats. These habitats will include estuarine, ocean, longleaf pine savanna, pocosin, and Carolina bays. Common techniques and concepts used in terrestrial, marine, and estuarine ecology and management will be taught. Field identification of habitats, animals, and plants. Use of multiple sampling gear including bottom trawl, beam trawl, beach seine, gill nets, and coverboards. Use of water quality measurement equipment. This course meets all day for 1 week off-campus at CMAST in Morehead City, NC. Additional charge for room and board and boat rental. Students must provide their own transportation to CMAST.

Prerequisite: BIO 181
Typically offered in Summer only

FW 333  Conservation Biology in Practice  (3 credit hours)
An introductory course designed to focus on the scientific fundamentals of conservation biology, including population dynamics, extinction and its causes, metapopulations, modeling, population viability analysis, the design and management of protected areas, rare species management, and captive breeding and release programs. Students will participate in active learning exercises, projects, and debates. Projects will require students to make their own arrangements for transportation to field locations within Wake County.

Prerequisite: FW 221 or PB 360 or BIO 360 or FOR 260
Typically offered in Fall only

FW 353  Wildlife Management  (3 credit hours)
Historical development of Wildlife Management from anecdotal, observational practices to modern, scientific approaches used around the world. Principles of population analysis, management, protection and conservation of animals, particularly those of conservation, aesthetic, sport or food values in urban, rural and wilderness areas. Ethics of hunting and trapping. Contradictory objectives challenging modern wildlife managers.

R: Sophomore Standing
Typically offered in Fall only

FW 373  Vertebrate Natural History  (3 credit hours)
This course provides an introduction to the natural history of vertebrates, including fish, amphibians, reptiles, birds, and mammals. The emphasis is on systematics, identification, and natural history of each vertebrate group.

Prerequisite: BIO 360 or PB 360
Typically offered in Spring only

FW 403  Urban Wildlife Management  (3 credit hours)
Issues facing wildlife in urbanizing landscapes and the general courses of action to minimize the negative effects of urbanization on native wildlife. Large-scale planning and zoning for roads, developments and open space; meso-scale planning and landscaping of new neighborhoods and other developments; and small-scale landscaping for backyard habitats. Coexistence between wildlife and humans in urban environments and management of wildlife damage to human property.

Prerequisite: Junior standing.
GEP Natural Sciences
Typically offered in Fall only

FW 404  Wildlife Habitat Management  (3 credit hours)
Relationships between forest and wildlife management and the effects of silvicultural systems on wildlife. Species-habitat requirements, forest wildlife management techniques, and forest-wildlife policies and economics.

Prerequisite: Junior standing
Typically offered in Fall only

FW 405  Tropical Wildlife Ecology  (3 credit hours)
This course provides an overview of tropical wildlife ecology and management, sustainable land use, and local culture. The course addresses the challenges of natural resource conservation in a developing country and the sustainable approaches that may be used to conserve natural resources there. Various methods to sample wildlife will be employed during the visit to a tropical country (Ecuador, Nicaragua, etc.), but emphasis will be on the use of mist nets in long-term bird monitoring program. Expenses associated with this course are the responsibility of the student. Requires instructor approval. Students register for this course through the Study Abroad Office.

Typically offered in Spring only
FW 411/FW 511 Human Dimensions of Wildlife and Fisheries (3 credit hours)
Study of human interactions with wildlife and fisheries, including principles important for understanding and addressing wildlife management and conservation challenges. Discussions of wildlife at the urban fringe, human attitudes towards hunting and fishing, and the public trust approach to wildlife management are included.

Juniors and Seniors Only
Typically offered in Fall only

FW 415 Professional Development in Fisheries, Wildlife, and Conservation Biology (1 credit hours)
This course provides guidance for students in the fall semester of their senior year in preparation for graduate school or a career in the field of Fisheries, Wildlife, and Conservation Biology. Junior or Senior standing.

Typically offered in Fall only

FW 444/FW 544 Mammalogy (3 credit hours)
The biology of mammals: evolution, functional morphology, reproduction, behavior, ecology, population biology, classification and identification. One weekend field trip planned. One independent field research project is required. Graduate students will prepare a full written report of their research projects, which will not be required of the undergraduates.

Prerequisite: PB 360 or BIO 360 or FOR 260
Typically offered in Fall only

FW 445 Human Dimensions of Conservation Biology in the Bahamas (3 credit hours)
This course examines the fundamental concepts, problems, and methods regarding human dimensions of conservation biology in The Bahamas. Combining lecture, lab, and fieldwork, students directly experience the process of science, with students conducting semester-long, group research projects tackling important unanswered questions involving conservation biology in The Bahamas. Gaining first-hand experience at the interface of basic and applied sciences, students will spend eight weeks on campus and two weeks in the largely undeveloped Andros Island in The Bahamas, home to the third largest coral reef in the world and over 1.5 million acres of national parks.

Prerequisite: One 200-level or higher course in BIO, ES, ET, FOR, FW, NR, PB, PRT, or ZO.
Typically offered in Summer only

FW 453 Principles of Wildlife Science (4 credit hours)
Principles and applications of population dynamics and biology to the management of terrestrial vertebrates. Predicting population levels, composition and growth rates with and without management constraints. Strategies for wildlife conservation, utilization, and enhancement. Laboratories stress the collection and analysis of data, and often meet in outdoor environments.

Prerequisite: FW 353 and ST 311
Typically offered in Spring only

FW 460/FW 560 International Wildlife Management and Conservation (3 credit hours)
An international perspective on wildlife management and conservation through investigation and comparison of historical events, policies, international conservation organizations and transboundary conservation areas. Fundamental principles necessary in managing the African savannah ecosystem, protected areas and game ranches. Identifying global biomes, zoogeography and the impacts of ecotourism. Cannot receive credit for both FW 460/560.

Prerequisite: Junior standing and above.
Typically offered in Spring only

FW 465/FW 565 African Ecology and Conservation (4 credit hours)
This course provides an international perspective on desert ecology, the African savanna ecosystem, African wildlife ecology and management. In addition, the management of a large national park of international importance, conservation of predators and their conflict with humans, and international tourism are discussed. Various sampling techniques are practiced during field work. A combination of lectures, field lectures, field work, field excursions, data analyses and home work form an integral part of the course.

Prerequisite: One 200-level or higher course in ES, ET, FOR, FW, NR, PB, PRT, or ZO
GEP Global Knowledge, GEP Natural Sciences
Typically offered in Summer only

FW 466 External Learning Experience (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall and Spring

FW 493 Independent Study in Fisheries, Wildlife, and Conservation Biology (1-6 credit hours)
Independent Study for Fisheries, Wildlife, and Conservation Biology students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

FW 494 Independent Study in Fisheries, Wildlife, and Conservation Biology (1-6 credit hours)
Independent Study for Fisheries, Wildlife, and Conservation Biology students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer
FW 495 Special Topics in Fisheries and Wildlife Science (1-3 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

FW 511/FW 411 Human Dimensions of Wildlife and Fisheries (3 credit hours)
Study of human interactions with wildlife and fisheries, including principles important for understanding and addressing wildlife management and conservation challenges. Discussions of wildlife at the urban fringe, human attitudes towards hunting and fishing, and the public trust approach to wildlife management are included.

Juniors and Seniors Only
Typically offered in Fall only

FW 515/AEC 515 Fish Physiology (3 credit hours)
The biology of fishes: physiology, anatomy, endocrinology, behavior and genetics. Designed especially for graduate students in fisheries. Several trips to research laboratories taken.

Typically offered in Fall only

FW 544/FW 444 Mammalogy (3 credit hours)
The biology of mammals: evolution, functional morphology, reproduction, behavior, ecology, population biology, classification and identification. One weekend field trip planned. One independent field research project is required. Graduate students will prepare a full written report of their research projects, which will not be required of the undergraduates.

Prerequisite: PB 360 or BIO 360 or FOR 260
Typically offered in Fall only

FW 553/ZO 553 Principles Of Wildlife Science (3 credit hours)
The principles of wildlife management and their application studied in the laboratory and in the field.

Prerequisite: BIO 260 or BIO/PB 360
Typically offered in Spring only

FW 560/FW 460 International Wildlife Management and Conservation (3 credit hours)
An international perspective on wildlife management and conservation through investigation and comparison of historical events, policies, international conservation organizations and transfrontier conservation areas. Fundamental principles necessary in managing the African savannah ecosystem, protected areas and game ranches. Identifying global biomes, zoogeography and the impacts of ecotourism. Cannot receive credit for both FW 460/560.

Prerequisite: Junior standing and above.
Typically offered in Spring only

FW 565/FW 465 African Ecology and Conservation (4 credit hours)
This course provides an international perspective on desert ecology, the African savanna ecosystem, African wildlife ecology and management. In addition, the management of a large national park of international importance, conservation of predators and their conflict with humans, and international tourism are discussed. Various sampling techniques are practiced during field work. A combination of lectures, field lectures, field work, field excursions, data analyses and home work form an integral part of the course.

Prerequisite: One 200-level or higher course in ES, ET FOR, FW, NR, PB, PRT, or ZO
GEP Global Knowledge, GEP Natural Sciences
Typically offered in Summer only

FW 586/AEC 586 Aquaculture (3 credit hours)
Biological and general principles of aquaculture. Emphasis on the present status of aquaculture, species involved, techniques employed, and problems encountered. Discussion of recent advances in research and development and identification of areas of future research and development.

Prerequisite: BO 360 or ZO 260 or Graduate standing or Senior standing
Typically offered in Spring only

FW 587/AEC 587 Aquaculture Laboratory (1 credit hours)
Methods and techniques of cultivating aquatic organisms. Field trips and reports on local hatcheries and facilities required. (Three to four overnight field trips taken on week days to coastal areas, state hatcheries, and private hatcheries; students responsible for shared room costs and their meals. Four field trips also taken on laboratory day within driving range of Raleigh.)

Prerequisite: BO 360 or ZO 260 or Graduate standing or Senior standing.
Corequisite: ZO 586
Typically offered in Fall only

FW 595 Special Topics in Fisheries and Wildlife Sciences (1-6 credit hours)
Special topics in various aspects fisheries and wildlife sciences are developed under the direction of a graduate faculty member. Also used to test and develop new courses.

Typically offered in Fall, Spring, and Summer

FW 602 Seminar In Wildlife Management (1 credit hours)
Current topics and issues in wildlife biology and management. Students select and research topics, give seminars and lead group discussions.

Typically offered in Fall only

FW 610 Special Topics in Fisheries and Wildlife Sciences (1-6 credit hours)
Special topics in various aspects fisheries and wildlife science are developed under the direction of a graduate faculty member. Also used to develop new courses.

Typically offered in Fall, Spring, and Summer

FW 685 Master’s Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer
FW 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

FW 695 Master's Thesis Research (1-9 credit hours)
Thesis research.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

FW 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master's student
Typically offered in Summer only

FW 720 Epidemiology of Wildlife Diseases (3 credit hours)
Concepts related to infectious disease outbreaks in free-ranging species of wildlife. Numerous examples of wildlife diseases will be used to illustrate factors affecting host-agent-environment interactions in fish, amphibians, birds, and both aquatic and terrestrial mammals. Enrollment in the Fisheries and Wildlife graduate program or Masters of Veterinary Public Health program; clinical residents or veterinary students at the College of Veterinary Medicine.

FW 726/AEC 726 Quantitative Fisheries Management (3 credit hours)
Current methods for assessment and management of exploited fish populations, including sampling methods, data analysis and modeling. A required research paper or project.
Typically offered in Fall only

FW 730 Ethics in Fisheries and Wildlife Sciences (2 credit hours)
Students will explore historical and current thinking concerning the search for truth about natural systems, and the complex ethics scientists and practitioners who operate in the public sector must consider. Standards of professional and ethical behavior specific to Fisheries and Wildlife Sciences will be addressed. Faculty will introduce topics and guide discussions; students will give seminars and lead some discussions. For doctoral students in Fisheries and Wildlife Sciences.
Typically offered in Fall only

FW 801 Issues in Fisheries and Wildlife Sciences Doctoral Seminar (2 credit hours)
Current topics and issues in Fisheries and Wildlife Sciences Research. Students select and research topics, give seminars on Ph.D. proposals, and lead group discussions. For doctoral students in Fisheries and Wildlife Sciences.
Typically offered in Spring only

FW 802 Seminar in Fisheries and Wildlife (1 credit hours)
Current topics and issues in fisheries and wildlife biology and management. Students select and research topics, give seminars, and lead group discussions. For doctoral students in Fisheries and Wildlife Sciences.
Typically offered in Fall only

FW 810 Special Topics in Fisheries and Wildlife (1-6 credit hours)
Individual students or groups of students, under direction of a faculty member, will explore topics of special interest not covered by existing courses. Format may consist of readings and independent study, problems or research not related to dissertation. Also used to develop and test new 800-level courses. For doctoral students in Fisheries and Wildlife Sciences.
Typically offered in Spring and Summer

FW 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment. For doctoral students in Fisheries and Wildlife Sciences.
Typically offered in Fall and Spring

FW 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty. For doctoral students in Fisheries and Wildlife Sciences.
Typically offered in Fall, Spring, and Summer

FW 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research. For doctoral students in Fisheries and Wildlife Sciences.
Typically offered in Fall, Spring, and Summer

FW 896 Summer Doctoral Dissertation Research (1 credit hours)
Summer Dissertation Research. For doctoral students in Fisheries and Wildlife Sciences.
Typically offered in Summer only

Food Science (FS)

FS 201 Introduction to Food Science (3 credit hours)
Food science is an exciting, multidisciplinary career that draws on chemistry, microbiology, and engineering principles to produce, preserve, and protect the foods that we eat every day. This course is designed to help you understand the journey of foods from "farm to fork", the effect of diet on human health, and the laws governing food labeling and marketing. It's science you can eat!

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

FS 231 Principles of Food and Bioprocess Engineering (4 credit hours)
Engineering concepts and their applications to the food and bioprocessing industries. Mass and energy balances and principles related to fluid flow, heat transfer, refrigeration and freezing, psychrometrics, and selected unit operations found in these industries.
Prerequisite: PY 211 or PY 205 and PY 206
Typically offered in Spring only
FS 250 Basics of Food Safety & Quality  (3 credit hours)
This course examines the programs that maintain food safety and quality
in food processing environments. It is based on international standards
for food safety prerequisite programs in food manufacturing. Students will
learn how to evaluate and manage pre-requisite programs for food safety.
Examples include Good Manufacturing Practices (GMPs), Sanitation
Standard Operating Procedures (SSOPs), Sanitation Control Procedures,
and Preventive Controls.

Typically offered in Fall and Summer

FS 290 Careers in Food and Bioprocessing Sciences  (1 credit
hours)
Careers and opportunities related to food and bioprocessing industries
and regulatory agencies. Development of professional enhancement
skills. Resume preparation, interviewing techniques, leadership
development, oral and written communication, and team building.
Benefits of undergraduate research, internships, and graduate education.

Typically offered in Fall only

FS 295 Special Topics in Food Science  (1-4 credit hours)
Offerings of new or experimental courses in Food Science at the early
undergraduate level.

Typically offered in Fall, Spring, and Summer

FS 301/NTR 301 Introduction to Human Nutrition  (3 credit hours)
Functions, dietary sources, digestion and absorption, deficiencies and
excesses of essential nutrients in humans; dietary guidelines; food labels;
the study of diet-disease relationships; the role of diet in heart disease,
diabetes, hypertension, osteoporosis; energy balance and weight control;
dietary supplement regulation; diet and athletic performance.
Prerequisite: Sophomore standing
GEP Natural Sciences

Typically offered in Fall, Spring, and Summer

FS 322/PO 322/ANS 322 Muscle Foods and Eggs  (3 credit hours)
Processing and preserving fresh poultry, red meats, seafood, and
eggs. Ante- and post-mortem events as they affect quality, yield, and
compositional characteristics of muscle foods. Principles and procedures
involved in the production of processed meat items.
Prerequisite: ZO 160, BIO 181 or BIO 183

Typically offered in Fall only

FS 324/ANS 324 Milk and Dairy Products  (3 credit hours)
Introduction to the manufacture of dairy products. Dairy processing
procedures from the farm, through the dairy plant, and to the consumer
are studied. The course consists of 15 learning modules, three exams,
and a project.
Prerequisite: BIO 181 or 183, CH 101

Typically offered in Fall only

FS 325/BBS 325 Introduction to Brewing Science and
Technology  (3 credit hours)
For centuries brewing has been and remains a vitally important
application of fermentation science, both economically and socially. This
course will provide a detailed description of the fundamental chemical
and biological processes involved in brewing beer, as well as the physical
and hygienic aspects of modern beer production. Successful completion
of this course will provide students with the understanding of the science
and technology underlying the key steps in a commercial brewing
process and provide the basic knowledge necessary for an entry level
position in a commercial brewery.
Prerequisite: CH 101 and BIO 183 or BIO 181

Typically offered in Spring only

FS 326/BBS 326 Brewing Practices and Analyses  (3 credit hours)
This course will provide a hands on learning experience to both
complement the classroom lectures offered in BBS/FS 325 and acquaint
the student with the equipment and practices encountered in real-world
analytical labs of breweries of all scales. The laboratory experience will
replicate the sequence of events encountered in actual beer production
and illustrate the relevant evaluations and analyses which are concurrent
with those processing steps, stressing at each stage not only the
execution of the appropriate analytical or testing techniques, but also
corrective action that may be taken should undesirable results be
obtained.
Prerequisite: BBS/FS 325 Introduction to Brewing Science and
Technology

Typically offered in Fall only

FS 330 Science of Food Preparation  (3 credit hours)
Basic elements of culinary practices are taught in conjunction with the
scientific basis for how flavor, texture, and appearance of foods are
created or maintained during food preparation.
Prerequisite: FS 201 and CH 101

Typically offered in Spring only

FS 352 Introduction to Microbiological Food Safety Hazards  (3
credit hours)
For non-science students. The course is designed to provide an
introduction to the more prominent microbial foodborne safety hazards
and their control. Lessons are provided on specific pathogens, their
pathogenesis and transmission and the scientific basis for specific control
options. In addition, the course provides up-to-date information on current
“hot-topics” in food microbiology, including food safety regulations and
emerging food safety issues. Course is offered to non-science majors.
Students may not receive credit for both FS 352 and FS 405.

Typically offered in Fall and Spring

FS 354 Food Sanitation  (3 credit hours)
Discussion of hygienic practices, requirements for sanitation programs,
and modern sanitation practices in food processing facilities. At the end
of this course, students will have the knowledge to develop and maintain
a sanitation program.
Prerequisite: FS/ANS/PO 350 or equivalent HACCP industry experience

Typically offered in Fall and Spring
FS 401/NTR 501/FS 501/NTR 401 Advanced Nutrition and Metabolism (3 credit hours)
Nutritional biochemistry and physiology as it relates to establishment of nutrient requirements and Dietary Reference Intakes. Digestion, absorption, metabolism, storage, and excretion of nutrients and other markers of nutritional adequacy or excess with emphasis on micronutrients. Functions of nutrients, in bone muscle, blood, growth and development and communication. Credit will not be awarded for both NTR (FS) 401 and NTR (FS) 501.
Prerequisite: (NTR 301 or NTR 415) and (CH 221 or CH 220 or CH 225) Typically offered in Fall only

FS 402/FS 502 Chemistry of Food and Bioprocessed Materials (4 credit hours)
The course focuses on the properties of biological molecules (e.g., proteins, enzymes, lipids, carbohydrates, and pigments) found in foods and pharmaceuticals. Basic elements of molecules, such as structure and reactive groups, are presented in regard to how they affect the properties of foods and pharmaceuticals. Reactions such as Maillard browning and lipid oxidation are discussed regarding mechanisms, products, and controlling processes. Laboratory experiments emphasize basic concepts discussed in lecture and provide a practical working knowledge of select analytical equipment.
Prerequisite: CH 220 or 221 or 225 Typically offered in Fall only

FS 403 Analytical Techniques in Food & Bioprocessing Science (4 credit hours)
Principles, methods and techniques for quantitative physical and chemical analyses of food, nutraceuticals, and pharmaceutical products. Results of analyses evaluated in terms of quality standards and governing regulations.
Prerequisite: FS 402 Typically offered in Spring only

FS 405/MB 405/FS 505/MB 505 Food Microbiology (3 credit hours)
Microorganisms of importance in foods and their metabolic activities. Source of microbial contamination during food production, processing and storage. Microbial spoilage; foods as vectors of human pathogens. Physical and chemical destruction of microorganisms in foods and the kinetics involved. Conversions of raw foods by microorganisms into food products. Microbiological standards for regulatory and trade purposes. Credit will not be given for both FS/MB 405 and FS/MB 505.
Prerequisite: MB 351 Typically offered in Spring only

FS 406/MB 406/FS 506/MB 506 Food Microbiology Lab (1 credit hour)
Laboratory experience to complement FS/MB 405. Skills in detecting and quantitating microorganisms and their toxins in foods. Application of colony and direct microscopic counts, most probable numbers, enzyme immunoassays, nucleic acid probes and computer modeling are used to understand the numbers and types of microorganisms or microbial end products in foods. Laboratory safety and oral and written reports are emphasized.
Prerequisite: MB 351 and Corequisite: FS 405 or FS 505 Typically offered in Spring only

FS 416/FS 516 Quality Control in Food and Bioprocessing (3 credit hours)
This course provides an overview of the principles of quality management, assurance and control in the food and bioprocessing industries. The objectives are for students to be able to identify government regulations, private industry standards, and customer expectations that are relevant to food and bioprocessing, apply root cause analysis methodologies, apply and evaluate control charts for monitoring process control for variables and attributes, conduct process capability analyses, apply statistical hypothesis testing, and design producer and/or customer-centered sampling plans. Lab activities alternate between guest speakers from industry and exercises in which students develop their abilities to apply computer programs to solve quality problems. Note: students may not earn credit for taking both FS 416 and FS 516.
Restriction: FS, Bioprocessing, PSC, ANS, and NT students. Others may enroll with permission from the instructor. Section 601 is restricted to true distance education students (not regular term students). Typically offered in Fall only

FS 421/FS 521 Food Preservation (3 credit hours)
Food preservation methods. Emphasis on thermal, freezing, drying and fermentation processes and corresponding physical, chemical and organoleptic changes to products. Application of preservation schemes to the development of an overall processing operation.
Prerequisite: FS 231 and FS 405 Typically offered in Fall only

FS 426/BEC 426/BBS 526/FS 526/BEC 526/BBS 426 Upstream Biomanufacturing Laboratory (2 credit hours)
This course is an introduction to current food manufacturing practice (CGMP) as applied to the growth of microbial cells in bioreactors. Hands-on experience is obtained in the operation and control of 30 liter bioreactors to study agitation, oxygen transfer, cleaning, sterilization, media preparation and the growth of recombinant E. coli for protein production. Credit will not be awarded in both BBS 426 and BBS/FS 526. This is an eight week course.
Prerequisite: (MB 351 and FS 231) CHE/BEC 463 Typically offered in Fall and Spring

FS 435/FS 535 Food Safety Management Systems (3 credit hours)
This course teaches students how to develop and implement food safety management systems. It begins with the Hazard Analysis and Critical Control Points (HACCP) system and then teaches the Hazard Analysis and Risk-Based Preventive Controls (HARPC) system.
Prerequisite: FS 250 Typically offered in Fall only

FS 453/FS 553 Food Laws and Regulations (3 credit hours)
Federal and state laws and regulations, and case law history affecting food production, processing, packaging, marketing, and distribution of food and food products. History of food law, enactment of laws and regulations, legal research, and regulatory agencies. Credit will not be given for both FS 453 and FS 553.
Prerequisite: Junior standing.
FS 462/HS 462/HS 562/FS 562  Postharvest Physiology  (3 credit hours)
Preharvest and postharvest factors that affect market quality of horticultural commodities with an emphasis on technologies to preserve postharvest quality and extend storage life of fruits, vegetables and ornamentals.

Prerequisite: PB 421
Typically offered in Spring only

FS 471 Professionalism & Project Preparation in Food & Bioprocessing Science  (1 credit hours)
Discipline-specific professional development: teamwork, problem-solving and communication skills. Resume and interview preparation. Experimental design, literature review, budgeting and planning in preparation for the FS 475 Problems and Design in Food and Bioprocessing Science capstone course.

P: FS 201 and FS 231 and Senior Standing in Food Science or Bioprocessing Science
Typically offered in Fall only

FS 475 Problems and Design in Food and Bioprocessing Science  (3 credit hours)
Team approach to problem solving and product/process design and development. Ingredient functionality, formulation, safety, processing, packaging, sensory evaluation, regulatory issues, hazard analysis, critical control points (HACCP), nutritional labeling and other pertinent scientific, technical, marketing and financial aspects. Oral and written presentations are required.

Prerequisite: FS 231, FS 402, FS 405 or BAE(BBS) 425
Typically offered in Spring only

FS 481 Research Experience in Food and Bioprocessing Sciences  (3 credit hours)
Students actively engage in a research initiative at the USDA-Agriculture Research Service Food Science Research Unit. Students become familiar with the settings of food science laboratories, conduct literature reviews, manage the basic scientific structure applied to problem solving, are introduced to experimental design and data processing and synthesis to solve complex problems, and understand the unpredictable nature of scientific research. At the end of the course, students will be able to structure an informative public presentation on the results of the study and present their findings to diverse audiences. As part of the learning process students will acquire and/or further develop selected laboratory techniques associated with basic microbiology and chemistry. Course limited to rising juniors and seniors in good standing. Sophomores would need instructor approval to join the course.

Restriction: Juniors and Seniors Only
Typically offered in Summer only

FS 492 External Learning Experience  (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes campus facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by the student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Summer only

FS 493 Special Problems in Food Science (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes campus facilities and resources. Contact and arrangements with prospective employers must be initiated by the student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall and Spring

FS 495 Special Topics in Food Science  (1-3 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

FS 501/NTR 401/FS 401/NTR 501 Advanced Nutrition and Metabolism  (3 credit hours)
Nutritional biochemistry and physiology as it relates to establishment of nutrient requirements and Dietary Reference Intakes. Digestion, absorption, metabolism, storage, and excretion of nutrients and other markers of nutritional adequacy or excess with emphasis on micronutrients. Functions of nutrients, in bone muscle, blood, growth and development and communication. Credit will not be awarded for both NTR (FS) 401 and NTR (FS) 501.

Prerequisite: (NTR 301 or NTR 415) and (CH 221 or CH 220 or CH 225)
Typically offered in Fall and Summer

FS 502/FS 402 Chemistry of Food and Bioprocessed Materials  (4 credit hours)
The course focuses on the properties of biological molecules (e.g., proteins, enzymes lipids, carbohydrates and pigments) found in foods and pharmaceuticals. Basic elements of molecules, such as structure and reactive groups, are presented in regard to how they affect the properties of foods and pharmaceuticals. Reactions such as Maillard browning and lipid oxidation are discussed regarding mechanisms, products and controlling processes. Laboratory experiments emphasize basic concepts discussed in lecture and provide a practical working knowledge of select analytical equipment.

Prerequisite: CH 220 or 221 or 225
Typically offered in Fall only

FS 505/MB 505/FS 405/MB 405 Food Microbiology  (3 credit hours)
Microorganisms of importance in foods and their metabolic activities. Source of microbial contamination during food production, processing and storage. Microbial spoilage; foods as vectors of human pathogens. Physical and chemical destruction of microorganisms in foods and the kinetics involved. Conversions of raw foods by microorganisms into food products. Microbiological standards for regulatory and trade purposes. Credit will not be given for both FS/MB 405 and FS/MB 505.

Prerequisite: MB 351
Typically offered in Spring only
FS 506/MB 506/FS 406/MB 406  Food Microbiology Lab  (1 credit hour)
Laboratory experience to complement FS/MB 405. Skills in detecting and quantitating microorganisms and their toxins in foods. Application of colony and direct microscopic counts, most probable numbers, enzyme immunoassays, nucleic acid probes and computer modeling are used to understand the numbers and types of microorganisms or microbial end products in foods. Laboratory safety and oral and written reports are emphasized.
Prerequisite: MB 351 and Corequisite: FS 405 or FS 505
Typically offered in Spring only

FS 516/FS 416  Quality Control in Food and Bioprocessing  (3 credit hours)
This course provides an overview of the principles of quality management, assurance and control in the food and bioprocessing industries. The objectives are for students to be able to identify government regulations, private industry standards, and customer expectations that are relevant to food and bioprocessing, apply root cause analysis methodologies, apply and evaluate control charts for monitoring process control for variables and attributes, conduct process capability analyses, apply statistical hypothesis testing, and design producer and/or customer-centered sampling plans. Lab activities alternate between guest speakers from industry and exercises in which students develop their abilities to apply computer programs to solve quality problems. Note: students may not earn credit for taking both FS 416 and FS 516.
Restriction: FS, Bioprocessing, PSC, ANS, and NT students. Others may enroll with permission from the instructor. Section 601 is restricted to true distance education students (not regular term students).
Typically offered in Fall only

FS 520/FSA 520  Pre-Harvest Food Safety  (3 credit hours)
Dairy, beef, swine, poultry, and seafood modules: production, government regulation of products, use of antimicrobials in production, and the emergence of resistant human pathogens. Field fruit and vegetable crops section: hazards in food including pesticide residues and philosophy and practice of organic farming and public’s perception of food and biotechnology.
Typically offered in Fall only

FS 521/FS 421  Food Preservation  (3 credit hours)
Food preservation methods. Emphasis on thermal, freezing, drying and fermentation processes and corresponding physical, chemical and organoleptic changes to products. Application of preservation schemes to the development of an overall processing operation.
Prerequisite: FS 231 and FS 405
Typically offered in Fall only

FS 522  Food Packaging  (3 credit hours)
This course deals with the history of packaging, types of packages, and packaging equipment, factors involved in choice of package, aseptic packaging, shelf-life studies, modified atmospheric packaging, active packaging, packaging for e-commerce, automatic identification and data capture, closures, seal integrity, tamper evidence, graphic design & printing, distribution, labeling, environmental issues, regulatory agencies and stipulations, new frontiers in packaging, and packaging resources. Restricted to students enrolled in (or degree received) in the Food Bioprocessing and Nutrition Sciences Program or a closely related program such as the Biological & Agricultural Engineering Program.
Typically offered in Spring only

FS 526/BEC 526/BBS 426/FS 426/BEC 426/BBS 526  Upstream Biomanufacturing Laboratory  (2 credit hours)
This course is an introduction to current food manufacturing practice (CGMP) as applied to the growth of microbial cells in bioreactors. Hands-on experience is obtained in the operation and control of 30 liter bioreactors to study agitation, oxygen transfer, cleaning, sterilization, media preparation and the growth of recombinant E. coli for protein production. Credit will not be awarded in both BBS 426 and BBS/FS 526. This is an eight week course.
Prerequisite: (MB 351 and FS 231) CHE/BEC 463
Typically offered in Fall and Spring

FS 530/FSA 530  Post-Harvest Food Safety  (3 credit hours)
Background on the current issues and developments associated with post-harvest food safety, including biological, chemical, and physical food safety hazards. Additionally, regulations governing food safety and consumer perceptions.
Prerequisite: MB 351/352
Typically offered in Fall only

FS 535/FS 435  Food Safety Management Systems  (3 credit hours)
This course teaches students how to develop and implement food safety management systems. It begins with the Hazard Analysis and Critical Control Points (HACCP) system and then teaches the Hazard Analysis and Risk-Based Preventive Controls (HARPC) system.
Prerequisite: FS 250
Typically offered in Fall only

FS 540/FSA 540  Food Safety and Public Health  (3 credit hours)
Issues and developments related to the relationship between food safety and public health, including emerging foodborne pathogens; virulence and pathogenicity; foodborne toxins; epidemiological techniques used in the investigation of foodborne disease; rapid detection methods; and quantitative microbial risk assessment in food safety.
Prerequisite: MB 351/352
Typically offered in Spring only

FS 550  Food Industry Study Tour  (2 credit hours)
The Food Industry Study Tour is designed to give students a behind the scenes look into the food processing industry. This week-long trip, will allow students to travel throughout North Carolina and the Southeast region, touring various meat, dairy, seafood, produce, cereal, snack food, beverage, and candy production facilities. The class trip will run 5-6 days during the week of Spring Break holiday. Enrollment is limited and subject to the permission of the instructor.
Typically offered in Spring only
FS 553/FS 453  Food Laws and Regulations  (3 credit hours)
Federal and state laws and regulations, and case law history affecting food production, processing, packaging, marketing, and distribution of food and food products. History of food law, enactment of laws and regulations, legal research, and regulatory agencies. Credit will not be given for both FS 453 and FS 553.
Prerequisite: Junior standing.

FS 554/NTR 554  Lactation, Milk, and Nutrition  (3 credit hours)
Nutritional properties of milk as a high-quality food with nutritional diversity. Principles of physiology, biochemistry and cell biology in the mammary gland. Procedures of milk production and milk collection for milk quality and nutrition. Human lactation vs. that of domestic animals. Impacts of biotechnology and food safety on dairy production. Credit will not be given for both ANS 454 and 554.
Prerequisite: ANS 230 or FS/NTR 400; BCH 451 or ZO 421
Typically offered in Spring only

FS 555/NTR 555  Exercise Nutrition  (3 credit hours)
Metabolism of macro- and micronutrients as affected by exercise and physical activity. Effects of dietary patterns, specific foods, dietary supplements and ergogenic aids on sports performance. Reading and discussion of current literature and individual or group projects.
Prerequisite: NTR 400/500
Typically offered in Spring only

FS 557/NTR 557  Nutraceuticals and Functional Foods  (3 credit hours)
This course evaluates the weight of evidence from peer-reviewed scientific literature relating food bioactives, whole foods, and diets to disease prevention, athletic performance, and cognitive development/enhancement. Data are viewed in the context of processing effects, global food and supplement regulations, as well as commercial marketing claims. Key concepts include dose-response, signal transduction, and the use of advanced technologies such as genomics, proteomics and metabolomics. Students will work in teams to develop and write a critical review manuscript suitable for publication.
Typically offered in Fall only

FS 562/FS 462/HS 462/HS 562  Postharvest Physiology  (3 credit hours)
Preharvest and postharvest factors that affect market quality of horticultural commodities with an emphasis on technologies to preserve postharvest quality and extend storage life of fruits, vegetables and ornamentals.
Prerequisite: PB 421
Typically offered in Spring only

FS 567  Sensory Analysis of Foods  (3 credit hours)
Techniques of sensory analysis and data interpretation, a crucial aspect of food science research and marketing both at the academic and industrial levels. Fundamental and applied aspects of sensory analysis of foods, including human senses, descriptive analysis, scaling, consumer testing and sensory-instrumental relationships.
Prerequisite: Statistics 511
Typically offered in Spring only

FS 580/FSA 580  Professional Development and Ethics in Food Safety  (1 credit hours)
Professional development and ethics related to food safety. Focus on communication to lay-audiences and the media; the ethical frontier between science/policy and science/profit. Planned student and faculty presentations as well as guest lectures.
Prerequisite: FSA 520 or FSA 530 or FS 540
Typically offered in Spring only

FS 591  Special Problems In Food Science  (1-6 credit hours)
Analysis of scientific, engineering and economic problems of current interest in foods. Problems designed to provide training and experience in research.
Prerequisite: Graduate standing or Senior standing
Typically offered in Fall, Spring, and Summer

FS 592  Special Research Projects in Food Science  (1-6 credit hours)
Typically offered in Spring only

FS 620  Special Problems In Food Science  (1-6 credit hours)
Analysis of scientific, engineering and economic problems of current interest in foods. Problems designed to provide training and experience in research.
Prerequisite: Graduate standing or Senior standing
Typically offered in Fall, Spring, and Summer

FS 623  Special Research Problems In Food Science  (1-6 credit hours)
Directed research in a specialized phase of food science designed to provide experience in research methodology and philosophy.
Typically offered in Spring only

FS 685  Master’s Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master’s student
Typically offered in Fall and Spring

FS 690  Master’s Examination  (1-9 credit hours)
For students in non thesis master’s programs who have completed all other requirements of the degree except preparing for and taking the final examination.
Prerequisite: Master’s student
Typically offered in Fall and Spring

FS 693  Master’s Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

FS 695  Master’s Thesis Research  (1-9 credit hours)
Thesis research.
Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer
FS 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master's student
Typically offered in Summer only

FS 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

FS 725/MB 725 Fermentation Microbiology (3 credit hours)
Fermentation bioprocessing and characteristics, function and ecology of responsible microorganisms. Fermentative activities, growth responses and culture interactions related to metabolism, physiology and genetics of lactic acid bacteria and selected yeasts and molds. Current developments in starter culture technology and genetics; application to food and industrial fermentations.
Prerequisite: BCH 451, MB 351
Typically offered in Spring only

FS 741 Thermal Processing of Foods (3 credit hours)
Fluid flow, heat transfer, food preservation, kinetics of chemical, microbiological, and enzymatic reactions, decimal reduction time, pasteurization, sterilization, cook value, process lethality, canning of foods, thermal process evaluation, quality considerations, optimization, shelf-life studies, thermal processing equipment, hot-fill, extended shelf-life products, heat exchanger design, pumps, sanitation, aseptic processing, minimal processing, NFPA bulletins, alternative processing technologies, regulatory issues, HACCP.
Prerequisite: FS 231
Typically offered in Spring only

FS 751 Food Ingredient Technology In Product Development (4 credit hours)
Chemistry and functional properties of major food ingredient materials. Legal and regulatory restrictions, as well as consumer biases, in existence with respect to selection of ingredients, package materials, processes and labeling statements. Necessary skills and techniques for efficiently and successfully conducting food product development projects in a competitive corporate setting.
Prerequisite: FS 402, FS 405, FS 421
Typically offered in Fall only

FS 765 Polymer and Colloidal Properties of Foods (3 credit hours)
Theoretical and practical elements of applying principles from polymer and colloidal chemistry to foods. Major focus on proteins and polysaccharides in sols, foams, emulsions and gels.
Prerequisite: (CH 221 or CH 225) and (CH 223 or CH 227) and FS 402
Typically offered in Spring only

FS 780 Seminar In Food Science (1 credit hours)
Preparation and presentation of scientific papers, progress reports and research and special topics of interest in foods.
Typically offered in Fall and Spring

FS 785/BAE 785 Food Rheology (3 credit hours)
Principles and methods for measuring rheological properties. Theories of elastic, viscous, viscoelastic and viscoplastic behavior and relationships to food texture and commodity damage during harvest, handling and processing. Influence of time, composition and processing.
Prerequisite: FS 231 or MAE 314
Typically offered in Fall only

FS 791 Special Problems in Food Science (1-6 credit hours)
Directed research in a specialized phase of food science designed to provide experience in research methodology and philosophy. Credits arranged.
Typically offered in Fall only

FS 792 Special Research Projects in Food Science (1-6 credit hours)
Credits arranged
Typically offered in Fall, Spring, and Summer

FS 820 Special Problems In Food Science (1-6 credit hours)
Analysis of scientific, engineering and economic problems of current interest in foods. Problems designed to provide training and experience in research.
Prerequisite: Graduate standing or Senior standing
Typically offered in Fall, Spring, and Summer

FS 823 Special Research Problems In Food Science (1-6 credit hours)
Directed research in a specialized phase of food science designed to provide experience in research methodology and philosophy.
Typically offered in Spring only

FS 825 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

FS 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

FS 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

FS 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer
**FS 896 Summer Dissertation Research**  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student

Typically offered in Summer only

**FS 899 Doctoral Dissertation Preparation**  (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student

Typically offered in Fall, Spring, and Summer

**Food Science (FSA)**

**FSA 520/FS 520 Pre-Harvest Food Safety**  (3 credit hours)
Dairy, beef, swine, poultry, and seafood modules: production, government regulation of products, use of antimicrobials in production, and the emergence of resistant human pathogens. Field fruit and vegetable crops section: hazards in food including pesticide residues and philosophy and practice of organic farming and public's perception of food and biotechnology.

Typically offered in Fall only

**FSA 530/FS 530 Post-Harvest Food Safety**  (3 credit hours)
Background on the current issues and developments associated with post-harvest food safety, including biological, chemical, and physical food safety hazards. Additionally, regulations governing food safety and consumer perceptions.

Prerequisite: MB 351/352

Typically offered in Fall only

**FSA 540/FS 540 Food Safety and Public Health**  (3 credit hours)
Issues and developments related to the relationship between food safety and public health, including emerging foodborne pathogens; virulence and pathogenicity; foodborne toxins; epidemiological techniques used in the investigation of foodborne disease; rapid detection methods; and quantitative microbial risk assessment in food safety.

Prerequisite: MB 351/352

Typically offered in Fall only

**FSA 580/FS 580 Professional Development and Ethics in Food Safety**  (1 credit hours)
Professional development and ethics related to food safety. Food safety communications to lay-audiences and the media; the ethical frontier between science/policy and science/profit. Planned student and faculty presentations as well as guest lectures.

Prerequisite: FSA 520 or FSA 530 or FS 540

Typically offered in Spring only

**Foreign Language - Chinese (FLC)**

**FLC 101 Elementary Chinese I**  (3 credit hours)

Corequisite: FLC 103

Typically offered in Fall only

**FLC 102 Elementary Chinese II**  (3 credit hours)
Continuation of basic skills. Emphasis on speaking and listening with some reading, writing and Chinese culture.

Corequisite: FLC 104

Typically offered in Spring only

**FLC 103 Elementary Chinese I Conversation**  (1 credit hours)
Supplements conversational practice and handwriting skills for FLC 101. Students will gain practice at using their speaking skills in a variety of basic social situations.

Corequisite: FLC 101

Typically offered in Fall only

**FLC 104 Elementary Chinese II Conversation**  (1 credit hours)
Supplements conversational practice and handwriting skills for FLC 102. Students are encouraged to use their speaking skills in a variety of typical social situations. Special attention is given to naturalness of speech.

Prerequisite: FLC 101 and FLC 103; Corequisite: FLC 102

Typically offered in Spring only

**FLC 201 Intermediate Chinese I**  (3 credit hours)
Continuation of basic skills. Greater emphasis on reading, writing and Chinese cultural traditions.

Prerequisite: FLC 102; Corequisite: FLC 203

Typically offered in Fall only

**FLC 202 Intermediate Chinese II**  (3 credit hours)
Continuation of basic skills. Focus on reading, writing, Chinese cultural traditions and patterns of behavior.

Corequisite: FLC 204

GEP Global Knowledge

Typically offered in Spring only

**FLC 203 Intermediate Chinese I Conversation**  (1 credit hours)
Supplements conversational practice and handwriting skills for FLC 201. Students are encouraged to use their speaking skills in a variety of situations. Special attention is given to naturalness of speech and intonation.

Prerequisite: FLC 102 and FLC 104; Corequisite: FLC 201

Typically offered in Fall only

**FLC 204 Intermediate Chinese II Conversation**  (1 credit hours)
Supplements conversational practice and handwriting skills for FLC 202. Students are encouraged to use their speaking skills in a variety of situations. Special attention is given to naturalness of speech and intonation.

Prerequisite: FLC 201 and FLC 203; Corequisite: FLC 202

Typically offered in Spring only
FLC 301 Intermediate Chinese III (3 credit hours)
Last of the foundation courses in Chinese. Continued practice in speaking and understanding Chinese with new emphasis on writing and on the reading of cultural and literary texts.

Prerequisite: FLC 302
Typically offered in Fall only

FLC 302 Intermediate Chinese IV (3 credit hours)
Continued practice in speaking and understanding Chinese with greater emphasis on reading and writing. Continued study of cultural and literary texts.

Prerequisite: FLC 301
Typically offered in Spring only

FLC 351 Modern Chinese Popular Culture (3 credit hours)
Introduction to basic aspects of cultural practices and production in Chinese society, including consumer culture, education, work life, family relationships, everyday religious practices, aesthetic traditions, national identity, and gender. Reading and analysis of representative works of modern Chinese visual and print culture including literature, film, advertising, digital media and consumer products with attention to cultural analysis as well as to historical and cultural background.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FLC 401 Advanced Chinese: Readings in Literature and Social Sciences (3 credit hours)
Continued training in the foundations of Chinese language, with emphasis on nuances of written Chinese. This course introduces advanced Chinese language students to modern literature and social science texts. Students read and analyze some of the finest works of 20th c. Chinese intellectuals, authors and social critics. The class explores a wide range of prose forms, styles, and subject matter. Emphasis will be placed on developing advanced-level proficiency in reading & writing, and on literary analysis & discussion of cultural & historical contexts.

Prerequisite: FLC 302
Typically offered in Fall only

FLC 402 Advanced Chinese: Readings in Literature and Science (3 credit hours)
Continued training in the foundations of Chinese language, with emphasis on nuances of written Chinese. This course introduces advanced Chinese language students to modern literature and science texts. Students read and analyze some of the finest works of 20th c. Chinese intellectuals, authors and proponents of scientific advancement as well as original scientific research in Chinese. The class explores a wide range of prose forms, styles, and subject matter. Emphasis will be placed on developing advanced-level proficiency in reading & writing, and on literary analysis & discussion of cultural & historical contexts.

Prerequisite: FLC 302
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

Foreign Language - English (FLE)

FLE 100 Introduction to Academic Writing (4 credit hours)
For non-native speakers of English. Intensive introduction to critical writing and reading in academic contexts. Exploration of writing processes and academic literacy skills: interpreting assignments; comprehending, analyzing, and evaluating college-level texts; inventing, drafting, and revising; seeking, providing, and responding to constructive feedback; collaborating effectively under varied learning models. Extensive writing practice and individualized coaching. Attention to grammar and conventions of standard written English. Intended as preparation for FLE 101. Only for non-native speakers of English. Requires C- or better. Credit for FLE 100 is not allowed if student has prior credit for FLE 101

Typically offered in Fall and Spring

FLE 101 Academic Writing and Research (4 credit hours)
For non-native speakers of English intensive instruction in academic writing and research. Basic principles of rhetoric and strategies for academic inquiry and argument. Instruction and practice in critical reading, including the generative and responsible use of print and electronic sources for academic research, adapted for non-native speakers. Exploration of literate practices across a range of academic domains, laying the foundation for further writing development in college. Continued attention to grammar and conventions of standard written English. Satisfies freshman English requirements. Successful completion of FLE 101 requires a C- or better. Credit for FLE 101 is not allowed if the student has already fulfilled the first-year writing requirement.

Typically offered in Fall, Spring, and Summer

FLE 201 Oral Communication in English for International Students (3 credit hours)
Oral communication in English; active and interactive speaking skills, listening comprehension and reading. Specific tasks in spoken English such as communicating information, making inquiries, requests and complaints. Individual and group work in the form of oral reports, role play, presentations, etc. Listening to lectures and note taking skills.

Typically offered in Fall and Spring

FLE 400 American English Pronunciation for International Students (3 credit hours)

Typically offered in Fall and Spring

FLE 401 Advanced Oral Communication in English for International Students (3 credit hours)
Oral communication in English; pronunciation skills, reading, aural comprehension and oral skills; communication strategies and cross-cultural communication; individual and group activities such as presenting information, teaching a class, fielding questions and leading a discussion.

Typically offered in Fall and Spring
FLE 402  Advanced Written Communication in English for International Students  (3 credit hours)
Written communication skills for graduate students; integrated writing tasks focusing on writing, reading, grammar and comprehension, specifically geared to the needs of research students and teaching assistants. Reading, critical analysis and synthesis of written material such as journal articles, research reports, etc.

Typically offered in Fall and Spring

Foreign Language - French (FLF)

FLF 101  Elementary French I  (3 credit hours)
First in a four-course sequence to develop language skills. Oral and written practice in classroom and language laboratory. Readings in French culture and civilization.

Typically offered in Fall, Spring, and Summer

FLF 102  Elementary French II  (3 credit hours)
Continuation of FLF 101 with intensive practice in spoken French. Readings in French culture and civilization.

Prerequisite: FLF 101
Typically offered in Fall, Spring, and Summer

FLF 110  Accelerated Elementary French  (3 credit hours)
Content of FLF 101 and 102, at an accelerated pace, for students with previous study of French (1-2 years in high school) who placed into the course based on results of the NC State French Placement Test. Includes a refresher of 101 material before covering 102 material. Development of skills in listening, speaking, reading, writing and understanding Francophone cultures. Significant amount of work outside of class. Fulfills the FL 102 requirement.

Prerequisite: Placement into this course determined by The Department of Foreign Languages and Literatures Placement Test: http://sasw.chass.ncsu.edu/fl/place.htm
Typically offered in Fall and Spring

FLF 201  Intermediate French I  (3 credit hours)
Third of four consecutive courses to develop skills of speaking, listening, reading and writing. Readings and discussions of French culture, civilization and literature.

Prerequisite: FLF 102 or FLF 110
Typically offered in Fall, Spring, and Summer

FLF 202  Intermediate French II  (3 credit hours)
Last of four sequential language courses. Increased emphasis on reading and writing. Readings in the literature, culture, and civilization of France and the Francophone world.

Prerequisite: FLF 201 or FLF 212

FLF 203  French Phonetics and Pronunciation  (3 credit hours)
A study of the oral production of standard French with the aim of improving pronunciation, fluency and skill in communication. Extensive oral practice through conversation and phonetics.

Prerequisite: FLF 202
Typically offered in Fall and Spring

FLF 204  Advanced Conversation: Contemporary French Cultures  (3 credit hours)
Conversation and reading emphasizing idiomatic and practical usage with attention to contemporary civilization and cultures of the French speaking world. Emphasis on social structures, political features, events, world views and modes of communication.

Prerequisite: FLF 202
Typically offered in Fall only

FLF 205  Business French  (3 credit hours)
Business French vocabulary and concepts with emphasis on cultural differences and their importance in the new global village business world.

Prerequisite: FLF 202
Typically offered in Fall only

FLF 206  French Business Communication  (3 credit hours)
Study of major forms of written and oral business communication used in the French-speaking world. Extensive work with current, culturally authentic materials. Emphasis on development of practical communicative skills, with special attention to cross-cultural comparisons of French and American business practices and modes of communication.

Prerequisite: FLF 202
Typically offered in Fall only

FLF 207  Business French  (3 credit hours)
Business French vocabulary and concepts with emphasis on cultural differences and their importance in the new global village business world.

Prerequisite: FLF 202
Typically offered in Fall only

FLF 208  Advanced Conversation: Contemporary French Cultures  (3 credit hours)
Conversation and reading emphasizing idiomatic and practical usage with attention to contemporary civilization and cultures of the French speaking world. Emphasis on social structures, political features, events, world views and modes of communication.

Prerequisite: FLF 202
Typically offered in Fall only

FLF 209  French Phonetics and Pronunciation  (3 credit hours)
A study of the oral production of standard French with the aim of improving pronunciation, fluency and skill in communication. Extensive oral practice through conversation and phonetics.

Prerequisite: FLF 202
Typically offered in Fall and Spring

FLF 210  Intermediate French II  (3 credit hours)
Last of four sequential language courses. Increased emphasis on reading and writing. Readings in the literature, culture, and civilization of France and the Francophone world.

Prerequisite: FLF 201 or FLF 212

FLF 211  Advanced Conversation: Contemporary French Cultures  (3 credit hours)
Conversation and reading emphasizing idiomatic and practical usage with attention to contemporary civilization and cultures of the French speaking world. Emphasis on social structures, political features, events, world views and modes of communication.

Prerequisite: FLF 202
Typically offered in Fall only

FLF 212  French: Language, Culture, and Technology  (3 credit hours)
A study of the language structures and vocabulary necessary for an intermediate level of communication in French together with cultural and technological issues of our global society, in the context of the French-speaking world and the European Union. Students are responsible for providing their own transportation for required field trip. Fulfills the FLF 201 requirement.

Prerequisite: FLF 102 or FLF 110
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall only

FLF 301  Survey of French Literature from the Middle Ages through the Enlightenment  (3 credit hours)
Reading and discussion of representative works with attention to literary analysis as well as to historical and cultural background.

Prerequisite: An advanced language skills course (FLF 308 or FLF 310 or FLF 315) or FLF 202 with permission of instructor.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FLF 302  Survey of French Literature from Romanticism to the Contemporary Period  (3 credit hours)
Reading and discussion of representative works with attention to literary analysis as well as to historical and cultural background.

Prerequisite: An advanced language skills course (FLF 308, 310, 315) or FLF 202 with consent of instructor.
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLF 303  Business French  (3 credit hours)
Business French vocabulary and concepts with emphasis on cultural differences and their importance in the new global village business world.

Prerequisite: FLF 202
Typically offered in Fall only

FLF 304  Business French  (3 credit hours)
Business French vocabulary and concepts with emphasis on cultural differences and their importance in the new global village business world.

Prerequisite: FLF 202
Typically offered in Fall only
FLF 310 Advanced Written Communication (3 credit hours)
An in-depth study of French written communication at the advanced level, including the more advanced aspects of the French grammar with extensive writing practice serving a variety of practical communicative needs.
Prerequisite: FLF 202
Typically offered in Fall only

FLF 315 French Civilization and Culture (3 credit hours)
French civilization and culture from its origins to the modern period. Reading and discussion of the social, cultural, economic and political structures of France, including its geography, history, music, art and national consciousness.
Prerequisite: FLF 202

FLF 318 The Heritage of French Cinema (3 credit hours)
Survey of the major contributions of French cinema from its origins to the present. Attention to film as an artistic medium and to the cinematic representation of French history and culture. Reading, discussion, and viewing of films including Un Chien Andalou, La Passion de Jeanne d'Arc, Le Retour de Martin Guerre, La Marseillaise, Les 400 Coups, and Diva.
Prerequisite: 3 hrs. in French at 300 level

FLF 321 French Cultures and Contexts (3 credit hours)
An approach to important periods in the history of French culture through the reading of texts by several important writers. Films, slides, painting, music, and the Internet will be included to put the readings in a cultural context.
Prerequisites: FLF 308 and FLF 310
Typically offered in Fall and Spring

FLF 322 French Graduate Reading (3 credit hours)
Basic French grammar, with special attention to characteristics of formal expository style, and illustrative readings. Study of extracts from scholarly publications in students' areas of research. Prepares students to take the graduate foreign language certification exam.
Typically offered in Fall only

FLF 411 Approaches to French Translation (3 credit hours)
Intensive practice of translating to and from French a variety of texts selected from the areas of business, law, technology and science, as well as literature and the arts. Focus on Documentation, Research and Translation techniques and ethics.
Prerequisite: at least two French (FLF) 300 level courses

FLF 425/FLF 525 Literature, Cinema and Culture of the Francophone World (3 credit hours)
A study of a number of literary texts and films from across the spectrum of the Francophone world - West Africa, the Maghreb, and the Caribbean. Through these texts and films we will study the diversity of the French colonial empire as well as the different historical, political and cultural effects of colonialism and postcolonialism. Films, videos, internet sites will be used. Course taught in French.
Prerequisite: Junior Standing and one course in French literature.
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLF 492 Seminar in French Studies (3 credit hours)
A small-group study of a topic in literature resulting in either a substantial essay or series of essays by each student. Topics vary each semester.
Prerequisite: Junior standing and 6 hrs in French literature
Typically offered in Fall only

FLF 502 Variety in Language: French (3 credit hours)
Prerequisite: Graduate standing
Typically offered in Fall only

FLF 511 Approaches to French Translation (3 credit hours)
Intensive practice of translating to and from French a variety of texts selected from the areas of business, law, technology and science, as well as literature and the arts. Focus on Documentation, Research and Translation techniques and ethics. Course taught in French. Credit not allowed for both 411 & 511.
Prerequisite: Graduate standing
Typically offered in Fall only

FLF 516 Art and Society in France (3 credit hours)
An overview of the visual arts in France, defined broadly, and their relationship to French society and culture: painting, architecture, photography, cinema, book production, gardens, fashion, cuisine, television, popular culture, and mass media will be studied. Course taught in French.
Typically offered in Fall only

FLF 521 French Cultures and Contexts (3 credit hours)
Study of important periods in the history of French culture through the reading of key literary texts. Films, slides, painting, music, and the Internet will be included to put the readings in a cultural context. Topics vary. Students cannot get credit for both 421/521.
Prerequisite: Graduate status required for FLF 521
Typically offered in Fall only
FLF 525/FLF 425  Literature, Cinema and Culture of the Francophone World  (3 credit hours)
A study of a number of literary texts and films from across the spectrum of the Francophone world - West Africa, the Maghreb, and the Caribbean. Through these texts and films we will study the diversity of the French colonial empire as well as the different historical, political and cultural effects of colonialism and postcolonialism. Films, videos, internet sites will be used. Course taught in French.
Prerequisite: Junior Standing and one course in French literature.
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLF 592  Seminar in French Studies  (3 credit hours)
Seminar on literary, linguistic, or cultural topic in French studies. Research paper and oral presentation required. Conducted entirely in French. Rotating topics. Credit allowed for both 492 and 592 if topics are distinct.
Prerequisite: At least one 400-level French class or Graduate standing
Typically offered in Spring only

FLG 101  Elementary German I  (3 credit hours)
The first in a four-course sequence to develop the language skills of listening, speaking, reading, and writing. Emphasis on the acquisition of everyday German and cultural awareness. Active class participation, practice in the language lab and computer lab, and written assignments.
Typically offered in Fall, Spring, and Summer

FLG 201  Intermediate German I  (3 credit hours)
The third of four consecutive courses in German. Intensive conversational practice to develop proficiency in speaking and listening, advanced reading and writing skills by learning complex grammatical structures and through the use of authentic texts. Acquisition of cultural knowledge about the German-speaking countries.
Prerequisite: FLG 101
Typically offered in Fall, Spring, and Summer

FLG 202  Intermediate German II  (3 credit hours)
Last of four consecutive courses in German. Continued conversational practice to develop proficiency in speaking and listening. Development of advanced writing skills by refining grammatical structures and style through assignments, and of advanced reading skills through the use of cultural and literary texts from the German-speaking countries.
Prerequisite: FLG 201
GEP Global Knowledge
Typically offered in Fall, Spring, and Summer

FLG 212  German Language, Culture, Science, and Technology  (3 credit hours)
Discussion of German, Austrian and Swiss scientific discoveries and technological inventions as well as their impact on global society, such as aspirin, x-rays, printing technology, diesel engine, computer, microchip, television, mp3 format, genetics, and environmental technologies. Also a fourth semester German course with intensive practice to develop proficiency in intermediate speaking and listening, reading and writing, using materials from scientific and technological disciplines.
Prerequisite: FLG 201
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Spring only

FLG 301  Advanced German  (3 credit hours)
Review and consolidation of aspects of German grammar and development of writing skills. Listening and speaking practice through group activities and oral reports. Class discussions on topics from the cultures of Germany, Austria, and Switzerland, such as film, history, and the fine arts. FLG 301 and 302 can be taken in random order.
Prerequisite: FLG 202 or FLG 212 or a score of 688 on the NC State placement test.
Typically offered in Fall and Summer

FLG 302  German Oral and Written Expression  (3 credit hours)
Review and practice of spoken and written German using authentic texts and materials from contemporary Germany (short stories, films, and online media). Review of German grammar through conversation, writing, and vocabulary building exercises. Oral reports by students. FLG 301 and 302 can be taken in random order.
Prerequisite: FLG 202 or FLG 212 or a score of 688 on the NC State placement test.
Typically offered in Spring and Summer

FLG 630  Independent Study in French  (1-3 credit hours)
Individualized study in French language or literature at the graduate level. Topic and mode of study to be determined in consultation with the faculty member supervising work.
Typically offered in Spring only

FLG 675  Special Project in French  (1-3 credit hours)
Individual project in French language or literature at the graduate level. Topic and mode of study to be determined in consultation with student’s project advisory committee within the parameters of specific options.
Prerequisite: Student must be in final semester of his or her program.
Typically offered in Fall and Spring

FLG 688  Non-Thesis Masters Continuous Registration - Half Time Registration  (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.
Prerequisite: Master’s student
Typically offered in Fall only

Foreign Language - German (FLG)

FLG 101  Elementary German I  (3 credit hours)
The first in a four-course sequence to develop the language skills of listening, speaking, reading, and writing. Emphasis on the acquisition of everyday German and cultural awareness. Active class participation, practice in the language lab and computer lab, and written assignments.
Typically offered in Fall, Spring, and Summer

FLG 201  Intermediate German I  (3 credit hours)
The third of four consecutive courses in German. Intensive conversational practice to develop proficiency in speaking and listening, advanced reading and writing skills by learning complex grammatical structures and through the use of authentic texts. Acquisition of cultural knowledge about the German-speaking countries.
Prerequisite: FLG 101
Typically offered in Fall, Spring, and Summer

FLG 202  Intermediate German II  (3 credit hours)
Last of four consecutive courses in German. Continued conversational practice to develop proficiency in speaking and listening. Development of advanced writing skills by refining grammatical structures and style through assignments, and of advanced reading skills through the use of cultural and literary texts from the German-speaking countries.
Prerequisite: FLG 201
GEP Global Knowledge
Typically offered in Fall, Spring, and Summer

FLG 212  German Language, Culture, Science, and Technology  (3 credit hours)
Discussion of German, Austrian and Swiss scientific discoveries and technological inventions as well as their impact on global society, such as aspirin, x-rays, printing technology, diesel engine, computer, microchip, television, mp3 format, genetics, and environmental technologies. Also a fourth semester German course with intensive practice to develop proficiency in intermediate speaking and listening, reading and writing, using materials from scientific and technological disciplines.
Prerequisite: FLG 201
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Spring only

FLG 301  Advanced German  (3 credit hours)
Review and consolidation of aspects of German grammar and development of writing skills. Listening and speaking practice through group activities and oral reports. Class discussions on topics from the cultures of Germany, Austria, and Switzerland, such as film, history, and the fine arts. FLG 301 and 302 can be taken in random order.
Prerequisite: FLG 202 or FLG 212 or a score of 688 on the NC State placement test.
Typically offered in Fall and Summer

FLG 302  German Oral and Written Expression  (3 credit hours)
Review and practice of spoken and written German using authentic texts and materials from contemporary Germany (short stories, films, and online media). Review of German grammar through conversation, writing, and vocabulary building exercises. Oral reports by students. FLG 301 and 302 can be taken in random order.
Prerequisite: FLG 202 or FLG 212 or a score of 688 on the NC State placement test.
Typically offered in Spring and Summer

FLG 630  Independent Study in French  (1-3 credit hours)
Individualized study in French language or literature at the graduate level. Topic and mode of study to be determined in consultation with the faculty member supervising work.
Typically offered in Spring only

FLG 675  Special Project in French  (1-3 credit hours)
Individual project in French language or literature at the graduate level. Topic and mode of study to be determined in consultation with student’s project advisory committee within the parameters of specific options.
Prerequisite: Student must be in final semester of his or her program.
Typically offered in Fall and Spring

FLG 688  Non-Thesis Masters Continuous Registration - Half Time Registration  (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.
Prerequisite: Master’s student
Typically offered in Fall only

Foreign Language - German (FLG)

FLG 101  Elementary German I  (3 credit hours)
The first in a four-course sequence to develop the language skills of listening, speaking, reading, and writing. Emphasis on the acquisition of everyday German and cultural awareness. Active class participation, practice in the language lab and computer lab, and written assignments.
Typically offered in Fall, Spring, and Summer

FLG 201  Intermediate German I  (3 credit hours)
The third of four consecutive courses in German. Intensive conversational practice to develop proficiency in speaking and listening, advanced reading and writing skills by learning complex grammatical structures and through the use of authentic texts. Acquisition of cultural knowledge about the German-speaking countries.
Prerequisite: FLG 101
Typically offered in Fall, Spring, and Summer

FLG 202  Intermediate German II  (3 credit hours)
Last of four consecutive courses in German. Continued conversational practice to develop proficiency in speaking and listening. Development of advanced writing skills by refining grammatical structures and style through assignments, and of advanced reading skills through the use of cultural and literary texts from the German-speaking countries.
Prerequisite: FLG 201
GEP Global Knowledge
Typically offered in Fall, Spring, and Summer

FLG 212  German Language, Culture, Science, and Technology  (3 credit hours)
Discussion of German, Austrian and Swiss scientific discoveries and technological inventions as well as their impact on global society, such as aspirin, x-rays, printing technology, diesel engine, computer, microchip, television, mp3 format, genetics, and environmental technologies. Also a fourth semester German course with intensive practice to develop proficiency in intermediate speaking and listening, reading and writing, using materials from scientific and technological disciplines.
Prerequisite: FLG 201
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Spring only

FLG 301  Advanced German  (3 credit hours)
Review and consolidation of aspects of German grammar and development of writing skills. Listening and speaking practice through group activities and oral reports. Class discussions on topics from the cultures of Germany, Austria, and Switzerland, such as film, history, and the fine arts. FLG 301 and 302 can be taken in random order.
Prerequisite: FLG 202 or FLG 212 or a score of 688 on the NC State placement test.
Typically offered in Fall and Summer

FLG 302  German Oral and Written Expression  (3 credit hours)
Review and practice of spoken and written German using authentic texts and materials from contemporary Germany (short stories, films, and online media). Review of German grammar through conversation, writing, and vocabulary building exercises. Oral reports by students. FLG 301 and 302 can be taken in random order.
Prerequisite: FLG 202 or FLG 212 or a score of 688 on the NC State placement test.
Typically offered in Spring and Summer
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<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tr>
<td>FLG 307</td>
<td>Business German</td>
<td>(3 credit</td>
<td>Business German vocabulary and terminology. Readings and discussions on current business topics. Special consideration to intercultural communication relative to international business operations. Prerequisite: FLG 202 or FLG 212 or placement at 300 level. Typically offered in Fall only</td>
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<tr>
<td>FLG 311</td>
<td>Introduction to German Translation</td>
<td>(3 credit</td>
<td>Introduction to theory, methods, and techniques in translation applied to materials of various fields and professions. Emphasis on written translation. Prerequisite: FLG 202 or FLG 212 or placement at 300 level. Typically offered in Fall only</td>
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<tr>
<td>FLG 316</td>
<td>Germanic Civilization and Culture</td>
<td>(3 credit</td>
<td>Culture and civilization of the German-speaking countries. Analysis of the social, economic and political structures of Germany, Austria, and Switzerland. Lectures, reports, conversation. Taught in German. Prerequisite: FLG 202 or FLG 212 or placement at 300 level. GEP Global Knowledge, GEP Humanities Typically offered in Fall only</td>
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<td>FLG 318</td>
<td>New German Cinema and Beyond</td>
<td>(3 credit</td>
<td>Survey of the major contributions to German Cinema from the 1960's to the present day. Attention to film as an artistic medium and to the cinematic representation of German history and culture. Topics covered include Nazism, German Terrorism, former East Germany, debates on the position of minorities in Germany, and German Jewish relations. Taught in German. Prerequisite: FLG 202 or FLG 212 or placement at 300 level. GEP Global Knowledge, GEP Humanities Typically offered in Fall only</td>
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<tr>
<td>FLG 390</td>
<td>German Studies Topics</td>
<td>(3 credit</td>
<td>Presentation of material not available in regular course offerings, or offering of new courses on a trial basis. Course may be offered through videoconferencing with other UNC campuses as an offering of the German Studies Consortium. Content determined by faculty member in consultation with the department's German section coordinator. May be repeated. Prerequisite: FLG 202 or FLG 212 or placement at 300 level. Typically offered in Fall only</td>
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<td>FLG 398</td>
<td>Independent Study in German</td>
<td>(1-6 credit</td>
<td>Individualized study in German language, culture, or literature. Topic, mode of study, and credit hours to be determined in consultation with the faculty member supervising work. Departmental approval required. Individualized/Independent Study and Research courses require a “Course Agreement for Students Enrolled in Non-Standard Courses” be completed by the student and faculty member prior to registration by the department. Prerequisite: FLG 202 or FLG 212 or placement at 300 level. Typically offered in Fall, Spring, and Summer</td>
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<td>FLG 401</td>
<td>German Graduate Reading</td>
<td>(3 credit</td>
<td>Basic German grammar, with special attention to characteristics of formal expository style, and illustrative readings. Study of extracts from scholarly publications in students' areas of research. Prepares students to take the graduate foreign language certification exam. Prerequisite: Two courses at the FLG 300 level. Typically offered in Fall only</td>
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<td>FLG 420</td>
<td>Current Issues in German-Language Media</td>
<td>(3 credit</td>
<td>Using the internet and a textbook, the course will be constructed from current topics circulated in the German, Austrian and Swiss media, e.g. newspaper websites, radio programs and TV news in streaming video format. Overview of the different news genres, the German-language media scape, and major political, economic, social and cultural issues in the German-speaking countries. Discussion, oral presentations, written assignments. Prerequisite: Two courses at the FLG 300 level. Typically offered in Fall only</td>
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<td>FLG 430</td>
<td>Cultural Artifacts in the German-Speaking Countries</td>
<td>(3 credit</td>
<td>Focuse on major cultural achievements in Germany, Austria and Switzerland, including literature, film, art, and music. Topics will vary. Examples are: &quot;Kafka and Modernism&quot;, &quot;German/Austrian/Swiss Literature and Film-Adaptations&quot;, &quot;German-Language Opera&quot;, &quot;German Art and Society in the 20th Century&quot;, or &quot;The Faust Theme in Literature, Art, and Music&quot;. This course is repeatable so long as a different topic is covered each time. Prerequisite: One FLG 300-level course and one from this list: FLG 315, 316, 318, 320, 323, 325, 390. Typically offered in Fall only</td>
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FLG 440  Green Germany: Nature and Environment in German Speaking Cultures  (3 credit hours)
Survey of the long "Green" tradition in German-speaking cultures as reflected in the arts, in literature, and in scientific discoveries that have made Germany, Austria, and Switzerland leaders in development of alternative environmental technologies. Discussion in German of issues such as Romantic nature poetry, industrialization, Nazi attitudes towards nature, deforestation, the Green Party, air and water pollution, waste management, energy production, climate change, transportation systems, green architecture, sustainability, and the latest environmental technologies. Practice and assessment through class debates, group work, writing tasks, student presentations, and a portfolio.
Prerequisite: 3 Hours of 300-Level German
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall only

FLG 492  Senior Seminar in German Studies  (3 credit hours)
Capstone seminar in German literature or culture. Student presentations and either a substantial essay or a series of essays. Topics vary each semester.
Prerequisite: Two 300 level FLG courses on literature or culture or film
Typically offered in Spring only

FLG 499  Internship in Germany, Austria, or German-Speaking Switzerland  (1-6 credit hours)
Professional internship in a company or organization in Germany, Austria, or German-speaking Switzerland, with German as the main language of daily operations. Contract between the student, department, and company or organization about content, scope, and requirements. 1-6 credits for an approved internship. Essay describing and evaluating the internship experience in the context of student's professional development. Students are responsible for their own travel and living expenses. Departmental approval required. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.
Prerequisite: Two courses at the FLG 300 level
Typically offered in Fall, Spring, and Summer

Foreign Language - Greek (GRK)

GRK 101  Elementary Greek I  (3 credit hours)
Introduction to Classical Greek. Greek alphabet, basic grammar and syntax. Readings based on Greek mythology, philosophy, and literature.
Typically offered in Fall only

GRK 102  Elementary Greek II  (3 credit hours)
A second course in Classical Greek, continuing and expanding the work of GRK 101, and completing the study of grammar. Readings from major authors including Herodotus, Thucydides, and Xenophon.
Prerequisite: GRK 101
Typically offered in Spring only

GRK 201  Intermediate Greek I  (3 credit hours)
Introduction to Greek prose. Emphasis upon improvement of reading skill through vocabulary acquisition and study of complex grammar. Introduction to Attic dialect through reading Plato, and Koine Greek through reading the New Testament. Examination of the importance of these works to Western literature and culture.
Prerequisite: GRK 102
Typically offered in Fall only

GRK 202  Intermediate Greek II  (3 credit hours)
Prerequisite: GRK 201
GEP Global Knowledge
Typically offered in Spring only

GRK 399  Directed Readings in Greek  (3 credit hours)
Advanced Greek language course introducing students to research methods in classical studies. Readings may include Plato, Homer, Sophocles, New Testament, or others. May be taken up to two times with different readings for credit.
Prerequisite:GRK 202

Foreign Language - Hindi (FLN)

FLN 101  Elementary Hindi-Urdu I  (3 credit hours)
Introduction to standard Hindi-Urdu. Emphasis on speaking and listening, and on reading and writing in the Hindi writing system (Devanagari). Readings in South Asian culture and civilization.
Corequisite: FLN 103
Typically offered in Fall only

FLN 102  Elementary Hindi-Urdu II  (3 credit hours)
Continuation of FLN 101. Emphasis on oral communication and reading and writing in the Hindi writing system (Devanagari). Further readings in South Asian culture and civilization.
Prerequisite: FLN 101, Corequisite: FLN 104
Typically offered in Spring only

FLN 103  Elementary Hindi-Urdu I Conversation  (1 credit hours)
Required conversational practice for FLN 101. Special attention to individual pronunciation and intonation. Introduction of formal and informal speech. Use of audiovisual materials.
Corequisite: FLN 101
Typically offered in Fall only

FLN 104  Elementary Hindi-Urdu II Conversation  (1 credit hours)
Required conversational practice for FLN 102. Extensive use of speaking skills in variety of situations. Attention to supplemental non-verbal communication. Use of audiovisual materials.
Prerequisite: FLN 101, Corequisite: FLN 102
Typically offered in Spring only
FLN 201 Intermediate Hindi-Urdu I (3 credit hours)
Continuation of basic language skills. Further practice of Urdu/Hindi writing systems. Introduction to grammatical divergence of Hindi and Urdu. Readings in South Asian culture and civilization.
Prerequisite: FLN 102, Corequisite: FLN 203
Typically offered in Fall only

FLN 202 Intermediate Hindi-Urdu II (3 credit hours)
Continuation of FLN 201. Further practice of both Hindi/Urdu writing systems. Further distinction of spoken and literary Urdu and Hindi. Further readings in South Asian culture and civilization.
Prerequisite: FLN 201, Corequisite: FLN 204
GEP Global Knowledge
Typically offered in Spring only

FLN 203 Intermediate Hindi-Urdu I Conversation (1 credit hours)
Required conversational practice for FLN 201. Advancement of speaking skills through role playing, interviews, debates. Further Hindi and Urdu non-verbal communication. Use of audiovisual materials, including responses to commercial television and movies.
Prerequisite: FLN 102, Corequisite: FLN 201
Typically offered in Fall only

FLN 204 Intermediate Hindi-Urdu II Conversation (1 credit hours)
Required conversational practice for FLN 202. Refinement of speaking skills through role playing, interviews, debates. Further Hindi and Urdu non-verbal communication. Use of audiovisual materials, including responses to commercial television and movies.
Prerequisite: FLN 201, Corequisite: FLN 202
Typically offered in Spring only

FLN 301 Twentieth Century Hindi & Urdu Fiction (3 credit hours)
Introduces advanced Hindi-Urdu students to the prose fiction of major Hindi and Urdu literary figures including Munshi Premchand, Saadat Hasan Manto and others. Texts will be provided in both Hindi and Urdu scripts and/or English translation as available.
Prerequisite: FLN 202
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FLN 302 Modern Hindi & Urdu Poetry (3 credit hours)
Introduces advanced Hindi-Urdu students to representative works of 19th and 20th century Hindi and Urdu poets and poetic forms. Texts will be provided in both Hindi and Urdu scripts and/or English translation as available.
Prerequisite: FLN 202
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLN 401 Hindi Literature and South Asian Cultural Contexts (3 credit hours)
Selected topics in Hindi literature and/or South Asian literature in Hindi, such as drama in modern South Asia, the twentieth-century novel, literature and the nation, narratives of pain and resistance, gender and social reform. Readings and discussion in Hindi, with emphasis on the examination of formal literary characteristics and the interconnections of texts and relevant South Asian cultural contexts. Topics will be rotated so that students can take this course for credit up to three times.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

Foreign Language - Italian (FLI)

FLI 101 Elementary Italian I (3 credit hours)
Begins the development of a balanced foundation in all four language skills. Concentrates on listening and speaking, emphasizing idiomatic Italian. Short readings in Italian culture and civilization. Class and laboratory practice, written homework.
Typically offered in Fall, Spring, and Summer

FLI 102 Elementary Italian II (3 credit hours)
Continuation of FLI 101 with emphasis on acquisition of oral skills through class practice and use of audio aids. Readings in Italian culture, civilization and literature.
Prerequisite: FLI 101
Typically offered in Fall, Spring, and Summer

FLI 201 Intermediate Italian I (3 credit hours)
Third of four consecutive courses to develop skills of speaking, listening, reading and writing. Readings and discussion of Italian culture, civilization and literature.
Prerequisite: FLI 102
GEP Global Knowledge
Typically offered in Spring and Summer

FLI 202 Intermediate Italian II (3 credit hours)
Last of four sequential language courses. Increased emphasis on reading and writing. Readings in the literature, culture, and civilization of Italy.
Prerequisite: FLI 201
Typically offered in Fall and Summer

FLI 208 Intermediate Italian Conversation (3 credit hours)
Intensive practice in speaking and understanding Italian through role playing, discussion, interviews, and use of audio-visual materials.
Corequisite: FLI 202
Typically offered in Fall and Summer

FLI 308 Italian Reading and Conversation (3 credit hours)
Advanced readings and intensive conversational practice in Italian for students beyond the intermediate level.
Prerequisite: FLI 202
Typically offered in Spring and Summer

FLI 315 Italian Civilization and Culture (3 credit hours)
Italian culture and society from its origins to modern times, including its history, geography and national and regional identities, social images, political and economic structures, and technological and scientific development of the Italian society. As an extension of the classroom students participate in educational experiences such as excursions and Italian cooking classes. Taught in English and as NC State Study Abroad Program in Perugia, Italy.
GEP Global Knowledge, GEP Humanities
Typically offered in Summer only
FLJ 318 Italian Society Through Cinema (3 credit hours)
Italian culture and society through cinema from the fascist era to the present. A study of selected films representative of major social-political, ideological, and artistic developments. Weekly film viewings. Taught in Italian.

Prerequisite: FLI 202
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

**Foreign Language - Japanese (FLJ)**

FLJ 101 Elementary Japanese I (3 credit hours)
Introduction to standard, formal Japanese. Emphasis on speaking and listening skills. Exposure to Japanese culture, reading, and writing.

Corequisite: FLJ 103
Typically offered in Fall only

FLJ 102 Elementary Japanese II (3 credit hours)
Continuation of basic skills. Emphasis on speaking and listening skills; inclusion of Japanese cultural factors in communication. Some reading and writing.

Prerequisite: FLJ 101, Corequisite: FLJ 104
Typically offered in Spring only

FLJ 103 Elementary Japanese I Conversation (1 credit hours)
Supplements conversational practice in FLJ 101. Students are encouraged to use their speaking skills in a variety of situations. Special attention is given to correcting and improving pronunciation and intonation.

Corequisite: FLJ 101
Typically offered in Fall only

FLJ 104 Elementary Japanese II Conversation (1 credit hours)
Supplements conversational practice in FLJ 102. Extensive use of speaking skills in a variety of situations. Special attention given to correcting and improving pronunciation and intonation.

Prerequisite: FLJ 101, Corequisite: FLJ 102
Typically offered in Spring only

FLJ 201 Intermediate Japanese I (3 credit hours)
Continuation of basic skills. Greater emphasis on reading and writing. More exposure to Japanese cultural traditions.

Prerequisite: FLJ 102 or FLJ 105, Corequisite: FLJ 203
Typically offered in Fall only

FLJ 202 Intermediate Japanese II (3 credit hours)
Continuation of the learning of the basic skills. Emphasis on reading and writing as well as on spoken Japanese and on cultural patterns of behavior.

Prerequisite: FLJ 201, Corequisite: FLJ 204
GEP Global Knowledge
Typically offered in Spring only

FLJ 203 Intermediate Japanese Conversation (1 credit hours)
Practice in spoken Japanese through use of the language in a variety of situations. Increase vocabulary and develop fluency and ease in the structural patterns of the language. May be repeated for a maximum of three credit hours.

Prerequisite: FLJ 102, Corequisite: FLJ 201, FLJ 202 or FLJ 301
Typically offered in Fall only

FLJ 204 Intermediate Japanese II Conversation (1 credit hours)

Corequisite: FLJ 202
Typically offered in Spring only

FLJ 301 Intermediate Japanese III (3 credit hours)
Continued study of Japanese language. Primary emphasis on spoken Japanese, but attention also given to reading, writing and culture.

Prerequisite: FLJ 202
Typically offered in Fall only

FLJ 302 Intermediate Japanese IV (3 credit hours)
Continued training in the foundations of Japanese language. Primary emphasis on spoken Japanese, with increased attention to reading and writing.

Prerequisite: FLJ 301
Typically offered in Spring only

FLJ 342 Classical Japanese Literature in Translation (3 credit hours)
A survey of literature in Japan from earliest recorded times through the sixteenth century. Examples from major eras and genres (folktales, poetry, philosophy, fictional narrative, theater, etc.) will be considered, with attention to historical and cultural contexts, as well as to contemporary scholarship and approaches toward traditional literature. Examples from literature outside Japan will be included for comparative purposes. No prior knowledge of Japanese required: Readings and discussions in English.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLJ 344 Early Modern Japanese Literature in Translation (3 credit hours)
A survey of literature in Japan from 1600 to late Nineteenth Century. Examples from major periods and genres (novels, poetry, philosophy, drama, miscellaneous narrative, etc.) will be considered, with attention to historical and cultural contexts, as well as to contemporary scholarship and approaches toward the literature. Examples from literature outside Japan will be included for comparative purposes. No prior knowledge of Japanese required: Readings and discussions in English.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only
FLJ 345 Modern Japanese Literature in Translation (3 credit hours)
A survey in literature in Japan from the Meiji Era through World War Two. Examples from major periods and genres (novels, poetry, philosophy, drama, miscellaneous narrative, etc.) will be considered, with attention to historical and cultural contexts, as well as to contemporary scholarship and approaches toward the literature. Examples from literature outside Japan will be included for comparative purposes. No prior knowledge of Japanese required: Readings and discussions in English.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLJ 351/ANT 351 Contemporary Culture in Japan (3 credit hours)
Introduction to basic aspects of cultural practices in Japanese society, including education, work life, family relationships, everyday religious practices, aesthetic traditions, national identity, and gender. Students will develop an understanding of the interrelationships between language and culture.

Prerequisite: FLJ 101
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLJ 401 Advanced Japanese I (3 credit hours)
Continued training in the foundations of Japanese language, with emphasis on complex verb forms. Increased attention to reading and writing.

Prerequisite: FLJ 302
Typically offered in Fall only

FLJ 402 Advanced Japanese II (3 credit hours)
Elaboration on grammatical forms learned in the previous courses with applications in reading and writing, combined with more sophisticated vocabulary and idioms and attention to development of natural reading skills.

Prerequisite: FLJ 401
Typically offered in Spring only

LAT 202 Intermediate Latin II (3 credit hours)
Lyric poetry of Catullus and Horace emphasizing vocabulary, syntax, and techniques of Latin verse. Traditions and the evolution of lyric poetry and the social role of the Roman poet.

Prerequisite: LAT 201
Typically offered in Spring only

LAT 399 Directed Readings in Latin (3 credit hours)
Advanced Latin language course introducing students to research methods in classical studies. Readings may include Vergil, Ovid, Livy, Cicero, or others. May be taken up to two times with different readings for credit.

Prerequisite: LAT 202
Typically offered in Spring only

Foreign Language - Persian (PER)

PER 101 Elementary Persian I (3 credit hours)
For students with little or no background or previous study of the language. Development of communicative abilities within an integrated skill approach (speaking, listening, reading, writing). Introduction to the Persian-speaking world, including the Iranian Ta’arof, food and diaspora. Vocabulary level: 300 words.

C: PER 103
Typically offered in Fall only

PER 102 Elementary Persian II (3 credit hours)
The second-semester continuation of Persian 101. Students learn how to talk about their daily routines and spare time activities, likes and dislikes, and build a more complex language form. They are expected to ask and answer questions on the same topics as well. Throughout the course they learn common phrases and cultural perspectives which help them create a more natural interaction with speakers of Persian. Persian-Farsi is the language base, with Tehrani accent. This is a 500-word level class and ACTFL level of ILR 0+

P: PER 101 and PER 103, or by placement test; C: PER 104
Typically offered in Spring only

PER 201 Intermediate Persian I (3 credit hours)
Persian 201 is the third semester (beginning of second-year) in Persian. It deepens the students’ familiarity with the syntax of the literary language of Persia and expands their command of the spoken vernacular of Iran through exposure to more varied

Prerequisite: Elementary Persian 102, or instructor’s permission
Typically offered in Fall only
PER 202 Intermediate Persian II (3 credit hours)
Persian 202 is the fourth semester, which completes the intermediate level (second year) in Persian. It further deepens the students' familiarity with the syntax of the literary language of Persia and expands their command of the spoken vernacular of Iran through exposure to more varied and sophisticated communicational contexts. It deals principally with the acquisition of the conversation register of the language, which differs considerably from the formal written style. An intermediate textbook with grammar explanations in English is supplemented with tapes and videos of authentic language and culture used in situational communication.

Prerequisite: Elementary Persian (PER 201) or instructor's permission
GEP Global Knowledge
Typically offered in Spring only

Foreign Language - Portuguese (FLP)

FLP 101 Elementary Portuguese I (3 credit hours)
Introduction to the fundamentals of Brazilian Portuguese: pronunciation, comprehension, and spoken syntax and grammar.

Typically offered in Fall only

FLP 102 Elementary Portuguese II (3 credit hours)
Continuation of the essentials of Brazilian Portuguese. Further stress on pronunciation and comprehension and introduction of reading and writing skills.

Prerequisite: FLP 101
Typically offered in Spring only

FLP 201 Intermediate Portuguese I (3 credit hours)
The third level of Portuguese with special attention to speaking, reading, writing and developing a cultural awareness of the cultural heritage of the Portuguese-speaking peoples of Portugal, Brazil and Portuguese-speaking Africa.

Prerequisite: FLP 102 or placement in course
Typically offered in Fall only

FLP 401 Brazilian Portuguese for Spanish Speakers (3 credit hours)
A one semester on-line intensive introductory course to Brazilian Portuguese for Spanish speakers taught in Spanish focusing on the development of: 1) Reading Comprehension in Brazilian Portuguese; 2) Basic translation skills: Spanish>P ortuguese>Spanish; 3) Colloquial writing skills in Brazilian Portuguese; 4) Basic speaking ability in Brazilian Portuguese. This course is open to undergraduate, graduate and extension students with a formal knowledge of Spanish who fulfill the prerequisite. Instructor approval required.

Prerequisite: Native/Heritage Spanish Speaker or FLS 202 or Equivalent and Instructor's Approval
Typically offered in Fall and Spring

Foreign Language - Russian (FLR)

FLR 101 Elementary Russian I (3 credit hours)
First in a four-course sequence to develop language skills in Russian. Oral and written practice in the classroom and language laboratory and attention to Russian cultural heritage.

Typically offered in Fall only

FLR 102 Elementary Russian II (3 credit hours)
Emphasis on acquisition of basic oral skills, with complementary reading and writing exercises and attention to Russian cultural heritage.

Prerequisite: FLR 101
Typically offered in Spring only

FLR 201 Intermediate Russian I (3 credit hours)
Basic Russian language skills continued. More emphasis given to writing and essential conversational practice. Intermediate level readings in Russian literature and culture. Class and laboratory practice; written assignments.

Prerequisite: FLR 201
GEP Global Knowledge
Typically offered in Spring only

FLR 202 Intermediate Russian II (3 credit hours)
Advanced aspects of Russian syntax through study of text. Continued attention to conversational practice and vocabulary building.

Prerequisite: FLR 201
GEP Global Knowledge
Typically offered in Spring only

FLR 303 Russian Literature in Translation: The Nineteenth Century (3 credit hours)
A study of the great Russian writers of the nineteenth century. Examination of peculiarly Russian as well as the universal aspects of this literature. All readings, lectures and discussions in English.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FLR 304 Russian Literature in Translation: The Twentieth Century (3 credit hours)
A study of major Russian writers of the twentieth century. Examination of peculiarly Russian as well as the universal aspects of this literature. All readings, lectures and discussions in English.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLR 318 Russian Cinema and Society (3 credit hours)
Russian culture and society through cinema. A study of selected films representative of major social-political, ideological, and artistic developments. Weekly film screenings. No knowledge of Russian required.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only
Foreign Language - Spanish (FLS)

**FLS 101 Elementary Spanish I** (3 credit hours)
For students with little or no background or previous study of Spanish or those who place into course via Spanish placement exam. Development of communicative abilities within an integrated skill approach (speaking, listening, reading, writing). Introduction to the cultures of the Spanish-speaking world. Includes written and oral assignments of language structures and vocabulary. Conducted entirely in Spanish. Closed to native speakers of Spanish.

Typically offered in Fall, Spring, and Summer

**FLS 102 Elementary Spanish II** (3 credit hours)
Continuation of FLS 101. Development of communicative abilities within an integrated skills approach (speaking, listening, reading, writing). Introduction to the cultures of the Spanish-speaking world. Includes written and oral assignments of language structures and vocabulary. Conducted entirely in Spanish. Closed to native speakers of Spanish.

Prerequisite: FLS 101
Typically offered in Fall, Spring, and Summer

**FLS 105 Intensive Elementary Spanish** (3 credit hours)
An intensive course equivalent to FLS 101 plus FLS 102. Development of communicative abilities within an integrated skills approach (speaking, listening, reading, writing). Introduction to the cultures of the Spanish-speaking world. Includes written and oral assignments of language structures and vocabulary. Conducted entirely in Spanish. Closed to native speakers of Spanish.

Typically offered in Fall and Spring

**FLS 110 Accelerated Elementary Spanish** (3 credit hours)
Contents of FLS 101 and FLS 102 at an accelerated pace, for students placed into the course based on results of the Spanish placement test. Development of communicative abilities within an integrated skills approach (speaking, listening, reading, writing). Introduction to the cultures of the Spanish-speaking world. Includes extensive written and oral assignments of language structures and vocabulary. Conducted entirely in Spanish. Closed to native speakers of Spanish.

Prerequisite: A score of 167 or better on the Spanish placement exam is required for matriculation in this course
Typically offered in Fall and Spring

**FLS 201 Intermediate Spanish I** (3 credit hours)
Continued development of communicative abilities for students with previous study of elementary level Spanish. Integrated skills approach (speaking, listening, reading, writing). Students will learn to function in everyday situations, expressing opinions and doubts, and narrating and describing in present, past, and future time, and will explore cultural issues through literary and other types of readings. Includes written and oral assignments of language structures and vocabulary. Conducted entirely in Spanish. Closed to native speakers of Spanish.

Prerequisite: FLS 102,105 or 110
Typically offered in Fall, Spring, and Summer

**FLS 202 Intermediate Spanish II** (3 credit hours)
Development of communicative abilities at the intermediate level of the American Council on the Teaching of Foreign Language proficiency scale, with an integrated skills approach (reading, writing, speaking, listening) and additional emphasis on knowledge and competence in the cultures of the Spanish-speaking world. Includes written and oral assignments of language structures and vocabulary. Conducted entirely in Spanish. Closed to native speakers of Spanish.

Prerequisite: FLS 201 or FLS 212
GEP Global Knowledge
Typically offered in Fall, Spring, and Summer

**FLS 212 Spanish: Language, Technology, Culture** (3 credit hours)
A study of the language structures and vocabulary necessary for an intermediate level of communication in Spanish together with cultural and technical issues of our global society in the context of the Spanish-speaking world. Fulfills the FLS 201 require

Prerequisite: FLS 102 or FLS 110 or FLS 105
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

**FLS 295 Intermediate Special Topics in Spanish** (3 credit hours)
Special Topics in language and cultures of the Spanish speaking world for students at the intermediate (200) level. Includes courses taught in Spanish study abroad programs. Course may be taken up to three times.

Prerequisite: FLS 201
Typically offered in Fall, Spring, and Summer

**FLS 331 Spanish Oral and Written Expression I** (3 credit hours)
Development of speaking and writing skills at the Intermediate Mid to Intermediate High levels of the American Council on the Teaching of Foreign Languages proficiency scale, as well as listening/viewing and reading skills. Focus on sentence and paragraph-length discourse, narration and description in present, past, and future time frames within a variety of topics and contexts, and communication skills such as circumlocution. Course readings, video and discussion content center upon cultural aspects of the Spanish speaking world.

Prerequisite: FLS 202
Typically offered in Fall, Spring, and Summer

**FLS 332 Spanish Oral and Written Expression II** (3 credit hours)
Development of speaking and writing skills at the Intermediate High levels of the American Council on the Teaching of Foreign Languages proficiency scale, as well as listening/viewing and reading skills. Focus on paragraph-length discourse, narration and detailed description in present, past, and future time frames within a variety of topics and contexts, and communication skills such as circumlocution. Course readings, video and discussion content center upon cultural aspects of the Spanish speaking world.

Prerequisite: FLS 202
Typically offered in Fall, Spring, and Summer

**FLS 333 The Sounds of Spanish** (3 credit hours)
A study of the pronunciation and phonological system of Spanish, with the goals of improving student pronunciation and analyzing native Spanish pronunciation. Extensive practice in phonetic transcription and pronunciation, as well as phonetic/phonological dialect variation.

Prerequisite: FLS 202
Typically offered in Fall and Spring
FLS 335  **Spanish for Native and Heritage Speakers**  (3 credit hours)
This course is designed to meet the needs of native and heritage speakers of Spanish whose linguistic level is above that of our 200-level courses. Development of oral and writing skills at the Advanced-Mid through Superior levels of the American Council.

R: Native or heritage speaker of Spanish

**GEP Global Knowledge, GEP Humanities**

Typically offered in Fall only

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FLS 336  **Spanish for Business**  (3 credit hours)
Business Spanish vocabulary and terminology. Emphasis on everyday spoken and written Spanish. Readings and discussions of business topics. Cross-cultural considerations relative to international business operations.

P: FLS 331 or FLS 335

Typically offered in Fall only

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FLS 337  **Spanish for Tourism in the Hispanic World**  (3 credit hours)
Exploration of the tourism industry in the Spanish speaking world from cultural-historical, geographic, and linguistic perspectives. Course can lead to Tourism Certificate in Spanish from the Chamber of Commerce and Industry of Spain.

Prerequisite: FLS 202

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FLS 340  **Introduction to Hispanic Literatures and Cultures**  (3 credit hours)
Exploration of what literature is; what it means to read literature; and why one might be interested in analyzing literature. Introduction to literary terminology, as well as literary genres and movements in the Spanish language. Examination of social-cultural-historical contexts of Spain and Latin America, particularly matters of race, class, gender, and political ideas as they relate to literatures of the Spanish speaking world. Interpretation and analysis of literary texts, cultural institutions, and objects of national, mass, and popular cultures.

Prerequisite: FLS 331 or FLS 332 or FLS 335

**GEP Global Knowledge, GEP Humanities**

Typically offered in Fall and Spring

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FLS 341  **Literature and Culture of Spain I**  (3 credit hours)
Survey of literary and cultural contexts of medieval and early modern Spain (12th to 17th centuries). Examination of literary genres in connection with concurrent cultural and historical events. Exploration of literature as a reflection of the experiences and events meaningful to Spanish society during this time period. Emphasis on the ways in which literature and other cultural artifacts give voice to value systems, traditions, and beliefs.

Prerequisite: FLS 331 or FLS 332 or FLS 335

**GEP Global Knowledge, GEP Humanities**

Typically offered in Fall and Spring

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FLS 342  **Literature and Culture of Spain II**  (3 credit hours)
Survey of literary and cultural contexts of 18th and 19th century Spain. Examination of literary genres in connection with concurrent cultural and historical events. Exploration of literature as a reflection of the experiences and events meaningful to Spanish society during this time period. Emphasis on the ways in which literature and other cultural artifacts give voice to value systems, traditions, and beliefs.

Prerequisite: FLS 331 or FLS 332 or FLS 335

**GEP Global Knowledge, GEP Humanities**

Typically offered in Fall only

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FLS 343  **Literature and Culture of Spain III**  (3 credit hours)
Survey of literary and cultural contexts of 20th and 21st century Spain. Examination of literary genres in connection with concurrent cultural and historical events. Exploration of literature as a reflection of the experiences and events meaningful to Spanish society during this time period. Emphasis on the ways in which literature and other cultural artifacts give voice to value systems, traditions, and beliefs.

Prerequisite: FLS 331 or FLS 332 or FLS 335

**GEP Global Knowledge, GEP Humanities**

Typically offered in Fall only

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FLS 351  **Literature and Culture of Latin America I**  (3 credit hours)
Survey of literary and cultural contexts of Latin America from the pre-conquest, colonial and early-independence periods (15th to mid 19th centuries). Examination of literary genres in connection with concurrent cultural and historical events. Exploration of literature as a reflection of the experiences and events meaningful to Latin American society during this time period. Emphasis on the ways in which literature and other cultural artifacts give voice to value systems, traditions, and beliefs.

Prerequisite: FLS 331 or FLS 332 or FLS 335

**GEP Global Knowledge, GEP Humanities**

Typically offered in Fall only

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FLS 352  **Literature and Culture of Latin America II**  (3 credit hours)
Survey of literary and cultural contexts of Latin America from the Mid 19th to the Mid 20th centuries. Examination of literary genres in connection with concurrent cultural and historical events. Exploration of literature as a reflection of the experiences and events meaningful to Latin American society during this time period. Emphasis on the ways in which literature and other cultural artifacts give voice to value systems, traditions, and beliefs.

Prerequisite: FLS 331 or FLS 332 or FLS 335

**GEP Global Knowledge, GEP Humanities**

Typically offered in Spring only

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FLS 353  **Literature and Culture of Latin America III**  (3 credit hours)
Survey of literary and cultural contexts of Latin America since 1960. Examination of literary genres in connection with concurrent cultural and historical events. Exploration of literature as a reflection of the experiences and events meaningful to Latin American society during this time period. Emphasis on the ways in which literature and other cultural artifacts give voice to value systems, traditions, and beliefs.

Prerequisite: FLS 331 or FLS 332 or FLS 335

**GEP Global Knowledge, GEP Humanities**

Typically offered in Fall only

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FLS 360  **Hispanic Cinema**  (3 credit hours)
Survey of the major contributions of Hispanic cinema from its origins to the present. Analysis of film as an artistic medium and as the cinematic representation of Hispanic histories and cultures. Reading, discussions, and viewing of films by representative directors.

Prerequisite: FLS 331 or FLS 332 or FLS 335

**GEP Global Knowledge, GEP Visual and Performing Arts**

Typically offered in Spring only
FLS 395 Study Abroad Programs in Spanish (3 credit hours)
Specific category of courses in Spanish involving language and/or culture taught in Spanish-speaking countries through the Department Study Abroad Program.
Prerequisite: FLS 202
Typically offered in Fall, Spring, and Summer

FLS 399 Intensive Spanish Oral Proficiency Workshop (1 credit hour)
Extensive conversation centered upon the communicative functions of the intermediate high to advanced levels of the American Council on the Teaching of Foreign Languages (ACTFL) Oral Proficiency Scale. Assignments will include listening/viewing and speaking.
Prerequisite: 3 Hours of 300-level Spanish
Typically offered in Fall, Spring, and Summer

FLS 400 Methods and Techniques in Spanish Translation and Interpretation (3 credit hours)
Study and practical application of theory, methods and techniques of translation based on materials relevant to various fields and professions.
Prerequisite: 12 credits of 300-level Spanish
Typically offered in Spring only

FLS 401 Spanish Graduate Reading (3 credit hours)
Basic Spanish grammar, with special attention to characteristics of formal expository style, and illustrative readings. Study of extracts from scholarly publications in students’ areas of research. Prepares students to take the graduate foreign language certification exam.
Typically offered in Fall only

FLS 402 Introduction to Spanish Linguistics (3 credit hours)
Introduction to fundamental terminology and concepts in the study of linguistics. Overview of the Spanish phonetics and phonology, morphology, syntax, semantics, pragmatics, sociolinguistics and historical linguistics.
Prerequisite: 12 credits of 300-level Spanish or higher
Typically offered in Fall only

FLS 405 Spanish-English Comparative Grammar (3 credit hours)
Analysis of the linguistic and grammatical structure (phonology, morphology, syntax, and discourse) of English and Spanish in order to develop a deeper understanding of how both linguistic systems function in similar and different ways.
Prerequisite: 12 credits of 300-level Spanish or higher
Typically offered in Spring only

FLS 411 Topics in the Culture of Spain (3 credit hours)
Exploration of particular themes related to the culture of Spain, with culture broadly defined as history, social and political aspects of society, as well as human and artistic expression including use of language, literary production, performance, print, and electronic media. Themes in this course expand upon those introduced in the 300 level of the Spanish curriculum. Class discussion and assignments require greater depth and sophistication than introduction to literature and culture courses of the 300 level.
Prerequisite: 12 credits of 300-level Spanish
Typically offered in Fall and Spring

FLS 412 Topics in the Culture of Latin America and the Caribbean (3 credit hours)
Exploration of particular themes related to the culture of Latin America and the Caribbean, with culture broadly defined as history, social and political aspects of society, as well as human and artistic expression including use of language, literary production, performance, print, and electronic media. Themes in this course expand upon those introduced in the 300 level of the Spanish curriculum. Class discussion and assignments require greater depth and sophistication than introduction to literature and culture courses of the 300 level.
Prerequisite: 12 credits of 300-level Spanish

FLS 413 Spain and the Americas in Transatlantic Perspective (3 credit hours)
Exploration of key moments of communication, exchange and conflict between the different parts of the Spanish speaking world, from the point of contact between imperial Spain and the indigenous civilizations of the “New World”. Examination of the commonalities and distinctions of the quest for independence, modernity and democracy. Analysis of immigration across national frontiers in the present day Hispanic World and greater American continent.
Prerequisite: 12 credits of 300-level Spanish

FLS 445/FLS 545 Spanish Environmental Cultural Studies (3 credit hours)
This seminar will serve as an exploration of environmental cultural studies in contemporary Spain. It will examine questions such as climate change, industrial agriculture, animal rights, sustainability, environmental justice, eco-feminism and others in the context of contemporary Spanish culture. The course will also serve as an introduction to environmental activism and environmental politics in Spain and at the planetary level. It will make use of theoretical and critical readings, films, literary works, and other cultural products. Students cannot receive credit for both FLS 445 and FLS 545.
P: 12 hours of 300-level Spanish
Typically offered in Fall and Spring

FLS 492/FLS 592 Seminar in Hispanic Studies (3 credit hours)
Advanced seminar on a specific area of Hispanic studies (topics vary), leading to a major term paper and/or a series of essays by the student.
Prerequisite: 12 credits of 300-level Spanish or higher
Typically offered in Spring only

FLS 495 Advanced Study Abroad Programs in Spanish (3 credit hours)
Specific category of courses in Spanish at the 400-level involving language and/or culture taught in Spanish-speaking countries through the Department Study Abroad Program.
Prerequisite: 12 credits of 300-level Spanish
Typically offered in Fall, Spring, and Summer

FLS 502 Linguistic Structure of Spanish (3 credit hours)
Introduction to fundamental terminology and concepts in the study of linguistics. Overview of the Spanish sound system (phonology), principles of word formation such as derivation and inflection (morphology), structure and grammatical relations of phrases and sentences (syntax), as well as the relationship between linguistic levels. Graduate standing required.
Typically offered in Fall only
FLS 503 Spanish Applied Linguistics (3 credit hours)
Overview of prominent theoretical perspectives in the acquisition of Spanish as a second language. Application of theory to the learning and teaching of the Spanish language. Analysis of issues in the acquisition of Spanish phonology, morphosyntax, semantics, and pragmatics. Graduate standing required.
Prerequisite: FLS 502 (Linguistic Structure of Spanish)
Typically offered in Spring only

FLS 504 Spanish Language Change and Variation (3 credit hours)
Overview of phonological and morphosyntactic change from Latin to modern Spanish. Linguistic exploration of social and geographical dimensions Spanish language variation. Examination of issues of Spanish/English contact in the United States, including bilingualism and bilingual education. Graduate standing required.
Prerequisite: FLS 502 (Linguistic Structure of Spanish)
Typically offered in Fall only

FLS 509 Spanish Phonetics and Phonology (3 credit hours)
A theoretical introduction to the phonetics and phonological system of Spanish. Topics covered include articulatory phonetics, narrow and broad transcription, and the analysis of linguistic data with the goal of understanding the underlying system of Spanish sounds. Current topics in Spanish phonology are included. Graduate standing required.
Prerequisite: FLS 502 (Linguistic Structure of Spanish)
Typically offered in Fall, Spring, and Summer

FLS 512 Spanish in the United States (3 credit hours)
A study of the varieties of Spanish spoken in the United States from the linguistic perspective. The course examines the historical and socio-political motives for distinct waves of immigration as a means to understand the development of unique dialects and sociolects that are emerging across the country. Readings and lectures explore topics such as phonetic, morphosyntactic, geographic, and social variation; bilingualism and language contact; language acquisition and education; and language in the media and public space.
Prerequisite: FLS 502 or Permission of Instructor
Typically offered in Fall, Spring, and Summer

FLS 515 History of Spanish Language (3 credit hours)
Overview of historical evolution of modern Spanish from spoken Latin. Focus on theories of language change as applied to the historical development of Spanish. Graduate status or instructor permission required.
Prerequisite: FLS 502 or equivalent; or permission of instructor
Typically offered in Spring only

FLS 520 Survey of Hispanic Literature and Culture (3 credit hours)
This course covers literature from the 8th century on in the Peninsular context and/or from the times of the pre-Conquest in Latin America to the present. It focuses on short stories, poetry, essays and films as well as different critical and theoretical analyses of culture. Its purpose is to familiarize graduate students with Latin American and/or Peninsular literature and culture and to provide a foundation for the other course offerings in literature/culture in the graduate program. It can be taught as a survey of Peninsular or Latin American literature or both.
Prerequisite: Graduate standing
Typically offered in Fall only

FLS 528 Don Quixote (3 credit hours)
This course studies the historical and political contexts of Cervante's writing, his place in Renaissance culture, and the role of Don Quixote in the formation of the modern novel. Taught in Spanish. Graduate status or permission of the instructor.
Typically offered in Fall only

FLS 530 The Cultural Production of Spanish Democracy (3 credit hours)
Challenges, contradictions, accomplishments, and shortcomings in the political, social, economic, cultural, and literary dimensions of Spain in the last quarter of the 20th century. Treatment of literary texts, historical and journalistic documents, critical and theoretical essays, as well as fiction and non-fiction films, music, and other products of popular and mass culture since 1975. Particular attention to significant cultural events such as the 1992 Barcelona Olympics, and the celebration of the 500th anniversary of the "Discovery" of America. Must hold graduate standing.
Typically offered in Fall only

FLS 545/FLS 445 Spanish Environmental Cultural Studies (3 credit hours)
This seminar will serve as an exploration of environmental cultural studies in contemporary Spain. It will examine questions such as climate change, industrial agriculture, animal rights, sustainability, environmental justice, eco-feminism and others in the context of contemporary Spanish culture. The course will also serve as an introduction to environmental activism and environmental politics in Spain and at the planetary level. It will make use of theoretical and critical readings, films, literary works, and other cultural products. Students cannot receive credit for both FLS 445 and FLS 545.
P: 12 hours of 300-level Spanish
Typically offered in Fall and Spring

FLS 553 The Latin American Avant-Garde (3 credit hours)
An in-depth analysis of the cultural avant-garde in Latin America at the beginning of the twentieth century (1905-1939). Students will study European and Latin American theories of the avant-garde, literature, art, music, and manifestation from the period in several Latin American countries. Graduate standing required. Taught in Spanish.
Typically offered in Spring only

FLS 554 The Sixties in Latin America (3 credit hours)
An in-depth analysis of the cultural production during the 60s in Latin America. Students will study novels, short stories, poetry, music, and film from several Latin American countries. Graduate standing required.
Typically offered in Fall only

FLS 563 The Latin American Novel (3 credit hours)
The course offers a comprehensive view of Latin America novel (from the 19th Century until the present). It centers its attention foremost on canonical works (Isaacs, Gallegos, Vargas Llosa, Puig, etc.). Besides familiarizing students with the political, social and cultural contexts that gave rise to these texts, it also provides, through the reading of various theoretical articles, a basic introduction to narrative theory (Genette, Booth, Bai, Brooks, etc.). Graduate standing required.
Typically offered in Spring only
FLS 592/FLS 492 Seminar in Hispanic Studies (3 credit hours)
Advanced seminar on a specific area of Hispanic studies (topics vary),
leading to a major term paper and/or a series of essays by the student.
Prerequisite: 12 credits of 300 level Spanish or higher
Typically offered in Spring only

FLS 595 Special Topics in Spanish (1-3 credit hours)
In depth exploration of specialized topics in Spanish literature, culture or
language. Also used to test and develop new courses. Course taught in
Spanish.
Prerequisite: Graduate Standing or Permission of the Instructor
Typically offered in Fall and Spring

FLS 630 Independent Study in Spanish (1-3 credit hours)
Individualized study in Spanish language or literature at the graduate
level. Topic and mode of study to be determined in consultation with the
faculty member supervising work.
Typically offered in Fall only

FLS 675 Special Project in Spanish (1-3 credit hours)
Individual project in Spanish language or literature at the graduate level.
Topic and mode of study to be determined in consultation with student's
project advisory committee within the parameters of specific options.
Prerequisite: Student must be in final semester of his or her program
Typically offered in Fall and Spring

FLS 688 Non-Thesis Masters Continuous Registration - Half Time
Registration (1 credit hour)
For students in non-thesis master's programs who have completed all
credit hour requirements for their degree but need to maintain half-time
continuous registration to complete incomplete grades, projects, final
master's exam, etc.
Prerequisite: Master's student
Typically offered in Spring only

Foreign Language-Classical Studies (CLA)

CLA 110 Greek and Latin Roots of English (3 credit hours)
Study of the formation of English words from Greek and Latin roots,
designed to build English vocabulary and word power. (Students who plan
to enter medical professions should take CLA 115. Students may not receive credit for both CLA 110 and CLA 115.)
Typically offered in Spring only

CLA 115 Medical Terminology (3 credit hours)
Study of the formation of medical terms from their Greek and Latin
roots designed both to build vocabulary and to teach the uses of a
medical dictionary. Students may not receive credit for both CLA 110 and
CLA 115.
Typically offered in Fall, Spring, and Summer

CLA 210 Classical Mythology (3 credit hours)
Greek and Roman mythology through the writings and art of the Classical
period. Discussion of creation stories, the major gods and heroes, the
underworld and afterlife, intellectual, religious and educational role of
myth, and the most important theories of interpretation and classification.
All readings and discussion in English.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Summer

CLA 215 The Ancient World in Modern Media (3 credit hours)
Study of the ways classical myth and culture appear in modern media
such as film, TV, comics, the internet and others, with focus on why
ancient stories, ideas and images are still appealing, but also how and
why they are used in new ways with new meanings.
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

CLA 320 Masterpieces of Classical Lit (3 credit hours)
Study of great works of Greek and Latin Literature in a genre such as
tragedy, comedy, epic or lyric, with attention to both literary merit and
cultural importance. All readings in English. May be taken up to three
times in different genres for credit.
R: Sophomore Standing
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

CLA 325 Gender, Ethnicity & Identity in the Ancient World (3 credit
hours)
Study of the formation of ideas and practices regarding gender, ethnicity,
and identity in the ancient Greek and Roman world, with attention to both
continuities and difference between ancient and modern views
R: Sophomore Standing
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

CLA 395 Special Topics in Classical Studies (3 credit hours)
For topics not part of regular course offerings, or offering of new courses
on a trial basis. May be taken up to three times provided the topics are
different.

CLA 398 Independent Study in Classical Studies (1-3 credit hours)
Individualized study in classical language, culture or literature. Topic,
mode of study, and credit hours to be determined in consultation with
faculty member supervising work. May be taken up to three times
provided the topic is sufficiently different. Individualized/Independent
Study and Research courses require a "Course Agreement for Students
Enrolled in Non-Standard Courses" be completed by the student and
faculty member prior to registration by the department.
R: Sophomore Standing
Foreign Languages (FL)

FL 216 Art and Society in France  (3 credit hours)
An overview of the visual arts in France, defined broadly, and their relationship to French society and culture: painting, architecture, photography, cinema, book production, gardens, fashion, food, television, popular culture, and mass media, including the Internet. The principal themes of the course are how France's cultural heritage is embodied in its rich tradition of visual expression and how artists' visual expressions have either served to represent, glorify, or critique the nation.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

FL 219/ENG 219 Studies in Great Works of Non-Western Literature  (3 credit hours)
Readings, in English translation, or non-Western literary masterpieces from the beginnings of literacy in the Middle East, Asia, and Africa to the modern period, including excerpts from texts such as the Upanishads, the Ramayana, the Sundiata, Gilgamesh, A Thousand and One Nights, and the Quran and such authors as Confucius, Oe Kenzaburo, Omar Khayyam, Rumi, and Amos Oz.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

FL 220/ENG 220 Studies in Great Works of Western Literature  (3 credit hours)
Readings, in English translation, of Western literary masterpieces, from the beginnings of literacy in the Middle East and Europe towards the present, including such authors as Homer, Sophocles, Virgil, Ovid, Augustine, Dante, Machiavelli, Shakespeare, Cervantes, Moliere, Voltaire, Goethe, Austen, Flaubert, Dickinson, Tolstoy, Kafka, and Woolf.

Credit will not be given for both ENG/FL 220 and either ENG/FL 221 or ENG/FL 222.

Restriction: Credit is not allowed for both ENG 220 and ENG 221 or ENG 222.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

FL 221/ENG 221 Literature of the Western World I  (3 credit hours)
Readings from English translations of Biblical, Classical, Medieval, and Early Renaissance literature, including works by such authors as Homer, Plato, Virgil, Ovid, St. Paul, St. Augustine, Marie de France, and Dante.

Credit is not allowed for both ENG 221 and ENG 220.

Restriction: Credit is not allowed for both ENG 221 and ENG 220.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

FL 222/ENG 222 Literature of the Western World II  (3 credit hours)
Readings from English translations of Renaissance, Neo-Classical, Romantic, and Early Modern literature, emphasizing the cultures of continental Europe from the Renaissance to 1900, and including such authors as Petrarch, Erasmus, Rabelais, Machiavelli, Shakespeare, Moliere, Voltaire, Rousseau, Goethe, Flaubert, and Tolstoy.

Credit is not allowed for both ENG 220 and ENG 222.

Restriction: Credit is not allowed for both ENG 222 and ENG 220.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

FL 223/ENG 223 Contemporary World Literature I  (3 credit hours)
Twentieth-century literature of some of the following cultures: Russian, Eastern European, Western European, Latin American, Canadian, Australian.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

FL 224/ENG 224 Contemporary World Literature II  (3 credit hours)
Twentieth-century literature of some of the following cultures: Asian, Middle Eastern, African, Caribbean, Native-American.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

FL 246/ENG 246 Literature of the Holocaust  (3 credit hours)
Fictional and nonfictional versions of the Holocaust, focusing on themes of survival, justice, theology, and the limits of human endurance.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FL 275/ENG 275 Literature and War  (3 credit hours)
A geographical and thematic examination of war and questions it raises, as reflected in selected writings from Homer, Sophocles, Japan's Tale of the Heike, Shakespeare, The Bhagavad-Gita, Keegan, Kipling, Graham Green, Mulden, Michael Herr, Dexter Filkins, Lucius Shepherd as well as writers on Just War and Deterrence Theory, and military science.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

FL 295 Special Topics in Foreign Languages and/or Literatures  (1-6 credit hours)
A special projects course on topics to be determined as needed in the departmental program.

Typically offered in Fall, Spring, and Summer

FL 298 Independent Study in Foreign Language or Literature  (1-6 credit hours)
Individualized study in a foreign language or literature. Topic, mode of study and credit hours to be determined in consultation with the faculty member supervising work. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

FL 299/ED 299 Field Experience for 21st Century Teaching  (1 credit hour)
This course has a required fieldwork component in local K-12 schools, and students are responsible for their own transportation to and from the schools. Students are required to purchase internship liability insurance to participate in this course. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge. This course is restricted to Foreign Language Education majors.

Prerequisite: ECI 204 and ED 204
Typically offered in Spring only
FL 392/ENG 392 Major World Author  (3 credit hours)
Intensive study in English, of the writings of one (or two) author(s) from outside the English and American traditions. Sample subjects: Homer, Virgil and Ovid, Lady Murasaki, Marie de France and Christine de Pizan, Dante, Cervantes, Goethe, Balzac and Flaubert, Kafka, Proust, Lessing and Gordiner, Borges and Marquez, Neruda, Achebe, Soyinka, Calvino, Walcott and Naipaul. Topics will vary from semester to semester. May be repeated for credit with new topic.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

FL 393/ENG 393 Studies in Literary Genre  (3 credit hours)
Concentrated treatment of one literary genre, such as the epic, the lyric, the drama, satire, romance, autobiography, the essay, the novel, or the short story. Treatment of materials from several national or ethnic cultures and several periods. All readings in English. Course may be taken three times for credit. Course may be taken 3 times in different genres.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

FL 394/ENG 394 Studies in World Literature  (3 credit hours)
Study of a subject in world literature: for example, African literature, Asian literature, Hispanic literature, East European literature, Comedy, the Epic, the Lyric, Autobiography, the Faust legend, or Metamorphosis. Subjects vary according to availability of faculty. Readings in English translation.

Restriction: Sophomore Standing and Above
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

FL 395 Study Abroad Programs  (1-3 credit hours)
Specific category of courses involving language and/or culture taught in foreign countries through the Department Study Abroad Program.

FL 406/ENG 406 Modernism  (3 credit hours)
Review and discuss the International Modernist movement in literature, from its nineteenth-century origins to its culmination in the early twentieth century. Identify and discuss definitions of modernity, as embodied in a variety of genres. Discuss Modernist texts within a variety of cultures that produced them.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FL 407/ENG 407 Postmodernism  (3 credit hours)
Study literary expressions of postmodernism, from its origins in the Modernist movement through its culmination in the later decades of the twentieth century and after. Examine post modernity, as embodied in a variety of genres. Situate postmodernist texts within a variety of cultures that have produced them.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FL 424/FL 524 Linguistics for ESL Professionals  (3 credit hours)
Study of the diachronic nature of language and the phonological, morphological, syntactic, and semantic features of English in relation to other world language groups. Application of linguistic principles to the ESL classroom. Analysis of common errors in grammar due to first language interference. Discussion of teaching strategies based on current research in second-language acquisition. Credit will not be given for both FL 424 and FL 524.

Typically offered in Spring only

FL 427/ECI 427/ECI 527/FL 527 Methods and Materials in Teaching English as a Second Language  (3 credit hours)
Methodologies and current approaches to teaching English as a Second Language. Techniques and strategies for teaching reading, writing, listening, speaking and culture. Selection, adaptation, and creation of instructional materials for various levels of proficiency and teaching situations. Evaluation and assessment of written and oral language proficiency through standardized and non-standardized assessment tools. Students cannot receive credit for both FL/ECI 427 and FL/ECI 527.

Typically offered in Fall only

FL 436/ECI 436/FL 536/ECI 536 Perspectives on English as a New Language  (3 credit hours)
Examination of the complexity of multiculturalism in American society and the challenges faced by immigrant families in adapting to U.S. institutions. Emphasis on understanding historical, legal, cultural and pedagogical issues with respect to learning English as a new language [ENL]. No credit given for both FL/ECI 436 and FL/ECI 536.

Typically offered in Fall only

FL 440 Internship in Teaching English as a Second Language  (3 credit hours)
Skills and techniques required in teaching ESL in a public school setting. 15 hours of classroom observation and 30 hours in direct instruction. Demonstration of competencies essential for teaching ESL. Individualized/Independent Study and Research co

Prerequisite: Admission to ESL Licensure Program, Corequisite: Teacher Licensure in any primary area
Typically offered in Fall and Spring

FL 441 Strategies and Curriculum Design in Teaching English as a Foreign Language (TEFL)  (3 credit hours)
This course provides an overview of three main aspects of teaching English as a Foreign Language: planning, instructing, and assessing. Students will examine the most common types of curricula and practice syllabus design, lesson planning, and assessments. They will explore the characteristics of different types of learners (e.g., young learners, post-secondary adults, immigrants, etc.) and their motivation for learning English. Students will practice a variety of communicative, collaborative activities for all levels and contexts.

P: FL 427 (Methods and Materials in Teaching ESL)
Typically offered in Spring only
FL 492 Senior Seminar in Foreign Languages & Literatures (3 credit hours)
Senior seminar for foreign language majors with concentration in non-European / less-commonly taught languages. Focus on recent trends in scholarship, career guidance, senior research projects or equivalent. Conducted in English. Students will be required to provide a detailed summary of their project in the language of their concentration.
Prerequisite: FLJ 301 or FLC 301 or FLN 301 or FLA 301
Typically offered in Spring only

FL 495/FL 595 Special Topics in Foreign Languages and Literatures (1-6 credit hours)
A concentrated study of a special period, author or genre to be determined as needed in the departmental program.

FL 498 Independent Study in Foreign Language or Literature (1-6 credit hours)
Individualized study of a foreign language or literature. Topic, mode of study, and credit hours to be determined in consultation with the faculty member supervising work. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.
Typically offered in Fall, Spring, and Summer

FL 505/ECI 505 Issues and Trends in Foreign Language Education: Theory & Practice (3 credit hours)
An exploration of theory and practice issues related to foreign language teaching. Inquiry into proficiency-oriented instruction, innovative methodological approaches, the National Standards and learning scenarios, integrating culture, options for testing and assessment, content-based instruction, the role of grammar in second language acquisition, teaching foreign language students with learning disabilities, and Foreign Language in the Elementary School (FLES) in North Carolina. Students will examine case studies related to these topics and engage in a classroom action research project.
Prerequisite: Graduate standing
Typically offered in Fall and Summer

FL 506 Instructional Technology in Foreign Language Education: Addressing the Standards (3 credit hours)
Hands-on experience in appropriately selecting and applying a number of instructional technologies to foreign language teaching and learning in relation to the current National Standards. Analysis and use of effective technology tools including hardware, software, and courseware. Emphasis will be on the application of Technology-Enhanced Language Learning (TELL) as it integrates the National Standards' goals of Communication, Cultures, Connections, Comparisons, and Communities.
Restriction: Graduate standing; NC Initial/A licensure in French, Spanish or ESL
Typically offered in Summer only

FL 507 College Teaching of Foreign Languages (3 credit hours)
Principles of second language acquisition and foreign language pedagogy. Examination of problematic concepts in teaching Spanish and French. Thorough treatment of instructional technology appropriate to foreign language teaching and learning. Regular
Prerequisite: Graduate status
Typically offered in Fall only

FL 508 Second Language Acquisition Research: Interlanguage Development (3 credit hours)
This course introduces students to the objectives, methods, and findings of research investigating how classroom learners acquire French and Spanish as a second language. It examines specific features of French and Spanish interlanguage including: grammatical gender, copular ser/estar and idiomatic uses of etre/avoir, pronominalization, verbal systems, and longitudinal/cross-sections studies of interlanguage development. Course content bridges the gap between second language acquisition research, foreign language teaching methodology courses, and curriculum implementation. Graduate standing or consent of instructor required.
Prerequisite: Graduate Standing or Permission of the Instructor
Typically offered in Spring only

FL 524/FL 424 Linguistics for ESL Professionals (3 credit hours)
Study of the diachronic nature of language and the phonological, morphological, syntactic, and semantic features of English in relation to other world language groups. Application of linguistic principles to the ESL classroom. Analysis of common errors in grammar due to first language interference. Discussion of teaching strategies based on current research in second-language acquisition. Credit will not be given for both FL 424 and FL 524.
Typically offered in Spring only

FL 527/FL 427/ECI 427/ECI 527 Methods and Materials in Teaching English as a Second Language (3 credit hours)
Methodologies and current approaches to teaching English as a Second Language. Techniques and strategies for teaching reading, writing, listening, speaking and culture. Selection, adaptation, and creation of instructional materials for various levels of proficiency and teaching situations. Evaluation and assessment of written and oral language proficiency through standardized and non-standardized assessment tools. Students cannot receive credit for both FL/ECI 427 and FL/ECI 527.
Typically offered in Fall only

FL 535 Teaching Academic Writing to Multilingual Learners (3 credit hours)
Students will explore current theory and research in second language writing. Topics include intercultural rhetoric, second language writing curriculum, first language grammar interference, and the development of academic vocabulary. Students will learn innovative teaching strategies and activities that help multilingual writers practice writing across genres and disciplines.
Restriction: Graduate Standing
Typically offered in Fall only

FL 536/ECI 536/FL 436/ECI 436 Perspectives on English as a New Language (3 credit hours)
Examination of the complexity of multiculturalism in American society and the challenges faced by immigrant families in adapting to U.S. institutions. Emphasis on understanding historical, legal, cultural and pedagogical issues with respect to learning English as a new language [ENL]. No credit given for both FL/ECI 436 and FL/ECI 536.
Typically offered in Fall only
FL 539/ENG 539 Seminar In World Literature (3 credit hours)
Rotating topics in world literature, including treatment of the subject's theoretical or methodological framework. Possible subjects: colonialism and literature; orality and literature; the Renaissance; the Enlightenment; translation; comparison of North and South American literatures; African literary traditions; post-modernism and gender. Readings in English (original languages encouraged but not required).

**Typically offered in Spring only**

FL 541/ENG 541 Literary and Cultural Theory (3 credit hours)
A survey of literary theory in the 20th century from New Criticism to postmodernism. Examines the virtues and pitfalls of these approaches to the study of culture and literature. A course on issues, concepts, theorists and the sociohistorical and political context in which the theorists are writing. Taught in English. No formal pre-requisites. However, students who have not had advanced literature will be disadvantaged.

**Typically offered in Fall only**

FL 595/FL 495 Special Topics in Foreign Languages and Literatures (1-6 credit hours)
A concentrated study of a special period, author or genre to be determined as needed in the departmental program.

### Foreign Languages and Literatures - Arabic (FLA)

**FLA 101 Beginning Arabic 101** (3 credit hours)
Beginning Arabic is for students who have had no prior experience with the language. It is the first in a series of courses which develop reading and writing skills in Modern Standard Arabic with active speaking and listening skills in both formal Arabic and the Egyptian dialect. Authentic materials from the Arabic media will be used in addition to text-related video and audio materials. An introduction to Arab culture will be integrated throughout the semester. This course is designed for true beginners who have had no previous experience with the Arabic language, either written or spoken. Credit will be allowed for either FLA 101 or FLA 111, but not for both.

**Typically offered in Fall only**

**FLA 102 Beginning Arabic 102** (3 credit hours)
This course is the second in a series which develops reading and writing skills in Modern Standard Arabic with active speaking and listening skills in both formal Arabic and the Egyptian dialect. Authentic materials from the Arabic media will be used in addition to text-related video and audio materials. An introduction to Arab culture will be integrated throughout the semester. This course helps students develop oral proficiency at the intermediate level. Students will practice using their speaking skills in a variety of individual and group activities to build competency in basic social situations.

Prerequisite: FLA 101 or 111

**Typically offered in Spring only**

**FLA 103 Beginning Arabic 101 Conversation** (1 credit hour)
Supplements conversational practice for FLA 101 to help students develop oral proficiency at the beginning level. Students will practice using their speaking skills in a variety of individual and group activities to build competency in basic social situations.

Corequisite: FLA 101

**Typically offered in Fall and Summer**

**FLA 104 Beginning Arabic 102 Conversation** (1 credit hour)
Supplements conversational practice for FLA 102 to help students develop oral proficiency at the advanced beginning level. Students will practice using their speaking skills in a variety of individual and group activities to build competency in basic social situations.

Corequisite: FLA 102

**Typically offered in Spring and Summer**

**FLA 201 Intermediate Arabic I** (3 credit hours)
Intermediate Arabic I is the third in a series of courses which develop reading and writing skills in Modern Standard Arabic with active speaking and listening skills in both formal Arabic and the Egyptian dialect. An increased emphasis is placed on the cultural context. Taught in English. No formal pre-requisites. However, students who have not had advanced literature will be disadvantaged.

**Typically offered in Fall only**

**FLA 202 Intermediate Arabic II** (3 credit hours)
Intermediate Arabic II is the fourth in a series of courses which develop reading and writing skills in Modern Standard Arabic with active speaking and listening skills in both formal Arabic and the Egyptian dialect. A continued emphasis is placed on the cultural context. Taught in English. No formal pre-requisites. However, students who have not had advanced literature will be disadvantaged.

**Typically offered in Spring only**

**FLA 203 Intermediate Arabic Conversation I** (1 credit hour)
Supplements conversational practice for FLA level 201 or higher. This course helps students develop oral proficiency at the intermediate level. Students will practice using their speaking skills in a variety of individual and group activities to build competency in basic social situations.

Prerequisite: FLA 201

**Typically offered in Fall only**

**FLA 204 Intermediate Arabic Conversation II** (1 credit hour)
Supplements conversational practice for FLA level 202 or higher. This course helps students develop oral proficiency at the intermediate high level. Students will practice using their speaking skills in a variety of individual and group activities to build competency in basic social situations.

Prerequisite: FLA 201

**Typically offered in Spring only**

**FLA 301 Advanced Intermediate Arabic I** (3 credit hours)
Advanced Intermediate Arabic I is the fifth in a series of courses which develop whole language skills in Modern Standard Arabic with active speaking and listening skills in the Egyptian dialect. Upon completion of this course the student will have the ability to communicate in Arabic in a variety of settings.

**Typically offered in Fall only**

**FLA 318 Egyptian Culture through Film** (3 credit hours)
This course offers a survey of cinema in modern Egypt using film as a medium to learn about the cultural and social structures in Egypt. The course incorporates weekly screenings of feature films representing different styles and periods. Students will be required to read relevant material, take essay exam questions, write film reviews, a final paper, and give a presentation of their final paper. The course is taught in English.

GEP Global Knowledge, GEP Humanities

**Typically offered in Spring only**
FLA 330 Media Arabic (3 credit hours)
An introduction to the language of print and Internet news media of the Arab world, using authentic materials from Arabic newspapers, Internet news sites, and magazines. This course provides students with the tools necessary to build a core media vocabulary base, comprehend front page news stories, read critically, and detect bias, in selected news content, and develop listening skills necessary for understanding oral news reports.
Prerequisite: FLA 202
Typically offered in Spring only

FLA 440 Modern Arabic Short Story (3 credit hours)
An advanced language skills course which introduces students to contemporary Arabic literature through selected readings of modern Arabic short stories. Students will develop an understanding of this rich literary genre as a reflection of concurrent social structures, political landscapes, and cultural traditions in Middle Eastern societies. Emphasis will also be placed on recognizing advanced grammatical structures in Modern Standard Arabic with attention given to the increased use of vernacular expression in modern literary works. Assigned readings, writing assignments, and class discussions will be in Arabic.
Prerequisite: FLA 301 or FLA 330
Typically offered in Fall only

Forestry (FOR)

FOR 150 Critical Thinking and Data Analysis (2 credit hours)
Exploration and practical experience with basis for making resource management decisions. Learning to pose questions that drive research and analysis. Discovering differences between found and built answers. Examining spreadsheet structure and functionality for manipulating data. Establishing solid grounds for conclusions and actions in natural resources contexts. Experiencing thinking processes from posing questions to articulating well-founded answers in coherent, persuasive discourse.
Typically offered in Fall and Spring

FOR 172 Forest System Mapping and Mensuration I (2 credit hours)
Concepts and application of basic forest and land resource measurement techniques used in forestry and related fields. Measuring distances and areas; orienteering; basic air photo and topographic map interpretation; introduction to GPS; measuring tree
Typically offered in Fall only

FOR 204 Silviculture (2 credit hours)
Silvical characteristics and growth requirements of forest trees; dynamics of stand growth, species-site relationships, site productivity, forest pest interactions, hydrology and nutrient cycling in forest ecosystems; emphasis on understanding and applying ecological principles to the production of multiple benefits at the forest community level.
Typically offered in Summer only

FOR 248 Forest History, Technology and Society (3 credit hours)
Examining forest resource use and issues throughout history. Tracing developments and concepts that created the context for today’s issues concerning global forest resources. Examining how wood resource availability shaped civilization’s development, and examining consequences on forest resources of civilization’s scientific, social, and technological progress.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

FOR 250 Professional Development II: Communications in Natural Resources (1 credit hours)
Development of written and oral communication skills for forestry and natural resources management. Discussion topics include interactive communication, writing to a target audience, common pitfalls in technical writing, various kinds of technical writing, poster and oral presentations, reviewing and revising writing, and responding to questions in a professional manner.
Typically offered in Spring only

FOR 252 Introduction to Forest Science (3 credit hours)
Integration of biological principles into studies of tree growth, reproduction, establishment, survival, and disturbance. Discussions of regional silviculture and of effects of humans on forest ecosystems. Instruction in forest sampling and tree identification. Many laboratories meet outdoors. Not open to Forest Management majors.
Not open to Forest Management Majors (15FOMND, 15FORMTBS, 15FGM)
Typically offered in Spring only

FOR 260 Forest Ecology (4 credit hours)
Introduction to forest ecosystems, their structure and functions, and the processes that regulate them including: radiation, temperature, water, and biogeochemistry; productivity; plant populations; forest communities; succession; natural disturbances; and human influences. Must have a strong love of trees.
Typically offered in Spring only

FOR 261 Forest Communities (2 credit hours)
Study of the species composition, distribution, site requirements, and succession of the principal forest communities of southeastern North America. Identification of important member plant species. Field trips to typical examples.
Prerequisite: FOR 339 or PB 220 or PB 403
Typically offered in Summer only

FOR 264 Forest Wildlife (1 credit hours)
Diversity of fauna that inhabits forest communities in the Piedmont of North Carolina. Inventory terrestrial and aquatic habitats and identify various vertebrate and invertebrate species. Insect collection initiated. The life histories of representat
Typically offered in Summer only

FOR 265 Fire Management (1 credit hours)
Effects of wildfire and prescribed fire on forest ecosystem components and processes; fire behavior and the ecosystem and meterologic factors that affect it; silvicultural uses of fire; organization, equipment, and tactics for wildfire suppression; fire suppression exercises on the North Carolina Division of Forest Resources’ Forest Fire Simulator.
Typically offered in Summer only
FOR 273 Forest System Mapping and Mensuration II (3 credit hours)
Procedures and Instruments for measuring various tree and stand characteristics. Determination of stem volume and taper. Planning and implementation of forest resource samples to provide population estimates using fixed-radius and variable-radius sampling. Detailed coverage of land measurements and mapping of boundary surveys. Use of aerial photography, topographic maps, and GPS to aid in resource assessment. Incorporation of inventory data into a GIS. Basic statistical concepts applied to resource measurements. Taught off-campus at Hill Forest.
Prerequisite: FOR 172
Typically offered in Summer only

FOR 293 Independent Study in Forest Management (1-6 credit hours)
Independent Study for Forest Management students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Stan
Typically offered in Fall, Spring, and Summer

FOR 294 Independent Study in Forest Management (1-6 credit hours)
Independent Study for Forest Management students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Stan
Typically offered in Fall, Spring, and Summer

FOR 295 Special Topics in Forestry (1-6 credit hours)
Study of forestry topics not covered in existing courses at the introductory level. Development of a new course on a trial basis.
Typically offered in Fall, Spring, and Summer

FOR 303 Silvics and Forest Tree Physiology (3 credit hours)
Ecological and physiological processes influencing establishment, growth, and development of forest stands with particular emphasis on forest types of Southeastern United States; influence of resource availability on forest stand productivity; physical and biochemical processes associated with tree function, including water relations, mineral nutrition, transport and translocation, photosynthesis, respiration; internal and environmental factors regulating tree growth and development.
P: (CH 101 or 103) and [(CH 201 and 202) or (CH 203 and 204) or PY 205 or PY 211]
Typically offered in Fall only

FOR 304 Theory of Silviculture (4 credit hours)
Ecological processes affecting the establishment and growth of forest stands with particular emphasis on forest types of the Southeastern United States. Forest stand productivity, how productivity is influenced by site, stand, climatic factors, and the application of site specific prescriptions to establish and manipulate the composition, growth, and health of forest stands.
Prerequisite: FOR 260 or PB 360 or AEC 360
Typically offered in Spring only

FOR 318/PP 318 Forest Pathology (3 credit hours)
Major diseases of forest trees and deterioration of wood products emphasizing principles of plant pathology: diagnosis; nature, physiology, ecology, and dissemination of disease-causing agents; mechanisms of pathogenesis; epidemiology and environmental influences; principles and practices of control.
Prerequisite: PB 200
Typically offered in Fall and Spring

FOR 319 Forest Economics (3 credit hours)
Economic approaches for evaluating the production and costs of forest management, timber harvesting activities, and non-timber forest products. Estimating the financial returns of long-term investments in timber or other forest resources, including discounted cash flow analysis and capital budgeting techniques. Property taxes and income tax treatment of timber and their effects on investment returns. Demand estimation and timber supply analyses.
Prerequisite: ARE 201 or EC 205 or EC 201
Typically offered in Fall only

FOR 330 North Carolina Forests (3 credit hours)
An introduction and overview of forests in North Carolina with emphasis on the importance of forests in the 21st century. Topics include: history and distribution of forests, soils-site relationships, forestry practices, non-conventional management objectives. Two required Saturday field trips.
Typically offered in Fall only

FOR 334 Operations Research Applications in Natural Resources (1 credit hours)
Introduction to the application and use of management science in forestry and natural resources. The course will introduce decision and information theory and mathematical programming techniques including linear, nonlinear and integer programming concepts. The emphasis is on problem formulation and solution using computer programs. Half semester course.
Typically offered in Spring only

FOR 339 Dendrology (4 credit hours)
Identification and elementary silvics of woody plants of eastern North America with studies of their classification, characteristics, and habitats. Consideration of trees from northern and western North America and the Caribbean region. Field identification with trips to forest communities.
Typically offered in Fall only

FOR 350 Professional Development III: Ethical Dilemmas in Natural Resource Management (1 credit hours)
Study of ethical issues confronting natural resource management professionals, including: biodiversity conservation, private property rights, traditional religion and ecological values, community rights, environmental racism, hunting and animal rights, business ethics, and the purpose and content of professional codes of ethics.
Prerequisite: Junior standing.
Typically offered in Spring only
FOR 353 GIS and Remote Sensing for Environmental Analysis and Assessment (3 credit hours)
This course provides a survey of topics targeting the processing and analysis of remotely sensed and other geospatial data collected in forestry, environmental, and natural resource inventory and analyses. Students develop a fundamental understanding of analysis techniques and data requirements that include aerial and photogrammetry applications, geostatistical and 3D image analyses, DEM and hydrologic modeling, image enhancement techniques, land cover classifications and accuracy assessment.

Restriction: Juniors & Seniors Only
Typically offered in Fall only

FOR 374 Forest Measurement, Modeling, and Inventory (3 credit hours)
Mathematical functions required for quantifying the yield of timber and non-timber products. Procedures for planning, conducting, and analyzing forest inventories. Use of mathematical models to estimate growth and yield of forest stands and non-timber products for management decisions.

Prerequisite: FOR 273
Typically offered in Fall only

FOR 402/ENT 402 Forest Entomology (3 credit hours)
Fundamentals of morphology, classification, biology, ecology and control of insects attacking trees, with emphasis on silvicultural practices.

Prerequisite: Junior standing.
GEP Natural Sciences
Typically offered in Spring only

FOR 405/FOR 505 Forest Management (4 credit hours)
Fundamental principles and analytical techniques necessary in the planning, management and optimization of forest operations. Formulation of objectives and constraints, yield forecasting, forest regulation, procurement and marketing, inventory methods, and management plan preparation. Written and oral reporting.

Prerequisite: FOR 304, FOR 319, FOR 374
Typically offered in Fall only

FOR 406 Forest Inventory, Analysis and Planning (4 credit hours)
Independent project in designing and implementing a multi-resource survey; analyze stand conditions; forecast growth, yield and revenue of timber and forest products; use linear programming to prepare a long-term management plan subject to economic, social, and ecological constraints; assess economic and environmental impacts of potential actions; and report results orally and in writing.

Prerequisite: FOR 405, FOR 460
Typically offered in Spring only

FOR 408/FOR 508 Hardwood Management (3 credit hours)
Examines characteristics of and requirements for successfully manipulating stands of deciduous trees to meet specific economic, habitat and social objectives. Analyzes biological and site physical factors that affect growth and yield potential, opportunities for operational activities and expected results. Compares differences among deciduous species that affect responses to silvicultural stand manipulation.

Prerequisite: FOR 204 or Junior Standing
Typically offered in Fall only

FOR 411 Forest Tree Genetics and Biology (3 credit hours)
Genetics as it is applied in forest management for both conifers and hardwoods. The variation, evolution and genetics of forest trees. Methods for selection, breeding, seed production, and vegetative propagation. Exotics, wood properties, and tree improvement as a forest management tool.

Prerequisite: Junior standing
Typically offered in Spring only

FOR 414 World Forestry (3 credit hours)
Management of global forest resources; distribution and trends in forest cover; role of forests in economic development; international production and trade of forest products; current policy issues, including tropical deforestation, certification, and carbon sequestration; social forestry and non-timber forest products; international institutions and aid for conservation and development; identification and evaluation of sources of current information on global forestry issues.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

FOR 415 World Forestry Study Tour (1 credit hours)
Field trip to Mexico and/or Central America for seven days over spring break. Examine tropical forestry issues through field visits to timber concessions, plantations, nurseries, wood products firms, protected areas, and agroforestry projects; meetings with representatives of forest research institutes, government agencies, timber industry, cooperatives, and environmental organizations; and interaction with local people. Fee for field trip determined annually. Offered during spring break, as a one week field trip to Mexico and/or Central America.

Corequisite: FOR 414
Typically offered in Spring only

FOR 420/NR 420/FOR 520/NR 520 Watershed and Wetlands Hydrology (4 credit hours)
Principles of hydrologic science; classification and assessment of watersheds and stream networks; hydrologic, erosion, and water quality processes in natural and managed watersheds; wetlands hydrology; hydrologic measurements and data analysis; applications of hydrology and water quality management for forest agriculture, and urban ecosystems; watershed restoration. Emphasis field study of watersheds and hydrologic measurements. Two weekend field trips are required. Credit will not be given for both FOR(NR)420 and FOR(NR)520.

Prerequisite: SSC 200 and (FOR 260 or PB 360 or AEC 360)
Typically offered in Fall only

FOR 422/FOR 522 Consulting Forestry (3 credit hours)
Forest land acquisition and ownership; ownership, appraisal, legal considerations, financial management and planning. Producing forest resources: timber, wildlife, recreation, farm products, water, minerals, specialty products, and development. Marketing forest resources: timber, recreation, farm leases, minerals, specialty products, and developed property. Forest resources consulting: forms of organization, pricing of services, consultant client relationships (Law of Agency), professional ethics and continuing education.

Prerequisite: Senior standing in Forest Management
Typically offered in Fall only
FOR 430 Forestry Health and Protection (3 credit hours)
This course will introduce students to the major insect and disease problems of North American forests, both native and introduced, with an emphasis on the recognition and management of pests and the damage they cause. Wild land fire, invasive plants, and climate change and their interactions with forest insect and diseases will also be covered.

Prerequisite: PB 200 or BIO 181 or BIO 183 or FOR 260 or BIO 360 or PB 360 (or other Biology or Plant Biology course).
Typically offered in Spring only

FOR 434/FOR 534 Forest Operations and Analysis (3 credit hours)
Management science and operational techniques in forestry. Logging road layout and construction, and machine systems: harvesting machine optimization and selection. Harvesting, production and forest planning. Decision and inventory theory, and other techniques for solving problems typically encountered in forest operations management. Required overnight weekend field trip.

Junior standing or above
Typically offered in Spring only

FOR 472 Forest Soils (4 credit hours)
The course will evaluate how forest soils form in the natural environment, but also their relations to forest management and sustainability. Coursework includes soil physical, chemical, and biological properties, and also special topics such as soil fertility, soil formation, soil taxonomy and classification, soil organic matter management, and soil C and N cycles. There are many factors that contribute to forest soils differing from traditional cultivated soils. These factors will be explored in addition the variation in management styles for forest soils. The goal of this course is to gain an understanding of the basic properties and processes of forest soils as well as evaluate the role of these soils in sustainable forest management. Two Saturday Labs will be required.

Prerequisites: CH 101 & CH 102 and PB 200 or BIO 181
Typically offered in Fall only

FOR 491/NR 491 Special Topics in Forestry and Related Natural Resources (1-4 credit hours)
Independent (or group) study or research of a forestry or related natural resources topic with a faculty supervisor of the student's choice. Also courses offered on a trial basis.

Typically offered in Fall and Spring

FOR 493 Independent Study in Forest Management (1-6 credit hours)
Independent Study for Forest Management students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses"

Typically offered in Fall, Spring, and Summer

FOR 494 Independent Study in Forest Management (1-6 credit hours)
Independent Study for Forest Management students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses"

Typically offered in Fall, Spring, and Summer

FOR 501 Dendrology (3 credit hours)
Identification and natural history of eastern woody species with studies of their taxonomic classification, physical characteristics, and typical habits. Laboratories stress sight recognition and use of identification keys and trips to natural forest communities.

Prerequisite: PB 200
Typically offered in Fall only

FOR 502 Forest Measurements (1 credit hours)
One-third semester mini-course. Forest measurements covering principles, terminology, and practical field applications. Land area measurement, units of timber measure (cubic feet, cords, weight, board feet), estimating volume of standing trees, sampling techniques for forest inventory (strips, plots, points), measures of site quality and stand density, methods for projecting future timber volumes.

Typically offered in Fall only

FOR 503 Tree Physiology (1 credit hours)
One-third semester mini-course. Fundamental principles of physiological processes in forest trees affecting tree and stand growth and development in natural forests and managed plantations. Concepts of whole plant physiological processes including photosynthesis, respiration, water relations, nutrition, periodic growth, sexual and vegetative reproduction, and seedling quality with forestry examples of each process.

Prerequisite: Graduate standing
Typically offered in Fall only

FOR 504 The Practice of Silviculture (3 credit hours)
The theory and practice of stand regeneration, controlling composition, intermediate treatments and growth; application of the knowledge of silvics in the management of stands. Emphasis on forest communities of North America. Co-requisite course is FOR 506: Silviculture Laboratory (Optional)

Typically offered in Spring only

FOR 505/FOR 405 Forest Management (4 credit hours)
Fundamental principles and analytical techniques necessary in the planning, management and optimization of forest operations. Formulation of objectives and constraints, yield forecasting, forest regulation, procurement and marketing, inventory methods, and management plan preparation. Written and oral reporting.

Prerequisite: FOR 304, FOR 319, FOR 374
Typically offered in Fall only

FOR 506 Silviculture Laboratory (1 credit hours)
Development of site specific prescriptions to establish stands for a wide variety of objectives, including fiber, water, wildlife, recreation and health. Emphasis on forest communities of North America.

Corequisite: FOR 504
Typically offered in Spring only

FOR 507 Silviculture Mini Course (1 credit hours)
One-third semester mini-course. A condensed version of silviculture. Ecological processes affecting establishment and growth of forest stands with particular emphasis on forest types of southeastern United States. Forest stand productivity, how productivity influenced by site, stand, climatic factors, and application of site specific prescriptions to establish and manipulate composition, growth, and health of forest stands.

Typically offered in Spring only
FOR 508/FOR 408  Hardwood Management  (3 credit hours)
Examines characteristics of and requirements for successfully manipulating stands of deciduous trees to meet specific economic, habitat and social objectives. Analyzes biological and site physical factors that affect growth and yield potential, opportunities for operational activities and expected results. Compares differences among deciduous species that affect responses to silvicultural stand manipulation.
Prerequisite: FOR 204 or Junior Standing
Typically offered in Fall only

FOR 509  Forest Resource Policy  (1 credit hours)
One-third semester mini-course. Principles of forest policies and processes. Political processes, institutional and interest group participation, forestry laws and programs, current issues, and policy analyses.
Typically offered in Spring only

FOR 510  Introduction to GPS  (1 credit hours)
One-third semester mini-course. Introduction to collection and use of mapping grade global positioning satellite systems data. Includes review of cartographic properties, mission planning, hands-on collection of GPS points, lines, and areas, differential correction, editing, and exporting GPS files to a GIS.
Typically offered in Fall only

FOR 513  Silviculture for Intensively Managed Plantations  (3 credit hours)
This course provides an up-to-date understanding of the ecological and physiological bases of forest stand productivity and a silvicultural systems framework to use this knowledge for making site specific prescriptions that are cost effective and enviro
Prerequisite: FOR 507
Typically offered in Spring only

FOR 514  Woodland Stewardship  (3 credit hours)
An introduction and overview of non-industrial private forestry in the Southeast United States with emphasis on active forest management. Topics include history of human impact on forests, evolution of forest, forestry practices, timber and non timber management objectives, financial aspects of forest land management, and management planning. One required all day field trip.
Typically offered in Fall only

FOR 519  Forest Economics  (3 credit hours)
Economics applied to problems in forest management, including timber demand and supply models, optimal rotation length, benefit-cost analysis of forestry projects, impacts of forest taxation and consideration of non-market forest goods and services.
Prerequisite: Basic course in economics
Typically offered in Fall only

FOR 520/NR 520/FOR 420/NR 420  Watershed and Wetlands Hydrology  (4 credit hours)
Principles of hydrologic science; classification and assessment of watersheds and stream networks; hydrologic, erosion, and water quality processes in natural and managed watersheds; wetlands hydrology; hydrologic measurements and data analysis; applications of hydrology and water quality management for forest agriculture, and urban ecosystems; watershed restoration. Emphasis field study of watersheds and hydrologic measurements. Two weekend field trips are required. Credit will not be given for both FOR(NR)420 and FOR(NR)520.
Prerequisite: SSC 200 and (FOR 260 or PB 360 or AEC 360)
Typically offered in Fall only

FOR 522/FOR 422  Consulting Forestry  (3 credit hours)
Forest land acquisition and ownership: ownership, appraisal, legal considerations, financial management and planning. Producing forest resources: timber, wildlife, recreation, farm products, water, minerals, specialty products, and development. Marketing forest resources: timber, recreation, farm leases, minerals, specialty products, and developed property. Forest resources consulting: forms of organization, pricing of services, consultant client relationships (Law of Agency), professional ethics and continuing education.
Prerequisite: Senior standing in Forest Management
Typically offered in Fall only

FOR 531  Wildland Fire Science  (3 credit hours)
Physical, chemical, biological, and ecological processes associated with wildland fire, particular emphasis on fire behavior, fuels, weather, climate and the associated effects on ecology, management, fire suppression, prescribed fire, and smoke emissions and exposure. Fire's effect on national policy, social and natural history of North America. In-depth exercises in fire and smoke modeling using established predictive systems.
Typically offered in Spring only

FOR 532  Wildland Firefighter  (3 credit hours)
National Wildfire Coordination Group Firefighter Type II Certification, including study of the National Incident Command Systems (ICS-100), Human Dimensions in the Wildland Fire Service (L-180) Introduction to Wildland Fire Behavior (S-190), Firefighting Safety and Training (S-130). Weekly reading seminar, lectures and problem sessions. Last 4 weeks of semester will be prescribed fire planning and field implementation of methodologies learned in course.
Typically offered in Fall only

FOR 534/FOR 434  Forest Operations and Analysis  (3 credit hours)
Management science and operational techniques in forestry. Logging road layout and construction, and machine systems: harvesting machine optimization and selection, Harvesting, production and forest planning, Decision and inventory theory, and other techniques for solving problems typically encountered in forest operations management. Required overnight weekend field trip.
Junior standing or above
Typically offered in Spring only
FOR 540 Advanced Dendrology (3 credit hours)
Identification and life histories of native and naturalized woody plants. Use of taxonomic manuals and literature. Identification of problematic groups. Concentration on North America, with discussion of other continents. Overnight field trips to natural forest communities.

Prerequisite: BO 403 or FOR 339
Typically offered in Spring only

FOR 561 Forest Communities of the Southeastern Coastal Plain (1 credit hours)
Species composition, distribution, site requirements, and succession of principal forest communities of southeastern Coastal Plain. Identification of important member plant species. Overnight field trips to typical examples.

Prerequisite: FOR 212, FOR 501
Typically offered in Summer only

FOR 565 Plant Community Ecology (4 credit hours)
Consideration of structure and function of terrestrial vascular plant communities, with emphasis on both classical and recent research. Measurement and description of community properties, classification, ordination, vegetation pattern in relation to environment, ecological succession and a survey of vegetation of North America.

Prerequisite: Undergraduate Ecology Course
Typically offered in Spring only

FOR 574 Forest Mensuration and Modeling (3 credit hours)
Study of mathematical functions required for quantifying the yield of timber and non-timber products. Procedures for planning, conducting, and analyzing forest inventories, use of mathematical models to estimate growth and yield of forest stands and non-timber products for management decisions.

Prerequisite: ST 511 or equivalent; College Calculus preferred
Typically offered in Fall only

FOR 575 Advanced Terrestrial Ecosystem Ecology (3 credit hours)
Views organisms and physical environment as integrated system. Outlines processes governing assimilation and cycling of energy, carbon, lignin, nutrients, and water. Evaluates ecosystem responses to intensive management, global climate change, air pollution, biofuels production, fragmentation, large-scale land use change. Illustrates application of ecosystem science approach to important regional and global questions through scaling of empirical, ecosystem-level data, ongoing research. Provides experience in hypothesis testing and experimental design, data analysis and interpretation, proposal development, and publication for research professionals. Graduate Standing.

Typically offered in Spring only

FOR 583 Tropical Forestry (3 credit hours)
Principles of tropical ecology, dendrology and agroforestry. Primary emphasis on establishment and management of tropical plantations with lesser emphasis on natural stands. Operation and management of tropical nurseries.

Prerequisite: Senior standing
Typically offered in Fall only

FOR 595 Special Topics (1-6 credit hours)
Individual students or groups of students, under direction of a faculty member, may explore topics of special interest not covered by existing courses. Format may consist of readings and independent study, problems or research not related to thesis. Also used to develop and test new 500-level courses.

Typically offered in Fall, Spring, and Summer

FOR 601 Graduate Seminar (1 credit hours)
Weekly seminar in which students registered for course present the results of research and special projects. Invitation to all graduate students and faculty in department to attend and join discussion.

Typically offered in Fall and Spring

FOR 603 Research Methods in Forestry and Environmental Resources (1 credit hours)
Philosophy and objectives of scientific research and steps in the research process. Basic and applied research, inductive and deductive reasoning and need for hypothesis development and testing as a basis for scientific research. Special emphasis on preparation of study plans, graduate theses, published articles and technical presentations.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

FOR 610 Special Topics in Forestry (1-6 credit hours)
Individual students or groups of students, under direction of a faculty member, may explore topics of special interest not covered by existing courses. Format may consist of readings and independent study, problems or research not related to thesis. Also used to develop and test new 500-level courses. Credits Arranged.

Typically offered in Fall, Spring, and Summer

FOR 630 Independent Study in Forestry (1 credit hours)
Independent study in Forestry under the supervision of a Forestry and Environmental Resources faculty member. Restricted to graduate students in the Department of Forestry and Environmental Resources with consent of the supervising faculty. May not be

Typically offered in Fall, Spring, and Summer

FOR 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer
FOR 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.
Prerequisite: Master's student
Typically offered in Spring only

FOR 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.
Prerequisite: Master's student
Typically offered in Fall and Spring

FOR 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

FOR 695 Master's Thesis Research (1-9 credit hours)
Thesis research.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

FOR 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master's student
Typically offered in Summer only

FOR 713 Advanced Topics In Silviculture (3 credit hours)
Critical examination of selected silvicultural topics, with special emphasis on concepts and phenomena distinguishing forests from other biotic communities and silviculture from other fields of applied biology. Emphasis on intensive silviculture in United States and selected international locations. A required written research proposal.
Prerequisite: FOR 304
Typically offered in Fall only

FOR 725/GN 725 Forest Genetics (3 credit hours)
Application of genetic principles to silviculture, management and wood utilization. Emphasis on variation in wild populations, the bases for selection of desirable qualities and fundamentals of controlled breeding.
Typically offered in Spring only

FOR 726/CS 726/ANS 726 Advanced Topics In Quantitative Genetics and Breeding (3 credit hours)
Advanced topics in quantitative genetics pertinent to population improvement for quantitative and categorical traits with special applications to plant and animal breeding. DNA markers - phenotype associations. The theory and application of linear mixed models, BLUP and genomic selection using maximum likelihood and Bayesian approaches. Pedigree and construction of genomic relationships matrices from DNA markers and application in breeding.
Prerequisite: ST 511, Corequisite: ST 512
Typically offered in Spring only

FOR 727 Tree Improvement Research Techniques (3 credit hours)
Research methods involved in forest tree breeding and genetics programs. Emphasis on laboratory, greenhouse and field research techniques. Stress also on summary and presentation of research results.
Prerequisite: FOR 411 or GN 411
Typically offered in Spring only

FOR 728 Quantitative Forest Genetics Methods (3 credit hours)
Applications of basic quantitative genetic methods in forest tree breeding and genetic research. Principles and procedures for partitioning experimental variance, estimating genetic parameters from different mating and test designs. Predicting breeding value and gain and developing breeding strategies.
Prerequisite: GN 703, ST 701
Typically offered in Fall only

FOR 734 Advanced Forest Management Planning (3 credit hours)
History, principles, structures and use of modern forest management planning and decision-making techniques. Emphasis on optimization procedures and public forest management.
Prerequisite: FOR 405 or FOR 434 or OR 501, Corequisite: FOR 772
Typically offered in Spring only

FOR 750 Ecological Restoration (3 credit hours)
Prerequisite: BO 360, SSC 200, Corequisite: BO 565
Typically offered in Spring only

FOR 753 Environmental Remote Sensing (3 credit hours)
Principles and applications of remote sensing technology to earth resources and environmental studies. Electromagnetic energy, data acquisition platforms, sensors and scanners, processing of digital remotely sensed data, error analysis and accuracy assessments, and integration of remotely sensed data with other data types used in natural resource management.
Prerequisite: FOR 353
Typically offered in Fall only
FOR 784 The Practice Of Environmental Impact Assessment (4 credit hours)
Impact assessment principles, practices and their evolution. Lectures and field practicums concerning problems addressed by environmental assessment practitioners. Practical implications of current regulatory requirements, especially concerning endangered species and wetlands, as they affect environmental practitioners' performance. Required reports combine varied technical tasks and documentation for regulatory process review.

Typically offered in Fall only

FOR 795 Advanced Special Topics in Forestry (1-6 credit hours)
Individual students or groups of students, under direction of a faculty member, may explore topics of special interest not covered by existing courses. Format may consist of readings and independent study, problems or research not related to thesis. Also used to develop and test new 700-level courses.

Typically offered in Fall and Spring

FOR 801 Seminar (1 credit hour)
Weekly seminar in which students registered for course present the results of research and special projects. Invitation to all graduate students and faculty in department to attend and join discussion.

Typically offered in Fall and Spring

FOR 803 Research Methods in Forestry and Environmental Resources (1 credit hour)
Philosophy and objectives of scientific research and steps in the research process. Basic and applied research, inductive and deductive reasoning and need for hypothesis development and testing as a basis for scientific research. Special emphasis on preparation of study plans, graduate theses, published articles and technical presentations.

Prerequisite: Grad. standing
Typically offered in Fall and Spring

FOR 810 Special Topics In Forestry (1-6 credit hours)
Individual students or groups of students, under direction of a faculty member, may explore topics of special interest not covered by existing courses. Format may consist of readings and independent study, problems or research not related to thesis. Also used to develop and test new 800-level courses.

Typically offered in Fall, Spring, and Summer

FOR 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

FOR 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

FOR 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

FOR 896 Summer Dissertation Research (1 credit hour)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

Genetic Engineering and Society (GES)

GES 506/ENT 506 Principles of Genetic Pest Management (3 credit hours)
Introduction to the biological aspects of genetic pest management (GPM). Genetic techniques for GPM, including historical uses (such as the sterile insect technique) and approaches that are currently in development. Practical issues relating to the deployment of GPM, including ecological and economic considerations.

Typically offered in Fall only

GES 508/COM 508 Emerging Technologies and Society (3 credit hours)
Provides frameworks for understanding emerging technologies and their social, political, and cultural contexts. Presents historical case studies, ethnographic accounts, and theoretical perspectives that introduce students to ways of thinking about science and technology, nature and culture, and democracy and expertise. Graduate standing is required.

Typically offered in Spring only

GES 591 Special Topics in Genetic Engineering and Society (1-6 credit hours)
Special topics and experimental course offerings in Genetic Engineering and Society.

Typically offered in Fall, Spring, and Summer

Genetics (GN)

GN 301 Genetics in Human Affairs (3 credit hours)
Appreciation and understanding of genetics in everyday life. Topics include basic principles of transmission genetics, molecular genetics, population genetics, and the effects of the environment on gene expression and phenotype. Applications of genetics in human development and disorders, genetic testing for medical and forensic purposes, and genetic engineering will be covered. Basic principles as well as ethical, legal, social, and public health issues will be covered.

GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Fall, Spring, and Summer
GN 311 Principles of Genetics (4 credit hours)
Basic concepts and principles of prokaryotic and eukaryotic genetics. Mendelian inheritance, polygenic inheritance, linkage and mapping, chromosome aberrations, population genetics, evolution, DNA structure and replication, gene expression, mutation, gene regulation, extranuclear inheritance, bacterial and viral genetics, and recombinant DNA technology.
Prerequisite: BIO 183 or ZO 160
Typically offered in Fall and Spring

GN 312 Elementary Genetics Laboratory (1 credit hours)
Genetic experiments and demonstrations using a variety of bacterial, plant and animal organisms. Mendelian inheritance, linkage analysis, population genetics, cytogenetics, biochemical genetics, DNA isolation, electrophoresis, and Southern blotting.
Corequisite: GN 311
Typically offered in Fall and Spring

GN 421/GN 521 Molecular Genetics (3 credit hours)
Biological macromolecules and their interactions, DNA topology, eukaryotic genome structure, chromatin and chromosome structure, transcription and transcription regulation, epigenetics, RNAi and RNA processing, recombinant DNA technology, genetic transformation and cloning of plants and animals. Bacteria, viruses, plants, animals and fungi as genetic systems. Students cannot receive credit for both GN 421 and GN 521.
Prerequisite: C- or better in GN 421
Typically offered in Fall and Spring

GN 423 Population, Quantitative and Evolutionary Genetics (3 credit hours)
This course is an introduction to population, quantitative and evolutionary genetics. This course will acquaint students with basic population genetics models. The course will cover genetic variation; measures of genetic variation; basic and advanced topics of selection; ecological genetics; inbreeding; genetic drift and effective population size; mutation; neutral theory and coalescence; gene flow and population structure; linkage disequilibrium and recombination; quantitative genetics; heritability; quantitative trait loci; molecular population genetics and evolution.
Prerequisite: GN 311 and (MA 131 or MA 141) with grades of C- or better
Typically offered in Spring only

GN 425 Advanced Genetics Laboratory (2 credit hours)
This is a challenging advanced genetics laboratory designed to provide research and communication training and in-depth understanding of modern genetics through hands-on activities. Students will participate in a semester-long supervised research project in contemporary genetics using a model genetic organism and state-of-the-art techniques. The project will be directly related to research in the coordinating faculty member's laboratory. The project will require literature review, hypothesis development, experimental design and execution, data analysis and presentation of results in written and oral form.
Prerequisite: GN 312; Corequisite: GN 421
Typically offered in Fall and Spring

GN 427 Introductory Bioinformatics (3 credit hours)
This course is an introduction to bioinformatics for genetic and biological sciences. The course will provide a foundation in biological computing that includes command line interfaces, reformatting data, creating and editing graphics, automating analyses and database access, and scripting in biological programming languages used for bioinformatics such as Python, Perl, and R. Laptop required.
Prerequisite: GN 311 and (MA 131 or MA 141) with grades of C- or better
Typically offered in Fall only

GN 428 Introduction to Machine Learning in Biology (3 credit hours)
New techniques in genomics have revolutionized biology, but generate large quantities of data that present challenges in extracting signal from noise. This course will provide students the basic skills to manipulate and integrate different types of biological datasets and to learn how to mine them using data analysis tools ranging from basic to state of the art. Machine learning methods provide a framework to analyze vast amounts of biological information and extract meaningful signals. By the end of the semester, students will have had exposure to a variety of modern machine learning tools for classification and prediction. We will focus on exploration of DNA data (with millions of variants), expression data (> 20,000 genes), and microbiome data (thousands of features), combined with various disease/experimental measurements. The course will cover the basics of loading and exploring datasets using visualization, followed by basic machine learning basic methods including classification and regression algorithms.
Prerequisite: C- or better in GN 421 and C- or better in MA 131 or MA 141 and C- or better in ST 311
Typically offered in Spring only

GN 441/GN 541 Human and Biomedical Genetics (3 credit hours)
This course is an in depth study of human and biomedical genetics and the role of genetics in human health and disease. The course will acquaint students with contemporary knowledge of genetics in disease causation and susceptibility, the use of model organisms to inform human biology and contemporary topics in human genetics research like epigenetics, therapeutic cloning, gene therapy, role of genetics in response to drugs and predictive medicine. Credit cannot be given for both 441 and 541.
Prerequisite: C- or better in GN 421
Typically offered in Fall only
GN 450/GN 550 Conservation Genetics  (3 credit hours)
The main objective of this course is to expose upper division undergraduate students and graduate students to conservation genetic tools and applications. Students will learn the genetic and genomic theory and methods commonly used in conservation and management of species. In addition, the course will provide hands-on experience working on current conservation projects here at North Carolina State University. Working in groups, the students will collect, run, and analyze those data for a scientific paper. The final project for all students will be a conservation genetic grant proposal.
Prerequisite: GN 311
Typically offered in Spring only

GN 451 Genome Science  (3 credit hours)
Genomic approaches with a foundation in classical and molecular genetics, including both historical strategies used in early major genome projects, and cutting edge contemporary methods for genomics and systems biology; the sequencing, assembly, and annotation of genomes and transcriptomes; use of genomic methods to tackle problems in epigenetics, metagenomics, and proteomics; application to a wide variety of species and biological questions, including evolution and human health; reading, discussion, and presentation of current scientific literature.
Prerequisite: C- or better in GN 311
Typically offered in Spring only

GN 453 Personal Genomics  (3 credit hours)
This course will teach students the principles and practices of data analysis associated with human genetic research. Students will gain an understanding of how DNA variation explains human ancestry and how DNA variation is used to identify genes affecting health.
Prerequisite: C- or better in GN 311 and C- or better in ST 311
Typically offered in Spring only

GN 456 Epigenetics, Development, and Disease  (3 credit hours)
Scientists are just beginning to fully appreciate how our genes and the environment interact to influence human development and disease. The emerging field of epigenetics offers new insights into these complex connections. Epigenetics is the study of heritable changes in gene expression and phenotypes caused by mechanisms other than changes in the underlying DNA sequence. Topics may include imprinting, mechanisms driving epigenetic modifications, how environmental exposures may influence your grandchildren's health, why identical twins exhibit differences in behavior or disease susceptibility, and epigenetic and environmental bases of diverse diseases. We will also discuss experimental strategies for studying epigenetics. JR standing.
Prerequisite: B or better in GN 311
Typically offered in Spring only

GN 461 Advanced Bioinformatics  (3 credit hours)
This course provides in-depth experience in applying bioinformatic computing techniques to experimental data with a focus on the genetic and biological sciences. The course will provide experience in genome sequence analysis and assembly, extracting, manipulating and visualizing genetic and molecular data, analysis of macromolecular sequences, and generating and visualizing phylogenetic date. Laptop required.
Prerequisite: GN 427 and ST 311 with grades of C- or better
Typically offered in Spring only

GN 490 Genetics Colloquium  (1 credit hours)
This course will involve critical study of research in genetics. Students will evaluate primary research publication on prepared topics assigned by instructor, with emphasis on review of recent and current research.
Prerequisite: GN 421
Typically offered in Spring only

GN 496 Genetics Research Experience  (3 credit hours)
GN 496 provides an opportunity for students to gain real-world experience by conducting independent research in a genetics research program. A minimum of 135 hours must be completed for the three credit hours. The experience must be arranged by the student and approved by the Director of the Undergraduate Genetics Program in advance of beginning the work. To gain approval, students must submit the completed GN 496 Contract, signed by their GN 496 supervisor (Research Mentor) and by their academic advisor. The student is required to write a research paper evaluating the results of their project. In addition to the work described in the contract, students will complete a series of reflective written assignments during and at the end of their GN 496 experience.
Minimum of sophomore standing. Limited to Genetics Majors and Genetics Minors. Students must submit required signed course contract prior to registration.
Typically offered in Fall, Spring, and Summer

GN 497 Genetics Teaching Experience  (3 credit hours)
GN 497 provides an opportunity for students to gain experience in an aspect of genetics education research and/or developing, implementing, and evaluating the effectiveness of materials for use in the genetics classroom. A minimum of 135 hours must be completed for the three credit hours. The experience must be arranged by the student and approved by the Director of the Undergraduate Genetics Program in advance of beginning the work. To gain approval, students must submit the completed GN 497 Contract, signed by their GN 497 Teaching Mentor and by their academic advisor. The student is required to write a scientific paper evaluating the results of their project. In addition to the work described in the contract, students will complete a series of reflective written assignments during and at the end of their GN 497 experience.
Minimum of sophomore standing. Limited to Genetics Majors and Genetics Minors. Students must submit required signed course contract prior to registration.
Typically offered in Fall, Spring, and Summer

GN 521/GN 421 Molecular Genetics  (3 credit hours)
Biological macromolecules and their interactions, DNA topology, eukaryotic genome structure, chromatin and chromosome structure, transcription and transcription regulation, epigenetics, RNAI and RNA processing, recombinant DNA technology, genetic transformation and cloning of plants and animals. Bacteria, viruses, plants, animals and fungi as genetic systems. Students cannot receive credit for both GN 421 and GN 521.
Prerequisite: C- or better in GN 311
Typically offered in Fall and Spring
GN 541/GN 441  Human and Biomedical Genetics  (3 credit hours)
This course is an in-depth study of human and biomedical genetics and the role of genetics in human health and disease. The course will acquaint students with contemporary knowledge of genetics in cause and susceptibility, the use of model organisms to inform human biology and contemporary topics in human genetics research like epigenetics, therapeutic cloning, gene therapy, role of genetics in response to drugs and predictive medicine. Credit cannot be given for both 441 and 541.
Prerequisite: C- or better in GN 421
Typically offered in Fall only

GN 550/GN 450  Conservation Genetics  (3 credit hours)
The main objective of this course is to expose upper division undergraduate students and graduate students to conservation genetic tools and applications. Students will learn the genetic and genomic theory and methods commonly used in conservation and management of species. In addition, the course will provide hands-on experience working on current conservation projects here at North Carolina State University. Working in groups, the students will collect, run, and analyze those data for a scientific paper. The final project for all students will be a conservation genetic grant proposal.
Prerequisite: GN 311
Typically offered in Spring only

GN 685  Master’s Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master’s student
Typically offered in Fall and Spring

GN 690  Master’s Examination  (1-9 credit hours)
For students in non-thesis master’s programs who have completed all other requirements of the degree except preparing for and taking the final master’s exam.
Prerequisite: Master’s student
Typically offered in Fall only

GN 693  Master’s Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master’s Student
Typically offered in Fall and Spring

GN 695  Master’s Thesis Research  (1-9 credit hours)
Thesis Research.
Prerequisite: Master’s Student
Typically offered in Fall and Spring

GN 696  Summer Thesis Research  (1 credit hour)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master’s student
Typically offered in Summer only

GN 699  Master’s Thesis Preparation  (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master’s degree and are writing and defending their thesis.
Prerequisite: Master’s Student
Typically offered in Fall only

GN 701  Molecular Genetics  (3 credit hours)
A discussion of the structure and function of genetic material at a molecular level. Consideration of both prokaryotic and eukaryotic systems. The aim to describe genetics in terms of chemical principles.
Prerequisite: GN 311
Typically offered in Fall only

GN 702  Cellular and Developmental Genetics  (3 credit hours)
Regulation of genes involved in cellular function, differentiation and development in eukaryotes. Presentation of biological systems and model organisms used to study genetic control of cellular and developmental processes.
Prerequisite: GN 701
Typically offered in Fall only

GN 703  Population and Quantitative Genetics  (3 credit hours)
Prerequisite: GN 311 and ST 512
Typically offered in Spring only

GN 708/ANS 708  Genetics of Animal Improvement  (3 credit hours)
Emphasis on the utilization of basic principles of population and quantitative genetics in animal improvement. Factors affecting genic and genotypic frequencies and methods of estimating genetic and nongenetic variance, heritabilities and breeding values. The roles of mating systems and selection procedures in producing superior genetic populations.
Prerequisite: GN 311 and ST 512
Typically offered in Spring only

GN 713/ANS 713  Quantitative Genetics and Breeding  (3 credit hours)
Quantitative and population genetic theory of breeding problems; partitioning of genetic variance, maternal effects, genotype by environment interaction and genetic correlation; selection indexes; design and analysis of selection experiments; marker-assisted selection.
Prerequisite: GN 509, ST 512
Typically offered in Fall only

GN 720/HS 720/CS 720  Molecular Biology in Plant Breeding  (3 credit hours)
Theory and principles of molecular biology applied to plant breeding. Experimental approaches to induce genetic change, cytoplasmic recombination, haploid utilization and potentials of molecular techniques for solving breeding problems.
Prerequisite: CS(GN,HS) 741, GN 701, GN 702, GN 703
Typically offered in Spring only
GN 721/ST 721 Genetic Data Analysis (3 credit hours)
Prerequisite: ST 430 and GN 311
Typically offered in Spring only

GN 725/FOR 725 Forest Genetics (3 credit hours)
Application of genetic principles to silviculture, management and wood utilization. Emphasis on variation in wild populations, the bases for selection of desirable qualities and fundamentals of controlled breeding.
Typically offered in Spring only

GN 730/MB 730/PP 730/PB 730 Fungal Genetics and Physiology (3 credit hours)
Basic concepts of genetics and physiology of fungi, with emphasis on saprophytic and plant pathogenic mycelial fungi. Current literature on evolution, cell structure, growth and development, gene expression, metabolism, sexual and asexual reproduction and incompatibility systems. Laboratory exercises on mutant isolation, sexual and parasexual analysis, genetic transformation, and RFLP and isozyme analysis.
Prerequisite: BCH 451, BO 775, GN 311 or PP 501
Typically offered in Spring only

GN 735 Functional Genomics (3 credit hours)
Methodology of experimental genomics; genome sequencing, gene expression arrays, genomic screens, proteomics. Aims and achievements of microbial, plant, animal, human genome projects. Applications of genomics including parasitology, breeding, functional genomics, evolutionary genetics. Interface with bioinformatics, data technology.
Prerequisite: GN 701
Typically offered in Spring only

GN 740 Evolutionary Genetics (3 credit hours)
Genetic basis of evolution. Molecular evolution, molecular population genetics, evolutionary genetics of quantitative characters and the genetics of speciation. Critical reading of original research publications and student seminars.
Prerequisite: GN 703
Typically offered in Fall only

GN 745/HS 745/CS 745 Quantitative Genetics In Plant Breeding (1 credit hours)
Theory and principles of plant quantitative genetics. Experimental approaches of relationships between type and source of genetic variability, concepts of inbreeding, estimations of genetic variance and selection theory.
Prerequisite: CS(GN, HS) 541, ST 712, course in quantitative genetics recommended
Typically offered in Spring only

GN 746/HS 746/CS 746 Cytogenetics in Plant Breeding (2 credit hours)
Theory and principles of plant breeding methodology including population improvement, selection procedures, genotypic evaluation, cultivar development and breeding strategies.
Typically offered in Spring only

GN 750 Developmental Genetics (3 credit hours)
Action and regulation of genes and gene-products in development and differentiation. Examples from microorganisms, plants and animals. Emphasis on molecular and biochemical aspects of mechanisms controlling gene expression in eukaryotic cell differentiation.
Prerequisite: GN 701, GN 702
Typically offered in Spring only

GN 755 Population Genetics (3 credit hours)
Theoretical population genetics and its relationship to natural and experimental populations. Single locus and multilocus systems, history of a gene in a population, diffusion approximations, suitability of models to natural and experimental populations.
Prerequisite: GN 703
Typically offered in Spring only

GN 756/ST 756 Computational Molecular Evolution (3 credit hours)
Prerequisite: GN 311 and ST 511
Typically offered in Fall only

GN 757/ST 757/HS 757 Quantitative Genetics Theory and Methods (3 credit hours)
The essence of quantitative genetics is to study multiple genes and their relationship to phenotypes. How to study and interpret the relationship between phenotypes and whole genome genotypes in a cohesive framework is the focus of this course. We discuss how to use genomic tools to map quantitative trait loci, how to study epistasis, how to study genetic correlations and genotype-by-environment interactions. We put special emphasis in using genomic data to study and interpret general biological problems, such as adaptation and heterosis. The course is targeted for advanced graduate students interested in using genomic information to study a variety of problems in quantitative genetics.
Prerequisite: ST 511
Typically offered in Fall only

GN 758/MB 758 Microbial Genetics & Genomics (3 credit hours)
Structure and function in microbial genetics, with emphasis on microbial genome organization, stable maintenance and evolution. DNA mutation and repair pathways, transcriptional and translational regulation, DNA replication and recombination and characterization of recombinant DNA molecules. Applications of genetic and genomic analysis methods to microbial processes, including strain construction, genome manipulation, and enhancement of gene expression.
Prerequisite: BCH 451 or GN 311
Typically offered in Spring only
GN 761/PB 761/BCH 761 Advanced Molecular Biology Of the Cell (3 credit hours)
An advanced graduate class involving integrated approaches to complex biological questions at the molecular level, encompassing biochemistry, cell biology and molecular genetics. The course will focus on an important, current area of research in eukaryotic biology using the primary scientific literature, and will involve class discussions, oral presentations, and a written research proposal.

Typically offered in Spring only

GN 768/BCH 768 Nucleic Acids: Structure and Function (3 credit hours)
An advanced treatment involving integrated approaches to biological problems at the molecular level, encompassing biochemistry, cell biology and molecular genetics. Broad, multidisciplinary approaches to solving research problems in biology and theoretical study of primary scientific literature, the development of a research proposal, oral presentations and class discussions.

Prerequisite: BCH 701 and 703
Typically offered in Spring only

GN 801 Seminar (1 credit hours)
Informal group discussion of prepared topics assigned by instructor.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

GN 810 Special Topics in Genetics (1-6 credit hours)
Critical study of selected areas and special topics of current interest in genetics and related fields.

Typically offered in Fall and Spring

GN 820 Special Problems (1-6 credit hours)
Special topics designed for additional experience and research training.

Prerequisite: Advanced Graduate standing
Typically offered in Fall and Spring

GN 850 Professionalism and Ethics (1 credit hours)
The course is designed to give students background in professionalism, scientific ethics and responsible conduct of science. Topics include the role of the scientist in society, ethical theory, data acquisition and ownership, scientific misconduct, authorship, peer review, conflicts of interest and commitment, intellectual property, ethics of teaching and mentoring, ethical treatment of animal and human subjects, ethics of genetics research, job hunting and interviewing.

Prerequisite: Graduate standing
Typically offered in Fall only

GN 860/HS 860/CS 860 Plant Breeding Laboratory (1 credit hours)
Visitation of plant breeding projects in the Depts. of CS and HS at NC State, along with commercial seed companies. Discussion and viewing of breeding objectives, methods and equipment and teaching and practice of hybridization methods.

Prerequisite: CS(GN,HS)741
Typically offered in Spring only

GN 861/HS 861/CS 861 Plant Breeding Laboratory (1 credit hours)
Visitation of plant breeding projects in the Depts. of CS and HS at NC State, along with commercial seed companies. Discussion and viewing of breeding objectives, methods and equipment and teaching and practice of hybridization methods.

Prerequisite: CS(GN,HS)741
Typically offered in Fall only

GN 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

GN 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

GN 893 Doctoral Supervised Research (1-6 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

GN 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student
Typically offered in Fall and Spring

GN 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

GN 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall and Spring
Geographic Information Systems (GIS)

GIS 205 Spatial Thinking with GIS (3 credit hours)
Spatial thinking and how it relates to the basic foundations of geospatial science and geographic information systems (GIS) are introduced. Students will learn to tell stories through maps using geographic information and geospatial data. Emphasis is placed on the nature of geographic information, working with spatial data, and elementary geospatial analysis. Students learn effective operation of GIS software and gain exposure to GIS tools that support these emphasis areas. Extensive independent learning and computer experiences include online laboratory sessions, alongside optional online or in-person weekly help sessions.

Typically offered in Fall and Spring

GIS 280 Introduction to GIS (3 credit hours)
This course provides an overview of the operations and functions of geographic information systems [GIS]. Students develop a fundamental understanding of geographic information management and analysis methods. Emphasis is placed on the nature of geographic information, working with spatial data, and elementary geospatial analysis and modeling techniques. Students learn effective operation of GIS software and gain exposure to GIS tools that support these emphasis areas. Extensive independent learning and computer experiences include online laboratory sessions, alongside optional online or in-person weekly help sessions.

Typically offered in Fall and Spring

GIS 295 Special Topics in Geospatial Information Science (1-4 credit hours)
Special Topics in Geospatial Information Science at the 200 level for offering courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

GIS 501 Geospatial Professionalism (2 credit hours)
Students will examine a variety of topics critical to successful navigation of the geospatial profession, with an emphasis on map communication and presentation, interpreting geospatial research, the ethical, legal, and social implications (ELSI) of using spatial data, metadata concepts, and linking results to policy actions. Students will engage in several writing, presentation, and interpretation exercises.

Typically offered in Fall and Spring

GIS 510 Fundamentals of Geospatial Information Science and Technology (3 credit hours)
This course provides an advanced overview of how geographic information systems [GIS] facilitate data analysis and communication to address common geographic problems. Students improve spatial reasoning and problem definition expertise while emphasizing geographic data models and structures, data manipulation and storage, customization through programming, and the integration of geospatial analysis and modeling into project-based problem solving applicable to a variety of disciplines. Skilled application of both desktop and cloud-based GIS software supports these areas. Extensive independent learning and computer experiences include virtual laboratory sessions, alongside optional online or in-person weekly help sessions to facilitate student learning.

Prerequisite: Graduate Standing or PBS or Permission of Instructor
Typically offered in Fall and Spring

GIS 512 Introduction to Environmental Remote Sensing (3 credit hours)
Principles and hands-on techniques for processing and analyzing remotely sensed data for natural resource applications. Topics include review of the electromagnetic spectrum, pre-processing (georectification, enhancements and transformations), processing (visual interpretation, indices, supervised and unsupervised classification) and post-processing (masking, change analysis and accuracy assessment) of digital image data. This course will provide students with fundamental concepts and skills needed to pursue further studies in digital processing of remotely sensed data.

Typically offered in Fall and Spring

GIS 515 Cartographic Design (2 credit hours)
Principles of cartographic design and how to apply them to produce high-quality geographic information system (GIS) based maps. Successful students will acquire an understanding of map design and experience applying it with GIS software. Students produce

Prerequisite: GIS 510
Typically offered in Fall and Spring

GIS 517/LAR 517 GIS Applications in Landscape Architecture and Environmental Planning (3 credit hours)
Introduction to the methods and applications of geographic spatial modeling technology in landscape architecture and environmental planning.

Typically offered in Fall only

GIS 520 Spatial Problem Solving (3 credit hours)
Focus on spatial problem solving from a geographic information perspective. Students learn to solve spatial problems through advanced analysis using geospatial technologies, learn to integrate and analyze spatial data in various formats, and explore methods for displaying geographic data analysis results to guide decision making. All course materials are delivered through the Internet, with optional weekly on-campus and synchronous online help sessions.

Prerequisite: GIS 510 or PA 541 or SSC 440
Typically offered in Fall, Spring, and Summer

GIS 521 Surface Water Hydrology with GIS (3 credit hours)
The application of geographic information systems (GIS) to surface water modeling including stream and watershed delineations, regulatory wetlands jurisdiction determinations, and flood mapping. In addition students will develop spatial computation methods to support hydrological analysis in land use planning, landscape management, and engineering assessments.

Prerequisite: GIS 510 or PA 541 or SSC 440
Typically offered in Fall and Spring
GIS 530  Spatial Data Foundations  (3 credit hours)
This course focuses on geospatial information systems from a mathematical and information science perspective. We discuss theoretical frameworks for conceptualizing geographic data, including levels of measurement, data control, and the vector data and raster data paradigms. Then we discuss the geometric underpinnings of geospatial systems: representing data with geographic elements, spatial referencing systems, and projection. Next, we explore map-related topology and computational geometry concepts. Finally, we survey the algorithms for core spatial manipulations, such as interpolation and polygon operations.
Prerequisite: GIS 510 or PA 541 or SSC 440
Typically offered in Fall and Spring

GIS 535  Web and Mobile GIS Protocols  (3 credit hours)
This course examines the design, development and deployment of web and mobile geospatial applications using internet and web-based protocols. Throughout the course, students will develop and deploy web and mobile GIS maps and applications relevant to their career using on-premises hosted infrastructure. Course participants will be required to complete assignments with data relevant to their interests. Additionally, students will search for and examine scientific and popular literature to understand how the course concepts are being employed and to foster ideas and discussion.
Prerequisite: GIS 510
Typically offered in Fall only

GIS 540  Geospatial Programming Fundamentals  (3 credit hours)
This course provides fundamental skills for geospatial programming. Topics include calling geographic processing tools, batch processing, performing file i/o in an external computing language and building, graphical user interfaces and displays. To support these tasks, students learn basic programming concepts, such as pseudocode, flow-control, code re-use, and debugging. In the final project, students streamline GIS work-flow and customize GIS user interfaces. Familiarity with GIS software is required, but no prior programming experience is expected.
Prerequisite: GIS 510 or PA 541 or SSC 440
Typically offered in Fall and Spring

GIS 550  Geospatial Data Structures and Web Services  (3 credit hours)
This course examines the spatial database models and structures used in geospatial information science and technology as well as the design and implementation of web and related mobile computing geospatial tools and systems. Students develop, evaluate, and deploy multiple spatial data models and web services that include connections to external data sources and systems.
Prerequisite: GIS 540
Typically offered in Fall and Spring

GIS 582/MEA 582  Geospatial Modeling  (3 credit hours)
The course provides foundations in methods for GIS-based surface analysis and modeling. The topics include proximity analysis with cost surfaces and least cost paths, multivariate spatial interpolation and 3D surface visualization. Special focus is on terrain modeling, geomorphometry, solar irradiation, visibility, and watershed analysis. Students are also introduced to the basic concepts of landscape process modeling with GIS and to the principles of open source GIS. Introductory level knowledge of GIS or surveying/ geomatics principles is required.
Typically offered in Fall and Spring

GIS 584/MEA 584  Mapping and Analysis Using UAS  (3 credit hours)
The course provides an overview of UAS mapping technology and its rules and regulations. The principles of UAS data collection are explained along with optional hands-on practice with in flight planning and execution. The main focus is on processing imagery collected from UAS using software techniques and deriving orthophoto mosaics and ultra-high resolution digital elevation models of land surface, vegetation and structures. More advanced topics include multi-temporal 3D data analysis, fusion with lidar data and 3D visualization.
Prerequisite: GIS 510 or GIS/MEA 582 or Permission of Instructor
Typically offered in Summer only

GIS 590  Geospatial Information Science Master's Project  (3 credit hours)
This is the culmination course for The Master of Geospatial Information Science and Technology degree. This course provides students with the opportunity to demonstrate their accumulated degree skills and expertise by developing and communicating the solution to a complex geospatial problem through a Master's Capstone project. The project will include interoperable spatial and non-spatial data, web services, customized user interfaces and workflows completed in collaboration with a community partner. The student will design and manage a major project and professionally communicate their analysis and results to a public audience.
Prerequisite: GIS 550
Typically offered in Fall and Spring

GIS 595  Special Topics in Geospatial Information Science  (1-6 credit hours)
Special Topics in Geospatial Information Science
Typically offered in Fall and Spring

GIS 601  Seminar in Geospatial Information Science  (1 credit hours)
Seminar in Geospatial Information Science
Typically offered in Fall and Spring

GIS 609  Geospatial Forum  (1 credit hours)
The Geospatial Forum brings together researchers, educators, practitioners, and students of the geospatial sciences in an exciting, weekly series of lively presentations and facilitated discussions centered upon frontiers in geospatial analytics and geospatial solutions to complex challenges. Live discussions are recorded and made available online for students.
Typically offered in Fall and Spring

GIS 610  Special Topics in Geospatial Information Science  (1-6 credit hours)
Special Topics in Geospatial Information Science
Typically offered in Fall and Spring

GIS 630  Independent Study  (1-3 credit hours)
Advanced topics not otherwise included in curriculum for advanced graduate students on a tutorial basis. Determination of credits and content by participating faculty in consultation with Director of Graduate Programs. Departmental consent required
Typically offered in Fall and Spring
GIS 660 MGIST Professional Portfolio (1 credit hours)
This course will focus on creating an effective digital portfolio, including content selection, description and reflection, and web site organization and design. The digital portfolio will present personal MGIST program accomplishments to demonstrate individual competences through knowledge, skills, and abilities of a geospatial science professional. Intended for students in their last semester in the MGIST Program.

Restriction: Graduate Student in the MGIST Program
Typically offered in Fall and Spring

GIS 710 Geospatial Analytics for Grand Challenges (3 credit hours)
Examination of sustainable solutions to grand societal challenges using geospatial analytics. Emphasis is placed on the roles that location, spatial interaction, and multi-scale processes play in scientific discovery and communication. Discussion of seminal and leading-edge approaches to problem-solving is motivated by grand challenges such as controlling the spread of emerging infectious disease, providing access to clean water, and creating smart and connected cities. Students also engage in several written and oral presentation activities focused on data science communication skills and professionalization.

Typically offered in Fall only

GIS 711/CSC 711 Geospatial Data Management (3 credit hours)
Data management principles and technologies for efficient implementation of geospatial applications. This course introduces students to: spatial and temporal data types, data models, geometry models, spatial predicates, spatial access methods, and spatial query processing. In addition, students will be exposed to modern data management systems for geospatial application development and data integration principles. Prior GIS programming knowledge and knowledge of database management systems and SQL is preferred.

Typically offered in Fall only

GIS 712 Environmental Earth Observation and Remote Sensing (3 credit hours)
Focus is on passive electro-optical (microwaves, infrared and visible) remote sensing and will cover the physics of remote sensing, light interactions with Earth surface materials, limitations, advantages and disadvantages of passive remote sensing techniques, estimation of bio/geo-physical parameters from remote sensing data, and sensor performance and mission design for applications including hydrology, cryosphere, atmosphere-ocean dynamics, ecosystems and carbon cycle, and land use land cover change. Students should have introductory knowledge of GIS and remote sensing.

Typically offered in Fall only

GIS 713 Geospatial Data Mining (3 credit hours)
This course equips students with the theoretical background and practical computational skills required to use data mining methodologies, including clustering, PCA, spatial autocorrelation, neural networks, classification and regression trees, and high performance, open source geocomputation. The course is designed around, and pays particular attention to, approaches for data with spatial components. Students are expected to have a working knowledge of basic geographic principles, statistical principles, GIS, and remote sensing. Some experience with R programming would also be beneficial.

Typically offered in Fall and Spring

GIS 714 Geospatial Computation and Simulation (3 credit hours)
This course focuses on theoretical concepts and computational methods that describe, represent and simulate the functioning of real-world geospatial processes. We define the general properties of geospatial computing and explain the role of simulations in analysis and understanding of observed spatial phenomena, testing of hypotheses and theories, and prediction of spatio-temporal systems behavior. We discuss the current methods and techniques for simulations using deterministic, stochastic and rule-based models as well as agent-based simulation of complex systems. Hands-on component of the course will cover implementation of simulations in GIS and advanced applications driven by the student’s research. Some prior programming experience is expected along with exposure to geospatial modeling, such as in GIS/MEA 582 or equivalent.

Restriction: 15GAPHD or Permission of Instructor
Typically offered in Spring only

GIS 715 Geovisualization (3 credit hours)
This course focuses on visualization and interface design for geospatial analytics. With readings from textbooks and visualization literature, we’ll discuss the applied science visualization, the human visual system, properties of light and color, visual salience, motion and space perception, human-computer interaction, and visual thinking processes at it relates to geospatial data. The course will also include hands-on exploration of free and open source geospatial data manipulation and geovisualization tools and interaction with current technologies within the Center for Geospatial Analytics' Geovisualization Laboratory. Some prior programming experience is preferred (GIS540 or equivalent).

Restriction: Graduate standing in Geospatial Analytics or Permission of Instructor
Typically offered in Spring only

GIS 790 Special Topics in Geospatial Analytics (1-6 credit hours)
Special Topics in Geospatial Analytics

Typically offered in Fall, Spring, and Summer

GIS 810 Special topics in Geospatial Analytics (1-6 credit hours)
Special topics in Geospatial Analytics

Typically offered in Fall, Spring, and Summer

GIS 855 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Typically offered in Fall and Spring

GIS 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Typically offered in Fall, Spring, and Summer
Geography (GEO)

GEO 200 Principles of Geography (3 credit hours)
Basic ideas in the field of geography. The scope of geography as an academic field explored. Emphasis placed on mastery of geographic tools, e.g., maps, globes, and media materials and sources. Regional study of contemporary world.

GEP Social Sciences
Typically offered in Spring only

GEO 220/SOC 220 Cultural Geography (3 credit hours)
Investigates the world's past and present cultural diversity by studying spatial patterns of population, language, religion, material and non-material culture, technology and livelihoods, communities and settlements and political organization and interaction.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall, Spring, and Summer

Global Knowledge (GK)

GK 295 Global Knowledge Special Topics (1-3 credit hours)
Special topics course offering for the general education Global Knowledge category.

Global Public Health (GPH)

GPH 201 Fundamentals of Global Public Health (3 credit hours)
Introduction to Public Health, providing a population-based perspective on disease and injury causation and prevention. Environmental, social, behavioral, and biological determinants of health and disease. Access to health services from a global perspective. Selected tools of disease control and health promotion and problems related to health-care delivery to society as a whole and to vulnerable populations.

Typically offered in Fall only

GPH 404/ST 404 Epidemiology and Statistics in Global Public Health (3 credit hours)
This course will provide a general introduction to the quantitative methods used in global health, combining elements of epidemiology and biostatistics. The course will focus on linear and logistic regression, survival analysis, traditional study designs, and modern study designs. Students will learn fundamental principles in epidemiology, including statistical approaches, and apply them to topics in global public health. The course prerequisite is a B- or better in one of these courses: ST 305, ST 311, ST 350, ST 370, or ST 371. In addition, a B- or better in GPH 201 is strongly recommended.

Pre-requisite: B- or better in one of these courses: ST 305, ST 311, ST 350, ST 370, or 371
Typically offered in Fall only

GPH 425 Global Health and Physiology (6 credit hours)
This Study Abroad course is designed to immerse students in current physiology and disease research, tropical medicine, and global health issues while providing students with an opportunity to gain hands-on experience in the field of global health. Students spend three weeks on campus exploring scientific, policy, cultural, and governmental influences on global health before traveling to a developing country to participate in medical service outreach for 2 weeks. Application to and acceptance into this Study Abroad course and payment for travel is required for course participation.

Prerequisite: C- or better in BIO 212 or BIO 250 of BIO 240 or BIO 245
Typically offered in Summer only

Graduate Economics (ECG)

ECG 505 Applied Microeconomic Analysis (3 credit hours)

Prerequisite: EC 301 and MA 121
Typically offered in Fall only

ECG 506 Applied Macroeconomic Analysis (3 credit hours)
Applied course in aggregate economics. Analysis of aggregate economic fluctuations and stabilization policy; inflation and disinflation; the Federal budget and international balance of trade; and economic growth. Capital markets, monetary and fiscal policy, banking system, foreign exchange markets and their effects on business conditions. Development of standard macroeconomic model in context of specific applications.

Prerequisite: EC 302 and MA 121
Typically offered in Spring only

ECG 512 Law and Economics (3 credit hours)
Economic analysis of sources and effects of law, including common law, statutory law and regulation. Property rights and contracts, liability rules, crime and punishment, statutory enactment, bureaucratic behavior and institutional reform.

Prerequisite: EC(ARE) 301 or EC(ARE) 401
Typically offered in Spring only

ECG 515 Environmental and Resource Policy (3 credit hours)
Application of price theory and benefit-cost analysis to public decisions related to resources and environment. Emphasis on evaluation of water supply and recreation investments, water quality management alternatives, public-sector pricing, common property resources and optimum management of forest and energy resources.

Prerequisite: EC(ARE) 301 or 401
Typically offered in Spring only
ECG 528/MBA 528/FIM 528/MA 528 Options and Derivatives

**Pricing (3 credit hours)**
The course covers (i) structure and operation of derivative markets, (ii) valuation of derivatives, (iii) hedging of derivatives, and (iv) applications of derivatives in areas of risk management and financial engineering. Models and pricing techniques include Black-Scholes model, binomial trees, Monte-Carlo simulation. Specific topics include simple no-arbitrage pricing relations for futures/forward contracts; put-call parity relationship; delta, gamma, and vega hedging; implied volatility and statistical properties; dynamic hedging strategies; interest-rate risk, pricing of fixed-income product; credit risk, pricing of defaultable securities.

Prerequisites: MA 341 and MA 405 and MA 421
Typically offered in Fall only

**ECG 530 Topics in Labor Economics (3 credit hours)**
This course covers topics in labor economics including labor supply, labor demand, human capital, household production, discrimination, and immigration. The course textbook will be supplemented with readings from academic research papers. Students will learn how empirical research evaluates the predictions of economic theory and the impact of public policy. Students will gain an understanding of how to read and critique empirical research by applying the theory and measurement techniques developed by economists.

Prerequisites: ECG 505 and ECG 561
Typically offered in Spring only

**ECG 537 Health Economics (3 credit hours)**
Microeconomic analysis of public and private policy issues concerning health care financing and delivery in United States including: choice under conditions of asymmetric information; health insurance; performance of physician, hospital, long-term care and pharmaceutical markets.
Prerequisite: EC(ARE) 401 or ECG 700
Typically offered in Fall only

**ECG 540 Economic Development (3 credit hours)**
Examination of problems encountered in promoting regional and national economic development. Consideration given to structural changes required for raising standards of living. Some basic principles of economics applied to suggest ways of achieving development goals. Planning strategies, policies and external assistance.
Prerequisite: EC(ARE) 301 or 401
Typically offered in Spring only

**ECG 548 International Economics (3 credit hours)**
This course covers the determinants of international trade, migration, and investment and their connection with economic growth. It also covers macro/monetary issues, including exchange rates, financial markets and monetary-fiscal policy in open economies.
Prerequisite: EC 301
Typically offered in Spring only

**ECG 561/ST 561 Applied Econometrics I (3 credit hours)**
Introduction and application of econometrics methods for analyzing cross-sectional data in economics, and other social science disciplines, such as OLS, IV regressions, and simultaneous equations models. Students should have had a statistical methods course at the 300 level or above as well as Calculus I and II.
Typically offered in Fall only

**ECG 562 Applied Econometrics II (3 credit hours)**
This course is a continuation of Applied Econometrics I (ECG 561). After a review of probability and statistics, and simple and multiple regression models, we explore the following topics: regression using panel (longitudinal) data, instrumental variables regression, regression with a binary dependent variable, prediction with many regressors and "Big Data" methods, and time series regression. The emphasis is on recognizing the conditions in which it is appropriate to apply the various techniques, formulating a relevant model, estimating the model and interpreting the results. This course will also provide the students practical experience in applied econometrics using STATA.
P: ECG 561
Typically offered in Spring only

**ECG 563 Applied Microeconometrics (3 credit hours)**
This course will survey econometric methods for the analysis of panel and limited dependent variable data. Both the theoretical foundation and empirical application of methods will be covered. Topics include fixed and random effects, program evaluation, censored, truncated, discrete choice and count data models. Although not required, ECG 561, ST 511 or ST 512 is encouraged prior to taking this class.
Typically offered in Fall only

**ECG 560 Master's Thesis Research (1-9 credit hours)**
Thesis research.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

**ECG 685 Master's Supervised Teaching (1-3 credit hours)**
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall and Spring

**ECG 690 Master's Examination (1-9 credit hours)**
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

**ECG 695 Master's Thesis Research (1-9 credit hours)**
Thesis research.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer
ECG 700 Fundamentals of Microeconomics (3 credit hours)
Prerequisite: MA 131 and EC(ARE)301
Typically offered in Fall only

ECG 701 Microeconomics I (3 credit hours)
Prerequisite: ECG 700, MA 231
Typically offered in Fall only

ECG 702 Microeconomics II (3 credit hours)
Prerequisite: ECG 701
Typically offered in Spring only

ECG 703 Fundamentals of Macroeconomics (3 credit hours)
Fundamental topics in macroeconomics, including investment, government purchases, taxation, government debt, output supply, money and inflation, unemployment, elementary economic growth. Emphasis is on the microeconomic foundations of macroeconomics. Economic intuition is stressed.
Prerequisite: EC(ARE) 301, EC 302, BUS(ST)350, MA 131
Typically offered in Spring only

ECG 704 Macroeconomics I (3 credit hours)
Rigorous examination of basic macroeconomic theory, including household choice of consumption demand and labor supply, capital accumulation and economic growth, government purchases, taxation, government debt, investment, consumption and investment under uncertainty, real business cycle models. Throughout the course, the connection between economic intuition and formal mathematical analysis is emphasized. The level of mathematical rigor is high.
Prerequisite: ECG 561, ECG 703, MA 242
Typically offered in Fall only

ECG 705 Macroeconomics II (3 credit hours)
Continuation of ECG 704. Topics include, but are not limited to, money demand and supply; money and growth; inflation; term structure of interest rates; money and fluctuations, including real and New Keynesian models; theories of unemployment; conduct of policy and problems of time consistency; asset pricing; introduction to open economy models.
Prerequisite: ECG 704
Typically offered in Spring only

ECG 706 Industrial Organization (3 credit hours)
Survey of microeconomic literature on industrial organization: internal structure of the firm, number and sizes of firms in an industry, pricing and output behavior of firms. Public policy, including antitrust laws, patent and copyright laws, and government regulation of industry.
Prerequisite: ECG 700
Typically offered in Fall only

ECG 707 Topics In Industrial Organization (3 credit hours)
Advanced study of selected topics such as oligopoly theory, empirical models of industry, principal-agent contracts, economic theories of firm organization, antitrust issues, economic theories of regulation and economics of property rights.
Prerequisite: ECG 700
Typically offered in Spring only

ECG 708 Advanced Microeconomic Theory (3 credit hours)
Survey of literature on game theory focusing on applications to numerous areas of economics. Course will cover the classic literature on auctions, matching theory and non-cooperative game theory. Special focus on applying these theoretical results to practical problems of market design.
Prerequisite: ECG 702
Typically offered in Fall only

ECG 709 Behavioral and Experimental Economics (3 credit hours)
Survey of literature on behavioral and experimental economics from a broad perspective, with coverage of numerous fields of economics, including both laboratory and field experiments. Methodology of experimental economics and design of laboratory and field experiments will be covered.
Prerequisite: ECG 702
Typically offered in Spring only

ECG 710 Environmental and Resource Economics (3 credit hours)
Theoretical tools and empirical techniques necessary for understanding resource and environmental economics, developed in both static and dynamic framework. Discussions of causes of environmental problems, possible policies and approaches to nonmarket valuation. Analysis of resource use over time using control theory for both renewable and exhaustible resources.
Prerequisite: ECG 700
Typically offered in Fall only

ECG 711 Topics In Environmental and Resource Economics (3 credit hours)
Advanced study of selected topics in environmental and resource economics. Topics vary with interests of instructor and students.
Prerequisite: ECG 710
Typically offered in Spring only

ECG 712 Labor Economics (3 credit hours)
Application of microeconomic theory and econometric methods to labor market behavior in both static and dynamic contexts. Labor demand analysis, labor force participation, hours of work, household production, human capital, distribution of earnings, information and search, and mobility.
Prerequisite: ECG 700 and one of the following: ECG(ST) 561, ST 422, ST 512, ST 708
Typically offered in Fall only
ECG 739  Empirical Methods for Development Economics and Applied Microeconomics  (3 credit hours)
This course will provide an in-depth study of the application of the core tools of causal inference and microeconometrics to answer questions in development microeconomics. The class will largely consist of two activities: (1) close reading and guided discussion of seminal and recent papers and (2) the analysis of real data to estimate causal relationships. While the particular applications we study will come largely from development economics, the course is intended to be useful to students in diverse areas of applied micro.
Prerequisite: ECG 751 and ECG 753
Typically offered in Fall only

ECG 740  Economic Growth and Development  (3 credit hours)
Microeconomic issues of growth. Technology adoption and the distributional effects of technical change; the role of agriculture in economic development; land tenure and tenancy arrangements; the role of agrarian institutions in the development process; and poverty, inequality and economic growth in developing countries. Approximately equal time devoted to theory and evidence.
Typically offered in Fall only

ECG 741  Agricultural Production and Supply  (3 credit hours)
Advanced study in logic of, and empirical inquiry into, producer behavior and choice among combinations of factors and kinds and qualities of output; aggregative consequences of individuals' and firms' decisions in terms of product supply and factor demand; factor markets and income distribution; and general interdependency among economic variables.
Prerequisite: ECG 700
Typically offered in Spring only

ECG 742  Consumption, Demand and Market Interdependency  (3 credit hours)
Analysis of behavior of individual households and of consumers in aggregate with respect to consumption of agricultural products; impact of these decisions on demand for agricultural resources, competition among agricultural regions and for markets; and interdependence between agriculture and other sectors of the economy.
Prerequisite: ECG 700
Typically offered in Spring only

ECG 743  Theory Of International Trade  (3 credit hours)
Consideration of specialized body of economic theory dealing with international movement of goods, services, capital and payments. A theoretically oriented consideration of policy.
Prerequisite: ECG 700, 703
Typically offered in Spring only

ECG 744  Monetary Aspects Of International Trade  (3 credit hours)
Macroeconomic problems of an open economy including balance of payments adjustment mechanism, alternative exchange rate systems, external effects of monetary and fiscal policy, optimum currency areas and international monetary reform.
Prerequisite: ECG 703
Typically offered in Fall only

ECG 750/ST 750  Introduction to Econometric Methods  (3 credit hours)
Introduction to principles of estimation of linear regression models, such as ordinary least squares and generalized least squares. Extensions to time series and panel data. Consideration of endogeneity and instrumental variables estimation. Limited dependent variable and sample selection models. Attention to implementation of econometric methods using a statistical package and microeconomic and macroeconomic data sets.
Prerequisite: ST 421; Corequisite: ST 422
Typically offered in Spring only

ECG 751/ST 751  Econometric Methods  (3 credit hours)
Introduction to important econometric methods of estimation such as Least Squares, Instrumental Variables, Maximum Likelihood, and Generalized Method of Moments and their application to the estimation of linear models for cross-sectional economic data. Discussion of important concepts in the asymptotic statistical analysis of vector process with application to the inference procedures based on the aforementioned estimation methods.
Prerequisite: ST 421, ST 422
Typically offered in Fall only

ECG 752/ST 752  Time Series Econometrics  (3 credit hours)
The characteristics of macroeconomic and financial time series data. Discussion of stationarity and non-stationarity as they relate to economic time series. Linear models for stationary economic time series: autoregressive moving average (ARMA) models;
Prerequisite: ECG(ST) 751
Typically offered in Spring only

ECG 753/ST 753  Microeconometrics  (3 credit hours)
The characteristics of microeconomic data. Limited dependent variable models for cross-sectional microeconomic data: logit/probit models; tobit models; methods for accounting for sample selection; count data models; duration analysis; non-parametric methods
Prerequisite: ECG 751
Typically offered in Spring only

ECG 765  Mathematical Methods For Economics  (3 credit hours)
Linear algebra and matrices, optimization with equality and inequality constraints, comparative statistics, differential and difference equations, intertemporal optimization. Economic applications to utility and profit maximization, national income determination, economic growth, business cycles.
Prerequisite: MA 231 , introductory course in linear algebra
Typically offered in Fall only
ECG 766  Computational Methods in Economics and Finance  (3 credit hours)
Fundamental methods for formulating and solving economic models numerically will be developed. Emphasis on defining the mathematical structure of problems and practical computer methods for obtaining model solutions. Major topics include solution of systems of equations, complementarity relationships and optimization. Finite and infinite dimensional problems will be addressed, the latter through the use of finite dimensional approximation techniques. Particular emphasis placed on solving dynamic asset pricing, optimization and equilibrium problems. MS in Financial Mathematics Program required.

Prerequisite: (MA 305 or MA 405) and MA 341 and EC 301 and EC 302 and (CSC 112 or 114) or equivalents.

Typically offered in Fall only

ECG 784  Advanced Macroeconomics  (3 credit hours)
Advanced study of macro-economics. Emphasis on business cycles and behavior of real variables. Real, incomplete information and disequilibrium theories of the business cycle; rational expectations; contract theory and indexation; investment; and effects of government expenditure, taxes and debt.

Prerequisite: ECG 704
Typically offered in Spring only

ECG 785  Monetary Economics  (3 credit hours)
Field course for students desiring a specialization in monetary economics or macroeconomics. Survey of current topics in monetary theory and policy.

Prerequisite: ECG 705
Typically offered in Spring only

ECG 790  Advanced Special Topics  (1-6 credit hours)
Typically offered in Fall and Spring

ECG 830  Independent Study  (1-3 credit hours)
Typically offered in Fall and Summer

ECG 885  Doctoral Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

ECG 890  Doctoral Preliminary Examination  (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

ECG 895  Doctoral Dissertation Research  (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

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**Graphic Communications (GC)**

**GC 120  Foundations of Graphics**  (3 credit hours)
Introductory course providing orientation to language of graphics for students majoring in any field. Designed to help develop ability to use CAD within the context of a concurrent design process to understand how everyday objects are designed, analyzed and created. Emphasis placed on decision-making processes involved with creating geometry and development of modeling strategies that incorporate intentions of designer.

**GEP Visual and Performing Arts**

**Typically offered in Fall, Spring, and Summer**

**GC 250  Architectural Graphic Communications**  (3 credit hours)
Architectural Graphic Communications is an advanced graphic course designed to expand on the concepts covered in the introductory courses (GC 120, GC 210, GC 211). The emphasis is on strengthening architectural sketching and CAD drawing skills and showing how specific construction processes and materials selected for an architectural design affect commercial and residential production architectural drawings. Topics include perspective drawing, shadow projection, texturization, rendered plans, elevations and other related topics.

Prerequisite: GC 120 or TDE 220

Typically offered in Fall and Spring

**GC 320  3D Spatial Relations**  (3 credit hours)
Analysis and solution of three-dimensional space problems utilizing graphic principles of orthogonal projection techniques. Application of studies of lines; surfaces; solids; surface intersections; surface development; vectors; and civil, mechanical, and geographical structures.

Prerequisite: GC 120

**GEP Mathematical Sciences**

**Typically offered in Fall and Spring**

**GC 330  Basic Technical Animation**  (3 credit hours)
Create technical animations to communicate scientific and technical information to a variety of audiences and environments. Includes performing basic skills in image processing including cropping, transformations, color manipulation and color enhancement. Students will apply basic concepts of constructing 3-D objects, spaces, and environments. Create technical animations which apply environmental attributes including surface study, texture, color, lighting models, photorealism, and raytracing.

Prerequisite: GC 120 or TDE 220

Typically offered in Fall only

**GC 340  Concepts of Website Development**  (3 credit hours)
An introduction to the essential elements of web site development for students in Technology Education and Graphic Communications. Content focuses on planning and executing web site for educational effectiveness, user interfaces, site testing, and maintenance. Course provides instruction in software appropriate for creating a website.

Typically offered in Summer only
GC 350 Applied CAD/D and Geometric Controls (3 credit hours)
Techniques for producing mid-level computer models of individual parts and assemblies of parts. Application of conventional tolerancing and geometric tolerancing and dimensioning. Investigation of design for manufacture and CAD/CAM (Computer-Aided Design) systems. 
Prerequisite: GC 120
Typically offered in Fall and Spring

GC 420 Visual Thinking (3 credit hours)
Develop visual thinking skills through a series of exercises using various visual media. Integrate and stress drawing and construction activities essential to visual thinking. Emphasis on direct observation (seeing), mental imagery and sketching that is based upon three-dimensional space. Develops students' visual and drawing skills and provides for their application toward solving open-ended spatial problems. Intended for the scientific and technically oriented student.

Typically offered in Fall and Spring

GC 450 Advanced Graphics Usage with CAD (3 credit hours)
Advanced applications of 3-dimensional solid modeling tools in technical and engineering environments. Theory and application of manufacturing databases developed with 3-D modeling tools. Development and management of 3-D geometry using modeling software.
Prerequisite: GC 350 -- Applied CAD/D and Geometric Controls
Typically offered in Fall and Spring

GC 496 Special Topics in Graphic Communications (1-4 credit hours)
Topical study in areas of current interest and need to students and/or needs of curricula served by Graphic Communications.
Typically offered in Fall, Spring, and Summer

GC 498 Independent Study in Graphic Communications (1-4 credit hours)
Independent study in areas of current interest and needs of students in the field of Graphic Communications and the visual sciences. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standards Program".
Prerequisite: GC 120 or TDE 220
Typically offered in Fall, Spring, and Summer

Graphic Design (GD)

GD 201 Design, Context, and Experience (6 credit hours)
Introduction to analysis and form-making in graphic design through investigations of design artifacts as components of larger and physical, social, cultural, and technological systems. Appropriate student-owned technology and software required. Graphic Design Majors Only, except with Department Head permission.
Prerequisite: GD 210 Co-requisite: GD 217
Typically offered in Fall only

GD 202 Designing for Settings, People, and Use (6 credit hours)
Relationships among audience/user interpretive behavior, attributes of physical and cultural settings, and objects with attention to different perspectives on the role of the designer. Graphic Design Majors Only, except with Department Head permission.
Prerequisite: GD 201, GD 217; Corequisite: GD 317
Typically offered in Spring only

GD 203 History of Graphic Design (3 credit hours)
Events, ideas, movements, designs and individuals that have historical significance and influence on contemporary graphic design and the graphic design profession. Concentration on graphic design of the last 100 years.
GEP Visual and Performing Arts
Typically offered in Spring only

GD 210 Image and Tech Tinkering (6 credit hours)
GD 210 is an introduction to exploration with imagery and technology. It introduces basic critical and interpretive ideas about images in context and with users in mind. This includes fundamentals of both the reproduction and experience of imagery that are particularly relevant to the Graphic Design curriculum. GD 210 also introduces students to technologies relevant to current and future design practice, and nurtures rapid ideation through prototyping techniques. Graphic Design majors only, except with Department Head permission.
Prerequisite: D 104
Typically offered in Spring only

GD 217 Typography and Technology (3 credit hours)
Introduction to typography with respect to four primary systems: reading, form, language, and technology. Appropriate student-owned technology and software required. Graphic Design majors only, except with Department Head permission.
Prerequisite: GD 210
Typically offered in Fall only

GD 301 Branding, Interaction, and Service Design (6 credit hours)
Investigations of branding, interaction, and service design in response to problems of complex systems and contexts. Graphic Design majors only, except with Department Head permission.
Prerequisite: GD 202. Corequisite: GD 417
Typically offered in Fall only

GD 303 Graphical Design Theory and Practice (3 credit hours)
An examination of theories and critical perspectives shaping graphic practice. The course includes a discussion of contemporary design strategy in business and the role of visual communication in the information age.
GEP Visual and Performing Arts
Typically offered in Fall only

GD 310 Visualization, Representation, and Display (3 credit hours)
Surveying, documenting, and interpreting sites and subjects; representing relationships among settings, people, and objects through image-making strategies, such as activity maps, interviews, panoramas, and visual essays. Graphic Design majors only, except with Department Head permission for other college of design majors.
Prerequisite: GD 210
Typically offered in Spring only
GD 317 Typographic Language, Writing, and Reading (3 credit hours)
Continuation of typography and technology with greater emphasis on the individual reading experience, including page sequencing, grids, and the relationship between historical conventions and new interpretive demands on readers. Graphic Design majors only, except with Department Head permission.
Prerequisite: GD 217
Typically offered in Spring only

GD 400 Advanced Graphic Design Studio (6 credit hours)
Topical and interdisciplinary studios addressing advanced visual communication problems. Graphic Design Majors only, except with Department Head permission.
Prerequisites: GD 301 and GD 203 and GD 303
Typically offered in Fall and Spring

GD 401 Graphic Design Practicum (3 credit hours)
Capstone experience focused on the transition from school to career. Individual capstone project and discussions of professional practice, guidelines, and ethics. Graphic Design majors only, seniors.
Prerequisite: GD 301 and GD 410 and GD 417
Typically offered in Fall only

GD 410 Online and Mobile Interaction Design Systems (3 credit hours)
Exploration of dynamic communication systems, including methods for visualizing user interaction, setting conditions for user experience, and managing collaborative work. Graphic Design majors only, except with Department Head permission for other College of Design majors.
Prerequisite: GD 310
Typically offered in Fall only

GD 417 Information and Publishing Design Systems (3 credit hours)
Continuation of typographic language, writing, and reading with attention to advanced grid, form, and font systems in the design of multi-page documents, as well as issues of production and printing. Graphic Design majors only, except with Department Head permission.
Prerequisite: GD 317
Typically offered in Fall only

GD 490 Graphic Design International Studio (6 credit hours)
Define visual communication design problems and develop design solutions in an international setting. Studio projects related to design, culture, and traditional and contemporary visual communication. Directed studies in history and culture, and in artifact making. Additional travel and trip costs are required beyond registration fees, as well as appropriate immunizations. Graphic Design majors and departmental approved Elective (“swing”) Studio for all other College of Design Majors with Junior or Graduate Standing in Major.
Prerequisite: Junior standing in the major and Study Abroad Office approval
Typically offered in Summer only

GD 492 Special Topics in Graphic Design (3 credit hours)
Topics of current interest in Graphic Design. Normally used to develop new courses. Graphic Design Majors, and department approved elective for all other college of Design Majors with Junior or Graduate standing in major.
Prerequisite: Jr standing in Graphic Design major
Typically offered in Fall, Spring, and Summer

GD 494 Internship in Graphic Design (3 credit hours)
Supervised field experience in graphic design offices and organizations. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior
Prerequisite: Junior standing in Graphic Design and 3.0 GPA or better
Typically offered in Fall, Spring, and Summer

GD 495 Independent Study in Graphic Design (1-3 credit hours)
Special projects in graphic design developed under the direction of a faculty member on a tutorial basis. Individualized/Independent Study and Research courses require a “Course Agreement for Students Enrolled in Non-Standard Courses” be completed by
Prerequisite: Junior standing in Graphic Design and 3.0 GPA or better
Typically offered in Fall, Spring, and Summer

GD 501 Graduate Graphic Design Studio (9 credit hours)
Student-defined graphic design projects in response to critical content framework presentation by GD 571 faculty. Center of framework on role of design objects as cognitive artifacts and extension, transformation or diminishment of human thought by their form and content. Interaction of potential audiences with designer-created artifacts. Graphic design majors only.
Corequisite: GD 571
Typically offered in Fall only

GD 502 Graduate Graphic Design Studio II (9 credit hours)
Student-defined graphic design projects in response to critical content framework presentation by GD 572 faculty. Center of framework on role of design objects as cultural artifacts and their reflection on social diversity of both designers and audiences. Creation, reproduction, distribution and reception of messages in both designer-created artifacts and audience’s response. Graphic design majors only.
Prerequisite: GD 501, Corequisite: GD 572
Typically offered in Fall only

GD 503 Graduate Graphic Design Studio III (9 credit hours)
Student-defined graphic design projects in response to critical content framework presentation by GD 671 faculty. Center of framework on nature of new information environments. Shape and response of technologies to new cognitive and cultural relationshi
Prerequisite: GD 573, Corequisite: GD 671
Typically offered in Spring only

GD 510 Imaging for Graphic Design IV (3 credit hours)
Advanced problems in the visual design and structuring of information in interactive multimedia presentations. Topics include the design of interfaces, navigation, motion graphics, and websites as well as exploration of narrative and hypermedia approaches to the organization of content.
Prerequisite: GD 410, Design Majors
Typically offered in Spring only
GD 517 Type IV (3 credit hours)
Advanced problems of typographic expression/communication in which
typographic variables are used to alter, enhance, or reinforce verbal
meaning. Historic precedent and experimentation with the conventions for
typographic form are explored. The impact of the computer on changes in
typographic aesthetics, including motion graphics, typeface design, and
website design.

Prerequisite: GD 417, Design Majors
Typically offered in Spring only

GD 571 Design As Cognitive Artifact (3 credit hours)
Relationship between theories of human cognition and graphic design.
Analysis and critique of design objects as cognitive artifacts and
extension, transformation or diminishment of human thought by their
form and content. A critical examination of cognitive, linguistic and social
science theories shaping graphic design. Non-majors by permission only.

Typically offered in Fall and Spring

GD 572 Design as Cultural Artifact (3 credit hours)
Introduction to recent theories in various disciplines concerning a cultural
understanding of graphic design. Theories of mass and popular culture,
critiques of creativity and authorial intentionality, influences of interpretive
criticism, theories of consumption and issues of cultural representation.
Emphasis on adaptation of these theories to an understanding of the
cultural significance of graphic design. Non-majors by permission only.

Typically offered in Fall and Spring

GD 573 New Information Environments (3 credit hours)
Changing role of graphic design in new information environments.
Implications of new technology on social construction of meaning, impact
of electronic media on culture and cognition, and differences in designing
artifacts and designing experiences. Non-majors by permission only.

Prerequisite: GD 503
Typically offered in Spring only

GD 580 Special Topics in Graphic Design History (1-6 credit hours)
Topics of current interest in interpretation, criticism, methodology and
research, related to graphic design history. Further specialized study
in history of printing, typography, communication, image-making and
information systems. Investigation of how we study artifacts, production
and producers.

Prerequisite: GD 242
Typically offered in Spring only

GD 581 Graphic Design Final Project Research (3 credit hours)
A seminar course to assist students in preparing foundation for final
project to be conducted in GD 688 Final Project Studio.

Prerequisite: GD 502
Typically offered in Fall only

GD 588 Final Project Studio in Graphic Design (6 credit hours)
Final project for graduate students supervised by members of their
graduate advisory committees.

Prerequisite: GD 581
Typically offered in Spring only

GD 592 Special Topics In Graphic Design (1-6 credit hours)
Topics of current interest to program/option offered by faculty in School.
Subjects offered under this number normally used to test and develop
new courses.

Prerequisite: Graduate standing
Typically offered in Fall only

GD 610 Special Topics In Graphic Design (1-6 credit hours)
An investigation of special topics in graphic design of a particular interest
to advanced students under direction of chair of graduate committee on a
tutorial basis; credit and content vary with each student.

Prerequisite: Permission of grad. advisor
Typically offered in Fall and Spring

GD 630 Independent Study In Graphic Design (1-3 credit hours)
Special problems in various aspects of graphic design developed under
the direction of a faculty member on a tutorial basis.

Typically offered in Fall, Spring, and Summer

GD 676 Special Project In Graphic Design (1-3 credit hours)
Seminar on subjects of current interest in graphic design, presented by
persons not part of regular faculty.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

GD 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the
student in planning for the teaching assignment, observe and provide
feedback to the student during the teaching assignment, and evaluate the
student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

GD 688 Non-Thesis Masters Continuous Registration - Half Time
Registration (1 credit hours)
For students in non-thesis master's programs who have completed all
credit hour requirements for their degree but need to maintain half-time
continuous registration to complete incomplete grades, projects, final
master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall and Spring

GD 689 Non-Thesis Master Continuous Registration - Full Time
Registration (3 credit hours)
For students in non-thesis master's programs who have completed all
credit hour requirements for their degree but need to maintain full-time
continuous registration to complete incomplete grades, projects, final
master's exam, etc. Students may register for this course a maximum of
one semester.

Prerequisite: Master's student
Typically offered in Spring only

GD 690 Master's Examination (1-9 credit hours)
For students in non-thesis master's programs who have completed all
other requirements of the degree except preparing for and taking the final
master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer
Health and Exercise Studies Minor (HESM)

HESM 201 Coaching Baseball/Softball (2 credit hours) Theories, techniques, and strategies of coaching baseball/softball.

HESM 202 Coaching Basketball (2 credit hours) Theories, techniques, and strategies of coaching basketball.

Typically offered in Fall, Spring, and Summer

HESM 203 Coaching Football (2 credit hours) Theories, techniques, and strategies of coaching football.

Typically offered in Fall and Spring

HESM 204 Coaching Golf (2 credit hours) Theories, techniques, and strategies of coaching golf.

Typically offered in Fall, Spring, and Summer

HESM 205 Coaching Soccer (2 credit hours) Theories, techniques, and strategies of coaching soccer.

HESM 207 Coaching Tennis (2 credit hours) Theories, techniques, and strategies of coaching tennis.

HESM 209 Coaching Volleyball (2 credit hours) Theories, techniques, and strategies of coaching volleyball.

HESM 211 Strength Training and Conditioning (2 credit hours) Knowledge and skills necessary for designing and implementing strength and conditioning programs. This course does not constitute credit toward meeting the minimum university Physical Education requirements.

Typically offered in Fall, Spring, and Summer

HESM 212 Alcohol, Drugs and Tobacco (2 credit hours) Theories of drug use, pharmacology, tolerance, dependence, nicotine, alcohol usage, alcoholism, sedative-hypnotics, narcotics, amphetamines, cocaine, marijuana, hallucinogens, steroids and treatment. This course does not constitute credit toward meeting the Physical Education GER requirement.

Typically offered in Fall, Spring, and Summer

HESM 213 Human Sexuality (2 credit hours) Physiological and psychosocial aspects of human sexuality. Emphasis placed on health-related topics of birth control, pregnancy, childbirth, abortion and sexually-transmitted diseases. Concepts of gender acquisition, sexual values, and sexual morality discussed as related to the promotion of healthy lifestyles within contemporary American culture.

HESM 214/PRT 214 Introduction to Adventure Education (3 credit hours) History and philosophy, social psychology of adventure, theories of adventure, benefits, risk-taking behavior, current trends and issues, research and evaluation, and model programs. Field trip required. Students are responsible for their own transportation for field trip.

Typically offered in Fall only

HESM 215/PRT 215 Principles and Practices of Outdoor Leadership (3 credit hours) Principles and practices of leadership in adventure education and recreation programs: group management, trip planning, staffing, group dynamics, health and safety issues, risk management and other relevant topics.

Typically offered in Spring only

HESM 216 Backcountry Instruction Methodology (2 credit hours) Techniques for teaching outdoor skills and activities are covered. Emphasis is placed on trip planning, presentations, and skills instruction for outdoor educators. Students will make numerous outdoor activity skills presentations. Students will also evaluate and provide feedback for classmates. Students must participate in two required weekend field trips. Additional charge assessed for the field trips. Refer to the online schedule of classes for the current charge and dates.

Typically offered in Fall only

HESM 275 Behavior Change in Wellness (2 credit hours) This course introduces students to the eight dimensions of wellness (social, physical, emotional, occupational, intellectual, environmental, spiritual, financial) and features a series of lectures, in-class activities and discussions, course readings, and personal wellness profile, co-curricular wellness activities, and a behavior change project. Wood Wellness Village first time residents; This course does not fulfill the health and exercise studies GEP requirement.

Restricted to: Wood Wellness Village Students only

Typically offered in Fall only

HESM 280 Responding to Emergencies (2 credit hours) This course introduces the basics of first aid treatment for the lay rescuer. Topics include CPR, AED use, choking and bleeding emergencies, and other basic first aid procedures. This course does not satisfy the Physical Education GEP requirement.

HESM 284 Women's Health Issues (2 credit hours) This course will review health and wellness issues affecting women through their life span. It will explore medical concerns and prevention as well as social health issues that disproportionately affect women in contemporary society. Discussions of curricula

Typically offered in Fall, Spring, and Summer

HESM 285 Personal Health (2 credit hours) Behavior change, wellness, stress management, cardiovascular diseases, alcohol and tobacco use, cancer, infectious diseases, arthritis, human sexual response, sexual assault, contraception, and sexually transmitted diseases. This course does not constitute credit toward meeting the Physical Education GER requirement.

Typically offered in Fall, Spring, and Summer

HESM 286 Nutrition, Exercise and Weight Control (2 credit hours) A nutrition, exercise and weight management program emphasizing the basics of proper nutrition and exercise. Emphasis on lifestyle changes and their relationship to appropriate weight management. Medical request

Typically offered in Fall, Spring, and Summer
HESM 287 Stress Management (2 credit hours)
Impact of stress upon the psychological and physiological function of the body. Exploration and interaction with stress management techniques. This course does not constitute credit toward meeting the Physical Education GER requirement.

Typically offered in Spring only

HESM 300 Practicum in Health (1 credit hours)
This course focuses on applying program development, management, evaluation, and educational strategies and techniques within a health-related setting. Students are required to purchase internship liability insurance to participate in the practicum; the fee is automatically charged upon registration. Contact University Insurance & Risk Management for more details.

Prerequisite: HESM 285, HESM 375, HESM 377, and 6 hours of electives from the Health Minor.

Typically offered in Fall, Spring, and Summer

HESM 301 Coaching Practicum (1 credit hours)
A 30-hour practical coaching experience in a middle school or high school setting. Specific placement will depend upon the various playing sessions for the sports involved. Students are required to purchase internship liability insurance to participate.

Prerequisite: Requires departmental consent, First Aid, and CPR Certification or Equivalent.

Typically offered in Fall, Spring, and Summer

HESM 302 Practicum Experience in Outdoor Programs (1 credit hours)
The practicum experience provides a short-term, supervised opportunity for students to participate in leading an outdoor activity course or program. The practicum is the integration of academic preparation with its application in a field setting. The student may be assigned to a Department of Health and Exercise Studies outdoor activity course, program or to an approved non-University program in order to meet this requirement. The practicum student must be directly involved in the program for a minimum of 30 hours. Students are required to purchase internship liability insurance to participate in the practicum; the fee is automatically charged upon registration. Contact University Insurance & Risk Management for more details.

Prerequisite: HESM 214, HESM 215, HESM 216, HESM 280 or equivalent.

Typically offered in Fall, Spring, and Summer

HESM 303 Sports Science Practicum (1 credit hours)
A 30-hour practical sports science specialist experience in a fitness specific setting within the triangle area. Course does not constitute credit toward meeting the physical education requirement. Students are required to purchase internship liability.

Prerequisite: Completed coursework in Sports Science Minor

Typically offered in Fall, Spring, and Summer

HESM 304 Dance Practicum (1 credit hours)
A 30-hour practical experience in the dance field. Assigned internships could include dance teaching, performing, choreographing, research, or other dance-related work dependent upon the student’s experiences and interests. Specific placement will be determined by the student and the instructor. Students are required to purchase internship liability insurance to participate in the practicum; the fee is automatically charged upon registration. Contact University Insurance & Risk Management for more details.

Typically offered in Fall and Spring

HESM 320 Movement Improvisation (1 credit hours)
Conceptually guided, spontaneous movement generation and invention reached through individual and group experiences.

Typically offered in Fall and Spring

HESM 322 Dance and Society (3 credit hours)
Dance and Society examines dance as an artistic, religious, cultural, and social form, including historic and aesthetic influences, basic dance elements, and relationship to other arts. This course incorporates multiple modalities of dance knowledge - lectures, films, demonstrations, and practical dance experience. A small fee may be required for concert attendance.

GEP Global Knowledge, GEP Visual and Performing Arts

Typically offered in Fall only

HESM 324 Concert Dance History (3 credit hours)
An overview of the development of Western theatrical dance. This course introduces the major figures and movement theories of the 19th & 20th Centuries with particular emphasis on major stylistic trends and cultural influences. Readings, discussions, lectures, and films/videotapes will introduce selected choreographers and the concerns that inform their work. Additional readings in dance philosophy and aesthetics will address ideas such as form, expression, audience expectations, and performance conventions. A small fee may be required for concert attendance.

GEP U.S. Diversity, GEP Visual and Performing Arts

Typically offered in Fall only

HESM 326 Current Trends in Dance (3 credit hours)
Critical and contextual examination of current trends in dance. While specific readings and video resources will vary by semester as the field of dance continues to change, major course topics will include at least three of the following: the role of dance supporters and presenters, media influences, non-concert and site-specific dance, current movement trends, political significance, and international concerns.

GEP Visual and Performing Arts

Typically offered in Fall only

HESM 328 Dance Composition - Group Forms (2 credit hours)
This course builds on skills and concepts learned in Movement Improvisation. Various approaches to group choreography will be discussed and explored. A student-choreographed group work will be created and performed.

Prerequisite: HESM 320

GEP Visual and Performing Arts

Typically offered in Spring only
HESM 330  Introduction to Laban Movement Analysis and Bartenieff Fundamentals (2 credit hours)
An introduction to Laban Movement Analysis (LMA) and Bartenieff Fundamentals (BF) through movement integration, observation, notation, analysis, and application. LMA is a method and language for describing, visualizing, interpreting, and documenting all varieties of human movement. It consists of the study of four major components: Body, Effort, Shape and Space, the relationships between them, and ways of notating them. BF consists of a set of concepts, principles and exercises developed by Irmgard Bartenieff in applying Laban's movement theory to the physical/kinesiological functioning of the human body. LMA/BF is used by dancers, actors, musicians, and dance therapists, among others.

Typically offered in Spring only

HESM 332  Dance and Technology (2 credit hours)
The exploration of dance creation, performance, documentation, practice, and analysis through existing and emerging practices in film, digital video production, and interactive media.

Typically offered in Spring only

HESM 370  Foundations of Sport Coaching and Instruction (2 credit hours)
This course will introduce methods of skill instruction, basic teaching strategies, and pedagogy in the area of sport coaching. Students will learn how to properly organize drills, plan safe and effective practices, present age-appropriate sport skills to athletes at the youth, middle and high school levels, and evaluate motor-skill development of athletes. This course will also explore psychomotor, cognitive, and affective development and performance of athletes in school and community settings. Students in this course will have the opportunity to teach cooperatively with peers and will also be presented with opportunities to teach micro-lessons in their area of sport interest.

Typically offered in Spring only

HESM 375  Health Planning and Programming (2 credit hours)
This course is designed to assist students in developing a foundation in health programming. Students will learn the necessary skills to develop, implement, and evaluate health education programs.

Prerequisite: HESM 285 Personal Health
Typically offered in Fall only

HESM 377  Methods of Health Promotion (2 credit hours)
This course focuses on methods and techniques for delivering health-related content to diverse populations. Cooperative learning, critical thinking, peer educator training, and decision-making will be applied to various health dimensions.

Typically offered in Spring only

HESM 381  Athletic Training (3 credit hours)

Prerequisite: HESM 280 or HESM 281 or or CPR/First aid Certification
Typically offered in Fall, Spring, and Summer

HESM 385  Special Topics in Health and Exercise Studies (1-3 credit hours)
Examination of selected topics in health, outdoor leadership, sports science, coaching, and dance. This course does not fulfill the GEP requirement for Health and Exercise Studies.

Typically offered in Fall, Spring, and Summer

HESM 476  Motor Learning and Sport Performance (3 credit hours)
This course will introduce the concepts, principles, and theories dealing with the performance of motor skills as applied in the areas of sport performance and physical activity. Topics will discuss how skilled movements are learned, maintained, and enhanced as well as explore some of the basic physiological, bio-mechanical, and cognitive influences which affect the quality of skilled performance. This course is primarily designed to benefit sport coaches, physical educators, and fitness instructors.

Typically offered in Fall only

HESM 477  Coaching Concepts (3 credit hours)
Practical and theoretical concepts essential to the preparation of coaches. This course does not constitute credit toward meeting Physical Education requirements.

Typically offered in Fall, Spring, and Summer

HESM 478  Exercise Physiology and Sports Science (3 credit hours)
Basic principles of human anatomy, physiology, and biomechanics and their relationship to athletic coaching.

Typically offered in Fall, Spring, and Summer

HESM 479  Sport Management (3 credit hours)
Planning, organizing, leading, and evaluating within a sport context; fundamentals of accounting, budgeting, economics, marketing, strategic planning, ethics, and their use in sport settings; techniques of personnel, facility, and sporting event management.

HESM 480  Principles of Exercise Programming (3 credit hours)
Fundamentals and scientific principles necessary to plan, design, implement, and evaluate individual exercise programs.

Prerequisite: HESM 478
Typically offered in Fall and Spring

Health Exercise Studies Dance (HESD)

HESD 227  African Dance I (1 credit hours)
Development of beginning level skill of East and West African dances, including history, culture, and context, emphasizing the central role that dance plays in African cultures.

GEP Global Knowledge, GEP Health and Exercise Studies
Typically offered in Fall only

HESD 228  African Dance II (1 credit hours)
Development of intermediate level skills in traditional and contemporary African dances with clear distinction between different African regions. Emphasis will be placed on culture, history, community and theoretical aspects of each dance.

Corequisite: HESD 227 (African Dance I)
GEP Global Knowledge, GEP Health and Exercise Studies
Typically offered in Fall only
HESD 230  Horton Dance Technique  (1 credit hours)
Development of beginning and intermediate-level skills in Horton dance technique, including alignment, vocabulary, performance, and history, with emphasis on strengthening the body for dance. Class format will include warm-up exercises, fortifications, studies, and traveling combinations. Course also includes the study of Lester Horton’s influence on American modern dance, particularly in relation to integration in concert dance and the formation of Alvin Ailey American Dance Theater.

GEP Health and Exercise Studies, GEP U.S. Diversity
Typically offered in Fall only

HESD 234  Country Dance  (1 credit hours)
This course is the development of beginning-level skills in country dance including vocabulary, technique, history, and performance. A variety of fundamentals for leading and following, combinations, figures, and calls will be emphasized in American Heritage Dance, Texas Two-step, and Western Square Dance.

GEP Health and Exercise Studies
Typically offered in Spring only

HESD 240  Social Dance  (1 credit hours)
Development of beginning-level skills in social dance, including vocabulary, technique, history, performance, with emphasis on leading and following in the : Cha-Cha, Foxtrot, Waltz, Rumba, and Shag.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESD 241  Social Dance II  (1 credit hours)
This course will focus on training students to understand and perform more complex dances in an improvisational environment. Emphasis will be on learning advanced level dance steps and combinations that are more challenging or complex social dances not

Prerequisite: HESD 240 or equivalent skills

GEP Health and Exercise Studies
Typically offered in Fall only

HESD 263  Tap Dance  (1 credit hours)
This beginning-level technique class covers basic tap dance skills in warm-up exercises, combinations, and compositions. Emphasis is placed on correct alignment in tap dance steps and the exploration of a variety of rhythms and patterns.

GEP Health and Exercise Studies
Typically offered in Spring only

HESD 264  Ballet I  (1 credit hours)
Development of beginning-level technical skills in ballet, including vocabulary, technique, history, performance, alignment, function and access of turnout, with emphasis on safe and efficient body use.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESD 265  Ballet II  (1 credit hours)
Further development of Ballet technique building on fundamental concepts and vocabulary introduced in Ballet I. Will include increased movement capabilities, rhythmic accuracy, alignment, performance, and access of turnout. A small fee may be required for dance concert attendance.

Prerequisite: HESD 264 or Instructor Permission

GEP Health and Exercise Studies, GEP Visual and Performing Arts
Typically offered in Fall only

HESD 273  Jazz Dance I  (1 credit hours)
This beginning-level technique class covers basic jazz dance skills in warm-up exercises, combinations, and compositions. A variety of jazz styles are covered including one or more of the following: classical (Luigi/Giordano), Broadway, contemporary, Afro-jazz, and others.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESD 274  Modern Dance I  (1 credit hours)
Development of beginning-level technical skills and movement concepts in modern dance, including vocabulary, technique, history, performance, and alignment, with emphasis on safe and efficient body use. Class format will include structured exercises and improvisations. A small fee may be required for dance concert attendance.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESD 275  Modern Dance II  (1 credit hours)
Further development of modern dance technique, building on fundamental movement concepts and vocabulary introduced in Modern Dance I. Will include increased movement capabilities, rhythmic accuracy, and spatial relationships. A small fee may be required for dance concert attendance.

Prerequisite: HESD/DAN 274 (or permission of instructor)

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESD 280  Jazz Dance II  (1 credit hours)
Further development of jazz dance technique building on fundamental concepts and vocabulary introduced in Jazz Dance I. Will include increased movement capabilities, rhythmic accuracy, alignment, and performance. A small fee may be required for dance concert attendance.

Prerequisite: HESD 273 or Instructor Permission

GEP Health and Exercise Studies, GEP Visual and Performing Arts
Typically offered in Spring only

Health Exercise Studies Fitness  
(HESF)

HESF 100  Cross Training  (2 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility, and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced aerobic activities as well as strength and endurance conditioning exercises.

GEP Health and Exercise Studies
Typically offered in Fall and Spring
HESF 101 Fitness and Wellness (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced running activities as well as strength and endurance conditioning exercises.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESF 102 Fitness Walking (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced fitness walking techniques and strength conditioning exercises.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESF 103 Water Aerobics (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues are also addressed. The components of fitness will be met through structured individually paced water aerobics classes that will take place in chest deep water. Muscular strength activities could take place in or out of water.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESF 104 Swim Conditioning (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. This course covers the mechanics of a variety of strokes, training methods, training principles, safety, with swim techniques that maximize fitness gains and minimize injuries.

Prerequisite: PE 215 or equivalent skill
GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESF 105 Aerobics and Body Conditioning (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced aerobics classes. Muscular strength activities could take place in or out of the aerobics room.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESF 106 Triathlon (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced swim, cycle and run training techniques. The student must provide bicycles and ANSI approved helmets.

Prerequisite: PE 221 or equivalent skill
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESF 107 Run Conditioning (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced running activities on an indoor or outdoor track, and/or a cross-country route. Muscular strength activities will occur in a weight room or incorporated during running activities.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESF 108 Water Step Aerobics (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced water step aerobics classes that will take place in chest deep water on an aquatic exercise step. Muscular strength activities could take place in our out of the water.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESF 109 Step Aerobics (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced step aerobics classes. Muscular strength activities could take place in or out of the aerobics room.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESF 110 Adapted Physical Education (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced aerobic, muscular strength and muscular endurance activities that meet the need of students with medical/physical limitations. For students with medical problems who are unable to take regular Physical Education classes. Repeatable up to two semesters.

GEP Health and Exercise Studies
Typically offered in Fall and Spring
HESO 253  Health Exercise Studies Outdoor (HESO)  (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced indoor group cycling classes. Muscular strength activities could take place in or out of the main classroom.

GEP Health and Exercise Studies  
Typically offered in Fall, Spring, and Summer

HESO 255  Basic Canoeing (1 credit hours)
Instruction and experience in flatwater canoe skills; emphasizing paddling skills, safety, flat and moving water travel techniques and proper equipment selection. Plan and participate in one required weekend fieldtrip. Additional charge assessed for the fieldtrip. Refer to the online schedule of classes for the current charge.

Prerequisite: Basic swimming ability required
GEP Health and Exercise Studies  
Typically offered in Fall and Spring

HESO 257  Backpacking (1 credit hours)
Designed for students with little or no backpacking experience. Safe and environmentally-sound camping practices. Equipment/clothing, first aid and safety management agencies, land navigation, and trip planning. Plan and participate in one required weekend fieldtrip. Additional charge assessed for the fieldtrip. Refer to online schedule of classes for the current charge.

Prerequisite: Must pass basic fitness test
GEP Health and Exercise Studies  
Typically offered in Fall and Spring

HESO 258  Basic Rock Climbing  (1 credit hours)
Instruction and direct experience for the beginning rock climber. Emphasis on safe rope systems for belaying and basic movement on rock.

GEP Health and Exercise Studies  
Typically offered in Fall, Spring, and Summer

HESO 259  Intermediate Rock Climbing (1 credit hours)
Development of intermediate rock climbing skills and practices including: climbing safety, belaying techniques, anchor systems, partner self-rescue, rappelling and ascending techniques, minimal impact climbing, and climbing hazards. Participate in one required weekend fieldtrip. Additional charge assessed for the fieldtrip. Refer to the online schedule of classes for the current charge.

Prerequisite: HESO 258
GEP Health and Exercise Studies  
Typically offered in Fall and Spring

HESO 262  Introduction to Whitewater Canoeing (1 credit hours)
Instruction and direct experience in fundamental whitewater canoeing skills. Basic paddling strokes and maneuvers for use on whitewater, river safety, basic river rescue, equipment selection and care, and environmental ethics. Participate in one required weekend fieldtrip. Additional charge assessed for the fieldtrip. Refer to the online schedule of classes for the current charge.

Prerequisite: HESO 255, Intermediate swimming ability required
GEP Health and Exercise Studies  
Typically offered in Fall only

HESO 263  Whitewater Kayaking (1 credit hours)
This class is designed for students with little or no whitewater kayaking experience to develop basic kayaking skills and help them become proficient paddlers. Topics will include whitewater safety, equipment use and care, paddle strokes and river running techniques, basic rescue techniques, kayak navigation, basic hydrology, and trip planning. Participate in one required weekend field trip. Additional charge assessed for the field trip. Refer to the online schedule of classes for the current charge. Students must pass swim test to participate in course.

Prerequisite: Intermediate swimming ability
GEP Health and Exercise Studies  
Typically offered in Fall and Spring
HESO 276 Whitewater Rafting (1 credit hours)
Whitewater rafting skills and practices emphasizing safe river travel, minimal impact river camping techniques, and trip planning. Participate in one required weekend field trip. Additional charge assessed for the field trip. Refer to PackTracks for the current charge.

Prerequisite: Intermediate swimming ability required
GEP Health and Exercise Studies
Typically offered in Spring only

HESO 277 Mountain Biking (1 credit hours)
Bike handling, minimal impact trail riding skills, safety, fitness, basic maintenance and repair, and equipment selection. Students must provide their own bike, helmet, protective equipment, and clothing.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESO 278 Fly-Fishing (1 credit hours)
Instruction and experience in basic fly-fishing skills. Emphasis on casting techniques, tackle selection, habitat evaluation, minimal impact travel, safety, fitness, equipment selection and trip planning. Basic swimming ability and field trip required. Transportation provided by the Physical Education Department. Charge required with a non-refundable deposit.

Prerequisite: Basic swimming ability
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESO 281 Challenge Course and Team Building Facilitation (1 credit hours)
Participants are introduced to ropes and group initiative courses including a variety of adventure games, initiatives, love and high ropes course events. Safety, risk management issues and facilitation techniques are presented and discussed. Transportation is provided to and from the challenge course by the department. An additional charge is assessed for the course. Refer to the online schedule of classes for the current charge and field trip date(s).

Prerequisite: HESO 258 or equivalent skills
GEP Health and Exercise Studies
Typically offered in Spring only

HESO 283 Mountaineering (1 credit hours)
Instruction and experience in alpine climbing skills emphasizing snow and ice travel, safety, land navigation, winter hazard evaluation, minimal impact camping skills, and equipment selection. Three full-day classroom sessions before the trip required. Plan and participate in a ten-day field trip over winter break. Additional charge assessed for the field trip with a non-refundable deposit. Refer to the online schedule of classes for the current charge. Final grades will not post until the second week of January. In the interim, a grade of LA will be given. December-graduating seniors should be aware this will delay graduation clearance and posting of degrees.

Prerequisite: HESO 258, HESO 257
GEP Health and Exercise Studies
Typically offered in Spring only

HESO 284 Sea Kayaking (1 credit hours)
Instruction and experience in basic sea kayaking skills. Emphasis on paddling techniques, open water travel, navigation, minimal impact camping, safety, fitness, equipment selection and trip planning. Plan and participate in one required field trip. Additional charge assessed for the field trip with a non-refundable deposit. Refer to the online schedule of classes for the current charge.

Prerequisite: Intermediate swimming ability
GEP Health and Exercise Studies
Typically offered in Fall and Spring

Health Exercise Studies Racquet (HESR)

HESR 242 Badminton (1 credit hours)
This is a beginning badminton course in which students will develop the basic skills necessary to play the game of badminton. Technical skills include the overhead and underhand clears, the short and long serves, drop shots and the smash. Instruction will include an emphasis on the fundamental strategies and rules used in both singles and doubles play. Basic fitness and training principles will be discussed as applicable to the sport of badminton.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESR 249 Tennis I (1 credit hours)
This is a beginning tennis course in which students will develop the basic skills necessary to play the game of tennis. Technical skills include forehand and backhand ground strokes, volleys, serves and proper footwork. Students will also learn the fundamental rules, basic strategies, and court positioning for singles and doubles play. Basic fitness and training principles will be discussed as applicable to the sport of tennis.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESR 250 Tennis II (1 credit hours)
This course will review some of the basic tennis skills introduced in the PE 249 Tennis I course. Additionally, this course will introduce more advanced techniques in stroke production and skill development such as the topspin and slice serves, approach shots, half-volleys, and drop shots. Students will analyze some of the various styles of play used in the game of tennis and perform drills as well as match play situations that will improve performance based on offensive and defensive tactics in both singles and doubles.

Prerequisite: HESR 249
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESR 255 Pickleball (1 credit hours)
This is a beginning pickleball course in which students will develop the basic skills to play the game of pickleball. Technical skills include forehand and backhand groundstrokes, volleys, serves, lobs, overheads, drop shots, and proper footwork. Students will also learn the fundamental rules, basic strategies, and court positioning for singles and doubles play. Basic fitness and training principles will be discussed as applicable to the sport of pickleball.

GEP Health and Exercise Studies
Typically offered in Fall and Spring
HESS 235  Systems and protocols will be introduced along with content of muscular weight exercises will be used to apply these principles. Various training benefit an individual in their daily activities, but also improve their overall fitness. Free weights, machines, exercise equipment, and body fitness and training principles will be discussed as applicable to the sport of racquetball. Approved protective eyewear must be provided by the student.

GEP Health and Exercise Studies Typically offered in Fall and Spring

Health Exercise Studies Specialty (HESS)

HESS 219 Gymnastics  (1 credit hours)
Develop basic gymnastics skills on vault, bars, beam, floor, and trampoline. 1) To assist the students in safely learning progressions on each of these events for skill development. 2) To acquire the fitness requirements associated with learning these skills. 3) To identify the hazards and risks associated with gymnastics and 4) To identify basic skills and terminology associated with the sport.

GEP Health and Exercise Studies Typically offered in Fall and Spring

HESS 230 Pilates/Core Training  (1 credit hours)
This course will teach the fundamentals of Pilates which are to improve body awareness, increase breathing capacity and improve postural alignment through simultaneous stretching and strengthening movements. The goal of Pilates exercises is to achieve optimal functional fitness. The knowledge and training gained from Pilates will not only benefit an individual in their daily activities, but also improve their performance in any physical activity they choose to participate in.

GEP Health and Exercise Studies Typically offered in Fall, Spring, and Summer

HESS 237 Weight Training  (1 credit hours)
This is an introductory weight training course in which students will learn the principles of muscular development, as well as development of overall fitness. Free weights, machines, exercise equipment, and body weight exercises will be used to apply these principles. Various training systems and protocols will be introduced along with content of muscular physiological adaptations.

GEP Health and Exercise Studies Typically offered in Fall, Spring, and Summer

HESS 239 Self Defense  (1 credit hours)
Basic self defense and techniques. Skills covered include strikes, blocks, and escapes; plus psychology of general and sexual assault. Physical contact will occur between students and with the instructor as well.

GEP Health and Exercise Studies Typically offered in Fall, Spring, and Summer

HESS 243 Bowling  (1 credit hours)
This is a beginning bowling course in which the students will develop the basic skills necessary to play and enjoy the game of bowling. Technical skills include ball rotation and delivery along with proper foot work. Students will also learn the fundamental rules, basic strategies for throwing a strike ball, general theory for converting spares, and scoring along with bowling etiquette, terminology, rules, and safety precautions. Basic fitness and training principles will be discussed as applicable to the sport of bowling. Additional fee assessed.

GEP Health and Exercise Studies Typically offered in Fall, Spring, and Summer

HESS 251 Target Archery  (1 credit hours)
Shooting fundamentals, safety, selection, and care of equipment.

GEP Health and Exercise Studies Typically offered in Fall, Spring, and Summer

HESS 252 Skiing/Snowboarding  (1 credit hours)
Instruction and experience in the fundamentals of skiing or snowboarding. Emphasis on safety, controlled turns and stops, equipment selections, and pre-season preparation. Slope instruction held at a selected site during winter break. Additional charge assessed for trip with a non-refundable deposit. Refer to the online schedule of classes for program format options, current charges and trip dates. Students must provide their own transportation to the ski area.

GEP Health and Exercise Studies Typically offered in Fall, Spring, and Summer

HESS 279 Yoga I  (1 credit hours)
This course will emphasize the physical practice of yoga at an introductory level. Coursework will introduce breathing exercises, relaxation techniques and a variety of yoga poses; standing, twisting, balancing, backward bending, and inversions. Students will develop the fitness skills required to perform these poses and maintain a safe yoga practice.

GEP Health and Exercise Studies Typically offered in Fall, Spring, and Summer
**HESS 280  Yoga II** (1 credit hours)
This course will build upon material introduced in Yoga I by emphasizing the practice of yoga at an intermediate level. Coursework will require a deeper level of understanding of a variety of yoga postures, breathing techniques, and meditation practices. Yoga philosophy will also be addressed through the study of historical yogic texts such as The Yoga Sutras of Patanjali.

Prerequisite: HESS 279

**GEP Health and Exercise Studies**
Typically offered in Fall and Spring

**HESS 296  Independent Study in Physical Education** (1-3 credit hours)
Independent study in Physical Education will vary according to the specialized topic of interest. Credit and content determined by instructor. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in N

Typically offered in Fall, Spring, and Summer

### Health Exercise Studies Team (HEST)

**HEST 216  Soccer** (1 credit hours)
Soccer with emphasis on skills development, playing strategies, and rules of the game.

**GEP Health and Exercise Studies**
Typically offered in Fall and Spring

**HEST 261  Basketball** (1 credit hours)
Offensive and defensive skills development and systems of team work. Coverage of strategies, history and rules of the sport.

**GEP Health and Exercise Studies**
Typically offered in Fall and Spring

**HEST 265  Slow Pitch Softball** (1 credit hours)
Develop basic skills, rules and strategies for playing slow pitch softball. This course provides an ideal setting for beginning through intermediate players to acquire or enhance skill sets and obtain knowledge to participate recreationally in a slow pitch softball game or league.

**GEP Health and Exercise Studies**
Typically offered in Fall and Spring

**HEST 266  Ultimate Frisbee** (1 credit hours)
Emphasis on skill development, aerobic fitness and spirit of competition. Includes flight dynamics, various throwing and catching techniques, offensive skills, defensive skills, equipment, strategies, and rules of the game.

**GEP Health and Exercise Studies**
Typically offered in Fall and Spring

**HEST 267  Flag Football** (1 credit hours)
An introduction to the skills, history, rules and strategy of flag football.

**GEP Health and Exercise Studies**
Typically offered in Fall only

**HEST 269  Volleyball I** (1 credit hours)
This course is designed to teach and apply the basic volleyball fundamentals of setting, passing, spiking, court movement, and game strategy.

**GEP Health and Exercise Studies**
Typically offered in Fall and Spring

**HEST 270  Volleyball II** (1 credit hours)
This course is designed to go beyond the basic volleyball skills. Emphasis will be placed on floater, top spin, and jump serves, forearm passing, setting, back setting, strong side and weak side attacking, blocking and advance serve reception techniques.

Prerequisite: HEST 269

**GEP Health and Exercise Studies**
Typically offered in Fall and Spring

### HESA - Health Exercise Aquatics (HESA)

**HEST 214  Beginning Swimming** (1 credit hours)
Swimming strokes and deep water skills for the non-swimmer to survive in the water.

**GEP Health and Exercise Studies**
Typically offered in Fall and Spring

**HEST 215  Advanced Beginning Swimming** (1 credit hours)
Continuation of Basic Strokes acquired in Beginning Swimming, additional new strokes, and survival skills.

Prerequisite: HESA 214 or equivalent skill

**GEP Health and Exercise Studies**
Typically offered in Fall and Spring

**HEST 217  Survival Swimming** (1 credit hours)
This course will provide NCSU students with the opportunity to learn water survival skills and techniques that will enhance their chances of survival if stranded in the water. Skills include drownproofing, underwater swimming, survival swim strokes, jumping from a height, clothing inflation techniques, and swimming through a simulated oil/debris field. These survival skills and techniques will help promote physical fitness and a healthy lifestyle.

Prerequisite: HESA 214 or equivalent skill

**GEP Health and Exercise Studies**
Typically offered in Fall and Spring

**HEST 221  Intermediate Swimming** (1 credit hours)
This course is designed to provide instruction in five basic swim strokes-front crawl (freestyle), back crawl (backstroke), breaststroke, elementary backstroke and sidestroke. Additional emphasis will be placed on increased cardiovascular fitness along with skill development in treading water, underwater swims, turns and dives.

Prerequisite: HESA 214 or equivalent skill

**GEP Health and Exercise Studies**
Typically offered in Fall and Spring
HESA 223 Lifeguard Training (2 credit hours)
This course is designed to provide entry-level lifeguard participants with the knowledge and skills needed to prevent, recognize, and respond to emergencies and provide care for injuries and sudden illnesses until Emergency Medical Services (EMS) personnel arrive and take over. Optional fee assessed for certification.
Prerequisite: PE 221 or equivalent skill
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESA 226 Skin and Scuba Diving I (2 credit hours)
This course is designed for students with little or no experience, emphasizing safety and responsible skin and scuba diving techniques. Topics include the use and care of scuba equipment, diving skills, problem solving, emergency procedures, basic rescue techniques, direct and indirect effects of pressure, medical contradictions, oxygen enriched air are diving, and gas management. Optional fee assessed for open-water training field trip and certification. Students must provide their own transportation for fieldtrip(s).
Prerequisite: HESA 227 or equivalent skill
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESA 227 Skin & Scuba Diving II (2 credit hours)
This course will build on the knowledge and skills learned in Skin & Scuba Diving I with emphasis on diver rescue techniques. Coursework will require a deeper understanding of dive planning, dive physiology, gas management, and diving first aid. Coursework will also require a higher skill level relating to propulsion techniques, navigation, equipment handling, buoyancy control, search & recovery techniques, and diving first aid than is required in Skin and Scuba Diving I. Optional fee assessed for open water training fieldtrip and certification. Students must provide their own transportation for fieldtrip(s).
Prerequisite: HESA 226 or equivalent skill
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESA 229 Scuba Leadership (2 credit hours)
This course will provide NCSU students with the opportunity to build upon the skills learned in PE 227 and progress towards proficiency as a scuba diving leader. This course will help promote physical fitness and skill development in scuba diving, as well as an understanding of the knowledge and skills of scuba diving leadership. Participation in scuba leadership provides interested students with the opportunity to seek clarification as a scuba diving leader. Fee is assessed for required fieldtrip(s). Students must provide their own transportation for fieldtrip(s).
Prerequisite: HESA 227 or equivalent skill
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESA 231 Scientific Diving (3 credit hours)
This course covers the knowledge, skills, and diving experience necessary to plan and safely conduct scientific dives with regards to site selection, safety procedures, gas mix considerations, equipment requirements, data collection techniques, and dive team selection. These skills and techniques will help promote physical fitness and a healthy lifestyle. Successful completion of all phases of the course will qualify students for certification as a "scientific diver." This course meets American Academy of Underwater Sciences (AAUS) guidelines. Fee is assessed for required fieldtrip(s). Students must provide their own transportation for fieldtrip(s).
Prerequisite: HESA 227 or equivalent skill
GEP Health and Exercise Studies
Typically offered in Fall and Spring

History (HI)

HI 205 Western Civilization Since 1400 (3 credit hours)
A survey of Western Civilization from the Renaissance to the present.
Typically offered in Fall and Spring

HI 207 Ancient Mediterranean World (3 credit hours)
The ancient cultures of the Middle East, Greece and Rome, including Mesopotamian, Egyptian, Hebrew, Phoenician, Greek and Roman societies and cultures.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

HI 208 The Middle Ages (3 credit hours)
Medieval civilization as it emerged from the declining Roman Empire through its apogee in the 13th century. The transition from the classical to the medieval world, the impact of the Germanic influx, the Islamic influence, the Crusades, and the political, economic, and social institutions of the High Middle Ages.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

HI 209 From Renaissance to Revolution: The Origins of Modern Europe (3 credit hours)
Exploration of the political, economic, social, and cultural history of Western Europe during an intense and exciting period of transition from a medieval to a modern world. Topics to be discussed include Renaissance art and philosophy; the printing revolution and the French Revolution; climate change and economic dislocation; witchcraze; religious reforms and religious wars; commercialization; navigation; empire; slavery; the new science; and new ideas about democracy, equality, and modernity.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

HI 210 Modern Europe 1815-Present (3 credit hours)
Survey of the history of European societies and political systems from 1815 to the present.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring
HI 214  History and Archaeology of Ancient Latin America  (3 credit hours)
Exploration of ancient Latin American civilizations and early Europeans in the region through archaeological and historical analysis. Major themes include migrations of people into the Western hemisphere, the rise and decline of states and empires such as the Maya, Aztecs, Moche, and Incas, inter-regional trade, development of writing and communication systems, religious ideology, social and political infrastructure and mechanisms of control. Unique cultural forms discussed include mummies, pyramids, military techniques, political propaganda, and agricultural innovation. Contemporary issues addressed include media representations of the past, indigenous rights, and looting and destruction of cultural property.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

HI 215  Latin America to 1826  (3 credit hours)
Exploration of the pre-Hispanic indigenous roots and the colonial period in Latin America. Major themes include the origins and development of social, political, economic and religious institutions from pre-conquest times to the achievement of independence. Topics include ancient American cultures, conquest and settlement by Spain and Portugal, colonial rule in theory and practice, religious life and structures, the colonial economy and labor, and independence movements.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

HI 216  Latin America Since 1826  (3 credit hours)
Analysis of the last two centuries of social, political, economic, and intellectual life in Latin America and the Caribbean. Course readings include primary sources, declassified CIA documents, and Latin American literature. Course themes include social and political conflicts, changing gender relations, human rights abuses, the effect of the US and global economic forces, and the impact of the growing Latino population in the U.S.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

HI 217  Caribbean History  (3 credit hours)
Exploration of the social, economic, political, intellectual, and cultural histories of the Caribbean. Major course topics include pre-Columbian indigeneity, colonization & imperialism, plantation slavery, abolition & emancipation, the Haitian and Cuban Revolutions, gender & migration, and decolonization & independence. The course emphasizes the diversity of the region and places the islands of the Caribbean within the wider context of a modern globalizing world.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

HI 221  British History to 1688  (3 credit hours)
History of the British peoples from earliest times to the Glorious Revolution. Social, political, constitutional developments; relationship between history and literature; synthesis of British cultures.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

HI 222  History of British Cultures and Societies From 1688  (3 credit hours)
British people from Glorious Revolution to the present. Social, political, constitutional development; history and literature; growth and decline of British empire; spread of British culture.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

HI 232  The World from 1200 to 1750  (3 credit hours)
The making of the modern world through interregional conquest and commerce from 1200 to 1750. Focus on the growing global circulation of peoples, pathogens, goods, and ideas.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

HI 233  The World Since 1750  (3 credit hours)
This course surveys the making of the world from 1750 to the present. Topics include: the Industrial Revolution, the development of the Nation-States, the rise of European, American and Japanese Empires, WWI, inter-war reconfigurations of colonial empires, anti-colonial nationalist movements, the Great Depression, the Cold War, struggles for political and economic independence among newly independent nations, the US-dominated neo-liberal order from the 1980s to the present, and contemporary global conflicts over ethnicity, religion, resources, disease, and the environment.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

HI 240/HA 240  Introduction to Visual Culture  (3 credit hours)
Introduction to the role of visual cultural production in the nineteenth and twentieth centuries in expressing and shaping both individual and collective identities. Case studies of imperialism, gender, and war draw from different regional histories and utilize a variety of visual genres - such as photography, popular posters, painting, advertising, and film stills - to study how visual culture can be used as evidence to understand the past, using the approaches of the disciplines of History and Art History.

Prerequisite: Sophomore standing
GEP Global Knowledge, GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

HI 251  American History I  (3 credit hours)
Themes in early American history: colonial clash and mix of cultures; generation of an American consciousness; federalism and democracy in national politics; expansion and immigration; racial and sectional division. Credit is not allowed for both HI 251

GEP Humanities
Typically offered in Fall, Spring, and Summer

HI 252  American History II  (3 credit hours)
Themes in post-Civil War American history: impact of war on American foreign and domestic policy; the repercussions of industrialization and economic modernization; continuity and change in American institutions and values; problem solving in pluralism

GEP Humanities
Typically offered in Fall, Spring, and Summer
HI 253  Early American History  (3 credit hours)  
The themes in early American history with an emphasis on diversity in 
the U.S.; focus on colonial clash and mix of cultures, generation of an 
American consciousness, federalism and democracy in national politics, 
expansion and immigration, and racial and sectional division. Credit is not 
allowed for both HI 253 and HI 251.

GEP Humanities, GEP U.S. Diversity  
Typically offered in Fall, Spring, and Summer

HI 254  Modern American History  (3 credit hours)  
Major themes in modern American history with an emphasis on diversity 
in the United States; focuses on aspects of race/ethnicity, gender, class, 
sexual orientation, disability, religious and/or age identities as it considers 
the impacts of industrialization and economic modernization; impact of 
war on American domestic and foreign policy; continuity and change in 
American institutions and values; problem solving in a pluralistic society. 
Credit is not allowed for both HI 254 and HI 252.

X: Credit not allowed for both HI 254 and HI 252.  
GEP Humanities, GEP U.S. Diversity  
Typically offered in Fall, Spring, and Summer

HI 263  Asian Civilizations to 1800  (3 credit hours)  
The history of China, India, Japan, and Southeast Asia from 500 to 1800. 
The making of the Asian region through the rise and fall of five great 
empires: the Tang, the Mongol, the Mughal, the Qing, and the British 
empires.

GEP Global Knowledge, GEP Humanities  
Typically offered in Fall and Spring

HI 264  Modern Asia: 1800 to Present  (3 credit hours)  
Introductory survey of 19th and 20th century Asia, with attention to 
Japan, Southeast Asia, India and China. Emphasis on cultural and 
political crises of the 19th century and revolutionary transformations of the 
20th century.

GEP Global Knowledge, GEP Humanities  
Typically offered in Fall and Spring

HI 270  Modern Middle East  (3 credit hours)  
Social and political change in the Middle East in the nineteenth 
and twentieth centuries. Decline of the Ottoman empire, the rise of 
nationalism, the waxing and waning of European imperialism in the 
region, and the creation of modern states and societies and their 
ideological and economic underpinnings.

GEP Global Knowledge, GEP Humanities  
Typically offered in Fall and Spring

HI 275/AFS 275  Introduction to History of South and East Africa  (3 
credit hours)  
The African kingdoms (Lunda, Buganda, and Zulu); the European 
encroachment; the origins of colonialism and the character of colonial 
societies and economies, South African apartheid; African protest, 
nationalism and independence.

GEP Global Knowledge, GEP Humanities  
Typically offered in Fall and Spring

HI 276/AFS 276  Introduction to History of West Africa  (3 credit 
hours)  
The history of Western Africa. Forest civilizations and the slave trade, 
trade and the expansion of Islam, colonialism in West Africa; African 
nationalism and the achievement of independence; and postcolonial 
West Africa.

GEP Global Knowledge, GEP Humanities  
Typically offered in Fall only

HI 298  Special Topics in History  (1-3 credit hours)  
Presentation of material normally not available in regular history course 
offerings, or offering of new introductory courses on a trial basis. 
Students cannot receive credit for multiple sections of HI 298 unless the 
topics are different.

Typically offered in Fall, Spring, and Summer

HI 300  Sophomore Seminar in History  (3 credit hours)  
Introduction to the process of researching and writing history. Techniques 
for locating and interpreting primary sources. The craft of historical 
writing. Analysis and criticism of the varieties of history. Basic computer 
literacy: basic computing terms, electronic mail, online searching of the 
NCSU Libraries, use of the Internet, and word processing.

Prerequisite: Sophomore standing, History Majors  
Typically offered in Fall and Spring

HI 305  Frauds and Mysteries of the Past  (3 credit hours)  
Myths, mysteries, misconceptions, and hoaxes in history and 
archaeology. Examination of popular fascinations with the past, fallacies 
invoked in historical myths, and misappropriation of the past. Students 
learn about and implement methods and evidence used by scholars 
to interpret past peoples and events, logic, skepticism, and critical 
thinking, interpretive, and analytical skills. Students apply these skills in 
discussions, in-class activities, and creative assignments to debunk and 
disprove inaccurate and problematic claims about the past. Case studies 
of topics such as: stereotypes about early humans, Atlantis, mythical 
beasts, pyramid alignment, conspiracy theories, art fakes and forgeries, 
and alien visitations.

GEP Humanities, GEP Interdisciplinary Perspectives  
Typically offered in Fall only

HI 307  Jewish History  (3 credit hours)  
Survey of major topics in the history of the Jews, focusing on the 
development of Jewish life on the European continent but also covering 
the patterns of migration that created a global diaspora as well as the 
forces that formed modern Israel.

GEP Global Knowledge, GEP Humanities  
Typically offered in Spring only

HI 317  Cuba Today: Historical and Sociopolitical Perspectives  (3 
credit hours)  
This course, offered in Havana, Cuba, through the Study Abroad Office, 
examines Cuban political, social and economic dynamics through 
historical and sociopolitical perspectives. It explores the process and 
legacy of colonization, the role of slavery in colonial society, Santeria, 
healthcare, education and international relations in revolutionary Cuba. 
In order to take this course, students must be degree seeking and it must 
count towards their degree.

GEP Global Knowledge, GEP Humanities  
Typically offered in Summer only
**HI 318  Environmental History of Cuba: Prehistory to the Present (3 credit hours)**
This course, offered in Havana, Cuba, is designed to introduce students to the environmental history of the country, from the pre-history to present. Among the core topics examined are the social, economic and environmental impacts of sugar, tobacco and coffee cultivation, the relationships between animal husbandry and deforestation, and the history of foreign tourism and its environmental implications. The course closes with an examination of the "Special Period" in Cuba beginning in 1989, and the rise of organic and urban agriculture in Cuba. In order to take this course, students must be degree seeking and it must count towards their degree.

**GEP Interdisciplinary Perspectives**
Typically offered in Summer only

**HI 320/REL 320  Religion in American History (3 credit hours)**
Representative people, movements and thought in the major religions within the context of American society and culture.

**GEP Humanities, GEP U.S. Diversity**
Typically offered in Fall only

**HI 321  Scientific Revolution and European Society, 1500-1800 (3 credit hours)**
Exploration of the changing role that the arts, technology, and sciences played in shaping early modern European culture, society, and global power, between 1500 and 1800. Examination of the historical context of developments such as machine-making, new scientific ideas, patronage of science and technology, the formation of distinct technical and scientific fields, nation-building projects, and global ventures.

**GEP Global Knowledge, GEP Humanities, GEP Interdisciplinary Perspectives**
Typically offered in Fall only

**HI 322  Rise of Modern Science (3 credit hours)**
Analysis of how "modern" science developed in Europe since the 1500s, exploring the foundation of the ideas, scientific practices, institutions, and cultural meaning and power of science in modern society. Examples taken from the creation of the mechanistic worldview and Newtonian science, and the development of modern disciplines such as chemistry, geology, biology, and physics.

**GEP Interdisciplinary Perspectives**
Typically offered in Fall and Spring

**HI 323  Science, American Style (3 credit hours)**
Exploration of the distinctive nature of American science and its place in American culture. Analysis of the historical context of developments, such as early contributions to science, natural history, and paleontology; the growth of professionalization of science; ideas about scientific management and social applications such as eugenics; and the creation of the atomic bomb and the rise of "Big Science" after WWII.

**GEP Interdisciplinary Perspectives**
Typically offered in Spring only

**HI 324  History of Common Law and Constitution (3 credit hours)**
Survey of the development of common law and constitution from the earliest Roman and Anglo-Saxon beginnings to the era of the French and American Revolutions. The focus will be on the European social, political and intellectual contexts within which Anglo-American law emerged, and the foundations of legal and constitutional principles. Topics include the origins of courts and the judiciary; the evolution of jury trial and the early history of the law of evidence; conflicts and compromised between secular and ecclesiastical law; rights and limits to property ownership at common law; and problems regarding the legal status of women, children, servants and slaves.

**GEP Global Knowledge, GEP Humanities**
Typically offered in Spring only

**HI 332  Germany and the World Wars (3 credit hours)**
Germany's rise as a world power in the years prior to World War I, the emergence of Adolf Hitler and national socialism, and the consequences in defeat of World War II. Topics include nationalism, industrialism and the struggle of workers, imperialism, religious minorities and racial theories, sexual revolution, democratization, international relations and war, postwar occupation and reconstruction, and popular culture in music and film.

Prerequisite: 3 hrs of History or Sophomore Standing

**GEP Global Knowledge, GEP Humanities**
Typically offered in Spring only

**HI 335  The World at War (3 credit hours)**
Comparative history of the experience of war over time and place. Topics include the interactions between war and society; effects on combatants and non-combatants, especially women and children; and the role of technology.

**GEP Global Knowledge, GEP Humanities**
Typically offered in Fall and Spring

**HI 337  Spy vs. Spy: Cold War Intelligence History (3 credit hours)**
This course will examine the often deadly intelligence efforts that characterized the Cold War (USA vs. USSR) of 1945-1991. While the history of that era marks the major political, economic, and military events, much occurred in the shadows. This wide-ranging intelligence competition affected - and was affected by - both American and Russian societies and cultures. Drawing on selected readings, this course will seek to describe this struggle to know and to conceal, and offer useful context to explain how and why it influenced the course of the Cold War.

**GEP Humanities**
Typically offered in Fall only

**HI 338  Empire, War, and Revolution in Russia (3 credit hours)**
Survey of Russian history since the advent of modern reform following the 1861 Serf Emancipation. The course treats the failure of an increasingly outdated monarchy to cope with the rise of an influential urban educated class, and industrial work force, and Populist and Marxist revolutionary movements. The course traces the degeneration of the 1917 socialist revolution into a hardened dictatorship which, forced by conditions outside its control, waged a destructive but victorious war, saving Europe from Nazism. It treats the 1991 Soviet collapse and the challenges and failures of the post-Stalin and post-Soviet periods.

**GEP Global Knowledge, GEP Humanities**
Typically offered in Spring only
HI 340 History of Agriculture (3 credit hours)
An introduction to the history of agriculture from a global perspective. The course explores our evolving relationship with plants and animals, including the earliest experiments in domestication and husbandry, short- and long-term developmental trajectories, local- and global-scale patterns, and coverage of diverse places and times. Themes include agricultural practices, food systems, landscape transformations, technological innovations, social and political organization, inequality, exploitation, food security, and sustainability.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

HI 341 Technology in History (3 credit hours)
The role of technology in society from earliest times to the present. Major achievements in technology and an examination of the nature of invention, innovation and adaptation of technologies and their impact on Western Civilization.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HI 344 Dinomania: Dinosaurs in Culture and Science (3 credit hours)
The cultural and scientific history of dinosaurs as simultaneously an object of scientific knowledge and of popular culture. Attention will be paid to early dinosaur discoveries and interpretations, the competitive exploration for dinosaurs in the US West and other exotic places, the origin and international spread of dinomania, dinosaurs as cultural icons, and the ways that dinosaurs have been represented in the media and in public museums. This course will include critical discussion of how natural science is done, how ideas about dinosaurs are culturally embedded, and how and why those ideas change over time.

GEP Interdisciplinary Perspectives
Typically offered in Fall only

HI 345 American Popular Culture (3 credit hours)
Popular culture as reflection of as well as contributor to American historical trends. Changes in forms of entertainment (music, books, popular art, theater, film, television, etc.), from the artisanal culture of the late 18th century through the rise of 19th- and early 20th-century commercial culture to the evolution of mass media culture in the late 20th and early 21st centuries.

GEP Humanities
Typically offered in Spring only

HI 346 The Civil War Era in Popular Culture (3 credit hours)
Survey of the causes, trajectories, and consequences of the American Civil War and the social, political, and economic struggles of Reconstruction. Draws on history and literary studies to investigate how Americans represented and misrepresented the Civil War era, through an examination of popular culture. Emphasis on conflicts concerning regional identity, race, class, gender, and sexuality in the history and memory of the Civil War era.

GEP Humanities, GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Spring only

HI 350 American Military History (3 credit hours)
American military experience and its relationship to other historical developments. Use of military force in terms of strategy and tactics and as an element in the nation's diplomatic, political, social, economic and intellectual life.

GEP Humanities
Typically offered in Fall only

HI 351 U.S. Naval History (3 credit hours)
The role of the U.S. Navy in American history. Seapower, national defense and foreign policy. The impact of technology on naval warfare and the historical evolution of missions of the U.S. Navy.

GEP Humanities
Typically offered in Spring only

HI 354 The Rise of the American Empire (3 credit hours)
This course investigates the rise of the American Empire from the Spanish American War of 1898 through the 2001 attacks on the World Trade Center. The purpose of the course is not only to acquaint you with the crises and triumphs of US foreign policy from 1898 to 2001, but also to help you develop your own analysis of whether the acquisition of empire was accidental or deliberate, or a combination of both.

GEP Humanities
Typically offered in Spring only

HI 360 U.S. Agricultural History (3 credit hours)
U.S. Agricultural history from colonial era to present. Attention to the major economic, social, political, environmental and cultural forces that shaped American agriculture from the 16th century to 21st century. Discussion of the role of technological change and evolution of governmental policy in U.S. agriculture. Exposure to major episodes demonstrating fundamental changes and continuities in U.S. agriculture. Discussion of the diversity of American farmers and farmworkers and their struggles for equality and access.

GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

HI 364 History of North Carolina (3 credit hours)
History of North Carolina from early European exploration to the present. Features of North Carolina society which made this state similar to and different from other southern states and the nation as a whole.

GEP Humanities
Typically offered in Fall, Spring, and Summer

HI 365 The American West (3 credit hours)
A history of the American borderlands with emphasis on the trans-Mississippi West. Cycles of exploration, conquest, and exploitation of this region. Influence of the frontier in the development of the United States.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only
**HI 366 Native American History** (3 credit hours)
An introductory interpretation of the varied historical experiences of many nations native to North America from the first migrations of peoples into the continent until the present, including the variety and diversity of Indian cultures and experiences; native resistance to colonialism, expansion, and U.S. federal policies; and the survival and continuity of native cultures and peoples through more than four centuries of contact, conquest, and change.

*GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only*

**HI 369 Sexuality in U.S. History** (3 credit hours)
Exploration of the social construction of sexualities from the early seventeenth century to the present day. This course will focus on the United States, but we will begin with the history of sexuality in early modern Europe to see where ideas of sexuality in colonial America had their roots. We will proceed through the chronological development of the history of sexuality in North America. Throughout the semester, we will explore dominant and alternative constructions of sexuality; trace the changing and contested meanings of sexuality; and explore the implications of these understandings in sexuality for power relations in the history of the United States. While issues of gender and race frequently intersect with sexuality, we will be focused primarily on the latter.

*GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only*

**HI 370 Modern Egypt** (3 credit hours)
Exploration of the political, socio-economic, and cultural history of Egypt from the end of the 18th century (the 1798 exploration led by Bonaparte) to the present day; including the late Ottoman period (1798-1805), the birth of the modern state (1805-1922), Egypt's liberal experiment (1922 -1952), the Nasser era (1952-1970), the neo-liberal age (since 1970), and concluding with the January 25th Revolution. The investigation follows two main threads: the conflictual relationships that developed over the past two centuries between the state and society in all its diversity, and the continuous struggle over the definition of the Egyptian nation that these conflicts have generated.

*GEP Global Knowledge, GEP Humanities
Typically offered in Spring and Summer*

**HI 371 Modern Japan, 1850 to Present** (3 credit hours)
Survey of Japan's emergence as a modern nation and world power. Topics include nation-state formation; modernization and its dislocations; democratization and authoritarianism; imperialism, international politics, and war; postwar reforms; changing gender relations; popular culture; and social problems.

Prerequisite: 3 hours of History or Sophomore standing

*GEP Global Knowledge, GEP Humanities
Typically offered in Spring only*

**HI 372/AFS 372 African-American History Through the Civil War, 1619-1865** (3 credit hours)
African background and continuity of the particular role, experience and influence of African Americans in the United States through the Civil War.

*GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only*

**HI 373/AFS 373 African-American History Since 1865** (3 credit hours)
The history of African-Americans from the Reconstruction era through the Civil Rights movement of the 1950s and 1960s to the present.

*GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only*

**HI 374 Visual Culture of Modern South Asia** (3 credit hours)
A history of visual-cultural production in expressing and shaping socio-political configurations in the South Asian subcontinent. Treats visual evidence over 300 years to understand the integrative relationship and flow of cultural production across elite.

*GEP Global Knowledge, GEP Humanities
Typically offered in Spring only*

**HI 375 Global History of Travel and Tourism** (3 credit hours)
This course traces the development of travel and tourism from ancient times to modern days, examining it as an agent that both produces and reflects social-cultural activities. It draws on different travel-energized materials-from topographic descriptions to sentimental narratives-to examine how people traveled long distances for various reasons and to analyze their impressions of foreign lands and reflections on their home population. Topics include how the crossing of boundaries reflected and reshaped the meanings of place, and the formation of identity, the spread of religion and aesthetics, the accumulation of knowledge and scientific empiricism, as well as the consumption of visual and material culture.

*GEP Global Knowledge, GEP Humanities
Typically offered in Fall only*

**HI 376 Indian History Since 1815** (3 credit hours)
Topics include nation-state formation; modernization and its dislocations; democratization and authoritarianism; imperialism, international politics, and war; postwar reforms; changing gender relations; popular culture; and social problems.

*GEP Global Knowledge, GEP Humanities
Typically offered in Spring only*

**HI 377 Naked Polities** (3 credit hours)
This course explores the historical development of nonprofits and philanthropy in the United States from the colonial period to the present: the origins of charity and philanthropy as concepts for social change and social justice, the rise of benevolent societies in the nineteenth century, the creation of philanthropic foundations and advocacy organizations in the twentieth century, and the construction of complex relationships between modern nonprofits, the state, and the private sector.

*GEP Humanities
Typically offered in Spring only*

**HI 380 History of Nonprofits, Philanthropy, and Social Change** (3 credit hours)
This course explores the historical development of nonprofits and philanthropy in the United States from the colonial period to the present: the origins of charity and philanthropy as concepts for social change and social justice, the rise of benevolent societies in the nineteenth century, the creation of philanthropic foundations and advocacy organizations in the twentieth century, and the construction of complex relationships between modern nonprofits, the state, and the private sector.

*GEP Humanities
Typically offered in Spring only*

**HI 381 NGO Nonprofits in a Global Context** (3 credit hours)
Non-Governmental Organizations (NGOs) are a crucial component and a revealing characteristic of the strength and effectiveness of a country's civil society. Examining their histories outside of the U.S. gives us a window into global culture, values, and modes of everyday life, and into notions about "charity" and "public good" in a given society. We will use India as a case study to develop a set of questions about how NGOs function in different societies, examining how researchers and activists partner with NGOs in different parts of the world to address pressing environmental, economic, social, and cultural-production issues.

*GEP Global Knowledge, GEP Humanities
Typically offered in Fall only*
HI 382 History of Capitalism in America (3 credit hours)
The phrase "capitalism in America" raises big questions, and this course will look at such questions as: What is capitalism anyway? What was the relation between slavery and capitalism? Is capitalism the story of heroic entrepreneurs who through vision and courage built new enterprises? Has the government played any positive role in American capitalism or has it just stood in the way? Is fraud an aberration or an essential part of capitalism? Why has America had all these financial crises and how have Americans responded to them? Is capitalism in the twenty-first century something new or is it just a continuation of longer trends? Is it even reasonable to talk about capitalism in the United States alone?

GEP Humanities, GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Spring only

HI 385 Introduction to Public History (3 credit hours)
History is about people: their societies, economies, cultures, and politics and how these changed over time. In Public History, history is also for people, in that careful and exacting historical research can facilitate dialogue and be applied to contemporary problems. Just as important, Public History is history saved, researched, and analyzed with people, for public historians work with individuals and groups to collaboratively understand history and preserve historical resources for future generations. This class treats the major concepts, scholarship, and research methods shaping the Public History field; it is also an opportunity to test the fields theories in projects that will create new resources for historical learning in our community. Required field trip fee of $10.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall and Summer

HI 390 Internship in History (3 credit hours)
Directed work experience for history students with internship-site mentoring and evaluation. Engagement in the community as a practitioner. Course requires 140 contact hours with the sponsoring organization. The course includes an on-campus class meeting and presentation at the end of the semester. Students must have at least a 3.0 overall GPA and at least a 3.0 GPA in the major, be a junior or senior, and must complete the application process with the Department of History. Students must provide their own transportation to the internship site. Modest liability insurance fee required.

Prerequisite: Juniors & Seniors with Cumulative GPA of 3.0 or above and 3.0 GPA or above in History courses, HI 300 and 12 hours of History courses and consent of the department
Typically offered in Fall, Spring, and Summer

HI 395 History: Study Abroad (1-3 credit hours)
Topical History courses taught in NCSU Study Abroad programs. (Current listings available in Study Abroad Office, CHASS Dean's Office and History Department).
Prerequisite: 3 hours of History or Sophomore standing
Typically offered in Fall only

HI 400/HI 500 Civilization of the Ancient Near East (3 credit hours)
The civilization of Mesopotamia and Egypt from earliest times to the fall of Babylon in 539 B.C. Credit for both HI 400 and HI 500 is not allowed

Prerequisite: 3 hours of History
Typically offered in Fall only

HI 402/REL 402 Early Christianity to the Time of Eusebius (3 credit hours)
Growth and diffusion of early Christianity from the end of the first century up to the time of Eusebius and the conversion of Constantine (early fourth century); Christianity in its Greco-Roman environment; Roman policy towards Christianity; heterodox C

Prerequisite, one of: REL 312, REL 317, or HI 207.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

HI 403/HI 503 Ancient Greek Civilization (3 credit hours)
The history of the Hellenes from the Minoan civilization through Alexander's legacy, with readings in Herodotus and Thucydides. Credit will not be given for both HI 403 and HI 503.

Typically offered in Spring only

HI 404/HI 504 Rome to 337 A.D. (3 credit hours)
The development of ancient Rome from its origins in Italy, through the rise as an Empire embracing the entire Mediterranean World and Western Europe, to Constantine, Christianity and the foundation of Constantinople. Examines critically the political achievement of a people who rose from an obscure Italian city to a world empire, with emphasis on the analysis of primary sources. Credit will not be given for both HI 404 and HI 504

P: 3 hrs. of History

HI 405/HI 505 History and Archaeology of the Roman Empire (3 credit hours)
Analysis of Rome's rule over the Mediterranean World in the first four centuries A.D. through the use of literary and archaeological sources. Special emphasis on imperial army and frontier security. Credit will not be given for both H1 405 and H1 505

P: 3 hrs. of History

HI 406/HI 506 From Roman Empire to Middle Ages (3 credit hours)
Late Antiquity and the early Middle Ages. The transition from classical civilization to the basis of modern civilizations; the fall of Rome, the Germanic kingdoms, Byzantium, the establishment of Christianity, the birth and growth of Islam. Credit will not be given for both HI 406 and HI 506

P: 3 hrs. of History

HI 407/REL 407 Islamic History to 1798 (3 credit hours)
The history of the Islamic Near East to 1798. Topics include the East Mediterranean before Islam, Muhammad and the development of Islam, sources of Muslim civilization, Islamic law, science, philosophy, art and architecture. Islam in Spain, India, Asia and Africa, the Crusades, the Ottomans, Islam and Europe. Credit will not be given for both REL/HI 407 and REL/HI 507.

Prerequisite: 3 hrs HI or REL 300 or above
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only
HI 408/REL 408  Islam in the Modern World  (3 credit hours)
Evolution of modern Islam from 17th century to the present. Primary
emphasis on North Africa, the Middle East and South Asia. Pre-modern
Islamicate empires, reform and revival. Historical origins of current issues
in the Islamic world. Students cannot receive credit for both REL/HI 408
and REL/HI 508.

Prerequisite: 3 hours of history or religious studies
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

HI 409/HI 509  The High Middle Ages  (3 credit hours)
Medieval culture from 10th through 13th centuries: revival of the Roman
Empire, monastic and papal reform, rise of universities, evolution of
representative bodies, the Gothic style, troubadour and goliardic poetry,
scholasticism, and revival of Roman law. Credit will not be given for both
HI 409 and HI 509

P: 3 hrs. of History
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Summer

HI 410  Italian Renaissance  (3 credit hours)
The historical, literary, and cultural developments defining the
"Renaissance" period of Italian history from the late fourteenth
to the end of the sixteenth century. Topics include critical analysis of the
concept of a "renaissance" and its usefulness for historical interpretation;
the intersection of politics, religion, society, art, and literature in relation to
defining a "Renaissance" culture; and the development of a global money
economy and the cultural output it inspired in Europe.

P: 3 hrs. of History
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Summer

HI 411/HI 511  Trials of Faith: Religious Reformation in Early-Modern
Europe  (3 credit hours)
Examination of the great disruption in European civilization associated
with the Protestant and Catholic Reformations. The course considers the
new religious ideas and practices associated with the Reformations and
transformation they produced in European political and economic life; the
violence they provoked; the new thinking about families and gender roles
they encouraged, the spread of European religions around the globe with
European voyages of discovery and conquest, and the beginning of ideas
about religious toleration. Credit will not be given for both HI 411 and
HI 511.

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 412/HI 512  The Sexes and Society in Early-Modern Europe  (3
credit hours)
Examination of changes in gender relations; ideas about the sexes,
femininity, and masculinity; the roles of women and men in political,
religious, economic, scientific, and family life in Europe between the late
Middle Ages and the French Revolution. Credit for HI 412 and HI 512 is
not allowed.

P: 3 hrs. of History
GEP Global Knowledge

HI 414/HI 514  From Kings to Revolution: The History of Early-
Modern France  (3 credit hours)
Examination of the most politically powerful and culturally dominant
kingdom in early-modern Europe, which dissolved into a revolution
that destroyed its monarchy while establishing ideas about democracy
and equality. From the glories of the Versailles palace to the misery
of peasant villages, topics include the beginnings of the French state
and nation in the warfare and religious conflicts of 1500s, political and
economic developments, the growth of an internationally influential
French culture, religious change, controversies over gender roles, and
the origins of the French Revolution. Credit will not be given for both
HI 414 and HI 514.

P: 3 hrs. of History
GEP Global Knowledge

HI 415/HI 515  The French Revolution  (3 credit hours)
Broadly based analysis of France's first revolutionary era; the
enlightenment and its impact, the causes and character of the Revolution
in France; impact of these events in France and Europe. Credit will not be
given for both HI 415 and HI 515

P: 3 hrs. of History
GEP Global Knowledge

HI 418/HI 518  Fascist Italy and Nazi Germany  (3 credit hours)
Fascism as a theoretical concept, rise of fascism in Italy and Germany,
seizure of power by Mussolini and Hitler, organization of the economy,
churches, military, women, youth, and culture under the dictatorships.
Students will not receive credit for both HI 418 and HI 518

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 419/HI 519  Modern European Imperialism  (3 credit hours)
Historical background of European overseas expansion; its impact on
the economics, politics and culture of both Europe and the colonized world;
the significance of imperialism and anti-colonial nationalism in shaping
the modern world. Credit will not be given for both HI 419 and HI 519

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Spring only

HI 421/HI 521  European Intellectual History: The Eighteenth
Century  (3 credit hours)
Historical examination of some of the major figures of the European
Enlightenment, beginning with Locke and ending with Kant. Credit will not
be given for both HI 421 and HI 521

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 422/HI 522  European Intellectual History: The 19th Century  (3
credit hours)
Historical examination of some of the major figures of European thought
during the 19th century, beginning with the enthusiasm of the period of
the French Revolution and ending with the disillusionment of the fin de
sicle. Credit will not be given for both HI 422 and HI 522

P: 3 hrs. of History
GEP Global Knowledge
HI 423/HI 523 Women in European Enlightenment (3 credit hours)
Historical analysis of feminist thought and action during the Enlightenment of the 1700s. Topics include women's role in the development of Western knowledge and science, historical construction of the gendered "nature" of women, education and political resources available to women, and their strategies for emancipation. Credit will not be given for both HI 423 and HI 523.

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Spring only

HI 425/HI 525 Tudor and Stuart England (3 credit hours)
British history from the Reformation through the Civil War. Emphasis on key developments in social, political and economic life: The development of a new concept of kingship, the growing independence of Parliament, the search for religious uniformity and the changing status of the aristocracy and gentry. Credit will not be given for both HI 425 and HI 525.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Summer only

HI 429 20th Century Britain (3 credit hours)
British political, social and economic history since 1914, with reference to the effects of two world wars, the growth of the Welfare State, Britain's decline as a power, and its search for a new role in the world. Credit will not be given for both HI 429 and HI 529.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Fall only

HI 430/HI 530 Modern France (3 credit hours)
French history from the downfall of Napoleon I to the present, with a short introductory survey of the Old Regime and the French Revolution. Cultural, social and economic developments and political trends. Credit will not be given for both HI 430 and HI 530

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Spring only

HI 434/HI 534 Theory and Practice of Digital History (3 credit hours)
Introduces students to the theory and practice of digital history. Students will examine theoretical scholarship on digital practices in history, learning how to acquire, edit, process, analyze, and present humanistic data. Students will critique examples of digital history including digital archives, exhibits, scholarship, and teaching resources, and then apply conceptual knowledge in the creation of their own digital history projects. The course is geared to students without prior knowledge of coding. Credit will not be given for both HI 434 and HI 534.

R: Graduate Standing or PBS
Typically offered in Fall only

HI 437 Topics in Central and East European History (3 credit hours)
Topical focus on specific problems and events occurring in the region in and between Germany and Russia in modern history. The course is designed to expose advanced undergraduates, principally history majors, to intensive reading, writing, and discussion of focused topics in the subject area. Previous modern European history credit is advised. This course is repeatable once for credit when offered with a different topic.

P: 3 hrs. of History
Typically offered in Spring only

HI 440/HI 540 American Environmental History (3 credit hours)
Interactions between humans and their environments in America; environmental focus on themes in American history such as colonial settlement, industrialization, progressivism, the New Deal, the 1960s. Credit will not be given for both HI 440 and HI 540.

Prerequisite: 3 hours of History
GEP Interdisciplinary Perspectives
Typically offered in Fall and Summer

HI 441/HI 541 Colonial and Revolutionary U.S. (3 credit hours)
Origins of the English colonies in America to the American Revolution. European background to colonization, merging of different cultures, effects of mercantile doctrine, causes of revolution. Credit will not be given for both HI 441 and HI 541

P: 3 Hours of History

HI 443/HI 543 U.S. Constitutional History to 1883 (3 credit hours)
This course examines the origins and development of the U.S. Constitution from the Articles of Confederation to 1883. The course specifically looks at the federal Convention of 1787, the national bank debate and early constitutional interpretation, the constitution and its interaction with politics, economics, and society; the powers of Congress-taxation, contracts, commerce and war. The course also examines sovereignty, slavery and civil rights. It ends with an analysis of the Civil War Amendments and the transformation in American constitutionalism. Credit for both HI 443 and HI 543 is not allowed.

P: 3 hrs. of History
Typically offered in Fall only

HI 444 U.S. Constitutional History Since 1870 (3 credit hours)
Examines the transformation of American Constitutional thought after the Civil War; the triumph of nationalism and the evolution of a new federal theory; the rise and fall of federal protections of civil rights in the late 19th-century and the Civil Rights Revolution in the 20th century. Explores key concepts as civil liberties, judicial activism and judicial restraint; procedural and substantive due process, liberty of contracts and entrepreneurial liberty, Japanese internment, privacy, women and gender issues; explores free speech, religious freedom, civil liberties. Credit for both HI 444 and HI 544 is not allowed.

P: 3 hrs. of History
Typically offered in Spring only

HI 445/HI 545 Early American Borderlands (3 credit hours)
Examines the social, political, and cultural development of the eastern American frontiers between the early seventeenth and mid-nineteenth centuries. Addresses the relationships between settlers and environments, settlers and Native Americans. Explores the structure and life of pioneer families, the development of new institutions, the role of governments in regulating settlements, and the evolution of the "frontier myth." Credit cannot be given for both HI 445 and HI 545.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only
HI 446/HI 546  Topics in Civil War and Reconstruction  (3 credit hours)
Examination of the historiography of the American Civil War and Reconstruction. Topics include the origins of the war, military strategy, the northern and southern homefront, nationalism and citizenship, slavery and freed labor, changing gender roles and ideologies, struggles over racial inequality, and conservatism and radicalism during Reconstruction. Credit will not be given for both HI 446 and HI 546.

Prerequisite: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

HI 447/WGS 447/HI 547/WGS 547  Women in America: From Contact to the Civil War  (3 credit hours)
The historical experience of women in America from Native American and European contact through the colonial period to the immediate post-Civil-War years (to 1890). Topics include the history of women's work, education, legal and political status, religious experience, and sex roles, with consideration of age, class, race, sexual preference, and region as significant variables in women's experience in America. Credit will not be given for both HI (WGS) 447 and HI (WGS) 547.

P: 3 Hours of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

HI 448/WGS 448/HI 548/WGS 548  American Women in the Twentieth Century  (3 credit hours)
Women's historical experience in America, 1890-1990. Changes in women's work, education, legal and political status, and sex roles, age, class, race, sexual preference and region as significant variables in women's experience. Credit will not be given for both HI (WGS) 448 and HI (WGS) 548.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

HI 449/HI 549  U.S. Labor to 1900  (3 credit hours)
This course explores the history of work, workers, and working-class life and labor in the United States from the founding of the first European colonies to the beginning of the twentieth century: bound and free labor in colonial America, the transformation of urban worklife in the decades preceding the Civil War, slavery and class formation in the antebellum South, the effects of immigration on American workers, and the impact of race and gender on workers' solidarity. Credit will not be given for both HI 449 and HI 549.

P: 3 hrs. of History
GEP U.S. Diversity

HI 450  U.S. Labor Since 1900  (3 credit hours)
This course explores the history of work, workers, and working-class organizations in the twentieth century United States; with particular attention to three core issues in twentieth-century American labor history: whether the US South has a particular form of labor history; the historical struggle for workers' rights to collectively act and protest; and the intersections between race, ethnicity, immigration and labor in the twentieth-century US. Credit will not be given for both HI 450 and HI 550.

P: 3 hrs. of History
GEP U.S. Diversity

HI 451/HI 551  The Vietnam War  (3 credit hours)
The Vietnam War in Vietnamese historical context. A study of major works on the legacy of French colonialism; the growth of Vietnamese radicalism and communism; World War II and the Vietnamese Revolution; the French Indochina War and political division

Prerequisite: 3 hours of History
Typically offered in Spring only

HI 452/HI 552  Recent America  (3 credit hours)
Examination of contemporary opinions and historical interpretations of major problems in American life since 1939, including World War II, its social and economic consequences; Korea and the Cold War, big business and labor; civil rights and feminist movements; countercultures, Vietnam and Watergate. Credit will not be given both for HI 452 and HI 552

P: 3 Hours of History

HI 453/HI 553  United States-Latin American Relations Since 1823  (3 credit hours)
Critical analysis of the last two centuries of relations between the US and Latin America. Exploration of major policies using primary sources and declassified CIA documents. Major themes include US economic, political, and military influence, covert and overt US interventions, and response by Latin American governments. Historical perspectives on contemporary inter-American problems such as drugs, environment, debt crisis, human rights abuses, and the impact of the Latino population in the U.S. Credit will not be given both for HI 453 and HI 553.

Prerequisite: 3 hrs. of History
Typically offered in Fall only

HI 454  History of U.S. Foreign Relations, 1900-Present  (3 credit hours)
America's emergence as a world power; American diplomatic history since 1900; the expansion of American economic and cultural relations; the evolution of the American foreign policy bureaucracy; and the historical forces and personalities that have shap

P: 3 hrs. of History

HI 455/AFS 455/HI 555/AFS 555  History of the Civil Rights Movement  (3 credit hours)
The black revolution; stages and leaders of the movement; successes and failures in the fight for desegregation, the vote, and economic opportunity; impact of Civil Rights movement on the United States. Credit will not be given both for AFS/HI 455 and AFS/HI 555.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

HI 459/HI 559  The Early American Republic  (3 credit hours)
Examines the social, political, and cultural development of the Early Republic, the period in American history roughly from the Revolutionary War through the Administration of John Quincy Adams. Employs the life of Thomas Jefferson-the quintessential American, as the foundation for delving into the historical problems, interpreting primary sources, and analyzing secondary sources. Encourages graduate students to analyze the ways in which historiographic debates complicate our understanding of the Early American Republic. Credit will not be given for both HI 459 and HI 559.

Prerequisite: 3 hrs. of History
HI 461/HI 561 Civilization of the Old South (3 credit hours)
The distinctive features of the Old South as part of the regional
development of United States history. Consideration of colonial factors
in the making of the South, development of the plantation system and
slavery, Southern social order, intellectual and cultural life, economic
development, and rise of Southern nationalism. Credit will not be given
for both HI 461 and HI 561.
Prerequisite: 3 hrs. of History

HI 462/HI 562 Southern History since the Civil War (3 credit hours)
Exploration of many American “Souths” from Reconstruction to the
present. How race/ethnicity, gender, class, geography, sexuality, and
culture inform “Southern” identity; major political and economic changes;
and the region’s relationship to the nation and the world. Credit will not be
given for HI 462 and HI 562.
Prerequisite: 3 hours of History

HI 463/HI 563 Topics in History and Memory (3 credit hours)
Explores how “collective memory” develops. Examines how memory is
represented through public speeches, civic celebrations, monuments
and memorials, and other forms of popular and political culture. Analyzes
what is recalled, what is forgotten, and who decides. Asks why memory
is made public. May be repeated once for credit when offered with a
different topic. Credit will not be given for both HI 463 and HI 563.
Typically offered in Fall, Spring, and Summer

HI 465 Oil and Crisis in the Gulf (3 credit hours)
Historical roots and development of the Persian Gulf region from the
late nineteenth century until the present with an emphasis on the social,
economic, cultural and political transformations following the discovery
of oil, and subsequent events such as the Arab Oil embargo of 1973, the
Iranian Revolution, the Iran-Iraq war, and the two Gulf wars.
P: 3 hrs. of History

HI 466 History of the Palestinian-Israeli Conflict (3 credit hours)
Historical roots and development of the Palestinian-Israeli conflict from the
late nineteenth century until the present through the study of the history
and historiography of Zionism, Palestinian nationalism, creation of the state of Israel, establishment of settlements, conflicts and peace
negotiations, as well as a study of the impact of this conflict on both
Israeli and Palestinian societies, economies and cultures.
P: 3 hrs. of History

HI 467 Modern Mexico (3 credit hours)
Major developments in Mexican national life since 1821. The 19th
century: the era of Santa Anna, the war with the United States, the
Reform, the French intervention, and the dictatorship of Porfirio Diaz. The
1910 Revolution and the resulting transformation of Mexico’s political,
social and economic institutions. Reading knowledge of Spanish helpful
but not required.
Prerequisite: 3 hours of History

HI 468/HI 568 Slavery in the Americas (3 credit hours)
Exploration of the development of chattel slavery throughout the Americas. Analysis of the emergence and development of New World slavery in ways that encourage students to think critically about the
historical processes of abolition, emancipation, and freedom across the
Atlantic world. The lectures and readings seek to dislodge the notion
that the “history of slavery” only pertains to the United States. The
course, instead, emphasizes commonalities and differences in ways that
challenge assumptions that the institution was exceptional in any given
region. Credit will not be given for both HI 468 and HI 568.
Prerequisite: 3 Hours of History and Junior Standing

HI 469/HI 569 Latin American Revolutions in the Twentieth Century (3 credit hours)
Comparative analysis of causes, participants, process, and outcome of
revolutions in Mexico, Bolivia, Cuba, and Central America. Credit for both
HI 469 and HI 569 will not be given

P: 3 hrs. of History

HI 470/HI 570 Exploring World History (3 credit hours)
Introduction to the methods, themes, and narratives of world history. As
a distinct approach to historical study, world history focuses on dynamic
connections and relationships among regions of the world and the variety
of global processes - related to trade, religion, production, consumption,
migration, imperialism, disease, and technologies - that connected them.
The course is a suggested elective for future teachers who will teach
world history in high school, as well as an ideal course for History majors
and graduate students who want to explore the connections among all
the regionally specific upper division courses they have taken. Credit will
not be given for both HI 470 and HI 570.

Prerequisite: 3 hours of History

HI 471/HI 571 Revolutionary China (3 credit hours)
China 1900 to present. Examination of political, cultural, and socio-
economic revolutionary phases of China’s 20th-century transformation from traditional empire to communism. Particular attention to post-1949
problems of nation-building. Credit will not be given for both HI 471 and HI 571

P: 3 hrs. of History

HI 472 Fashion, Food, and Fun: Material Culture in Chinese History (3 credit hours)
Exploration of the history of everyday material culture in China, covering
a wide range of physical objects such clothes, tea, architecture, and
woodblock printing. Examination of how the material culture of different
time periods evolved in response to varying historical factors and
contributed to the formation of cultural norms. Focus on both textual and
visual historical records, as well as objects from the Gregg Museum.

Prerequisite: 3 hours of History
HI 473/HI 573 Japan’s Empire in Asia, 1868-1945 (3 credit hours)
An advanced survey of Japanese relations with Asia in the nineteenth and twentieth centuries. Structures and ideologies of imperialism and colonialism; modernization, nationalism and social change; migration and mobility; resistance and collaboration; and legacies of empire. Credit will not be given for both HI 473 and HI 573.

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 474 Modern India (3 credit hours)
The history of the Indian sub-continent, from the 16th century to the present. Focus on political, economic and cultural change under the Mughal Empire and the British Raj; the problems of independent India, Pakistan and Bangladesh.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Fall only

HI 475/AFS 475/HI 575/AFS 575 History of the Republic of South Africa (3 credit hours)
Evolution of the Republic of South Africa’s society, with emphasis on the interaction of diverse peoples and cultures. Particular attention is given to the period since 1870. Credit will not be given for both HI (AFS) 475 and HI 575.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Fall only

HI 476/AFS 476/HI 576/AFS 576 Leadership in Modern Africa (3 credit hours)
Recent sub-Saharan African political history (excluding South Africa). Overview of concepts, vocabulary, historical trends. Detailed examination of specific African countries as case studies, such as Ghana, Nigeria, Zimbabwe, Tanzania. Credit will not be given for both HI (AFS) 476 and HI 576.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Fall and Spring

HI 477 Women in the Middle East (3 credit hours)
The varied forces influencing lives of women in Middle East from beginning of Islam to present.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Spring only

HI 478 Islam and Christianity in Sub-Saharan Africa (3 credit hours)
Expansion and interaction of Islam and Christianity in sub-Saharan Africa in the nineteenth and twentieth centuries, and their influence and impact on the economy, politics, and society. Topics include missionary activity, resistance to imperial authority, the role of the churches, and the influence of religion on leadership, education, nationalism, and post-colonialism. Credit will not be given for both HI 478 and HI 578.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Fall only

HI 479/AFS 479/HI 579/AFS 579 Africa (sub-Saharan) in the Twentieth Century (3 credit hours)
Developments in sub-Saharan Africa during the colonial period, from the end of the nineteenth century to the advent of decolonization in the early 1960s. Interplay of political, social, economic and cultural factors in the experiences of African peoples during this period. Credit will not be given for both HI (AFS) 479 and HI 579.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Fall only

HI 481/HI 581 History of the Life Sciences (3 credit hours)
Historical context of the individuals, ideas, scientific practices, and social goals that created the core concepts of the modern biological sciences, from Renaissance medicine to molecular biology, with a focus on interconnections of the scientific knowledge and perspective of the life sciences with other aspects of culture, including other sciences, views about nature and life, religious belief, medical practice, and agriculture. Topics include the development of biological experiments; theories of ecology and evolution; the chemical understanding of health, food, and drugs; and the modern molecular revolution. Credit will not be given for both HI 481 and HI 581.

P: 3 hrs. of History
GEP Interdisciplinary Perspectives
Typically offered in Spring only

HI 482/HI 582 Darwinism in Science and Society (3 credit hours)
Scientific development of Darwinism and its reception by the scientific community and the general public. Social impact of theories of evolution as reflected in Social Darwinism, eugenics, sociobiology, and relationship of sciences to ethics and religion. Credit will not be given both for HI 482 and HI 582

P: 3 hrs. of History
GEP Interdisciplinary Perspectives
Typically offered in Fall only

HI 483/HI 583 Science and Religion in European History (3 credit hours)
Are science and religion inherently in conflict with each other? Historical analysis of the idea of the “warfare between religion and science,” treating their complex relationship and respective cultural authority before 1800, including the relationship of science and religion in Europe during periods of the Reformation, the creation of early modern states, and the Enlightenment of the 1700s. Topics include visions of nature and utopias, the creation of mechanistic science in the 1600s, and natural theology. Credit will not be given for both HI 483 and HI 583.

P: 3 hrs. of History
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Spring only

HI 484/HI 584 Science in European Culture (3 credit hours)
The role of science in shaping early modern European identity, culture and polity in the 1600s and 1700s. Drawing on documents and material culture, topics include the meaning of natural wonders, explorations, travel literature, instruments and mapping, colonies and empire, and universal expos. Credit will not be given for both HI 484 and HI 584.

P: 3 hrs. of History
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall only
HI 485/HI 585 History of American Technology (3 credit hours)
Technology in American history: the ideological, social, economic, and institutional contexts of technological change from the 1760's to the present. Impacts of new technological systems. Credit will not be given for both HI 485 and HI 585.

Prerequisite: 3 hours of History
GEP Interdisciplinary Perspectives
Typically offered in Spring only

HI 486/HI 586 Science and Empire (3 credit hours)
The development of European science in the context of world exploration, global commercial expansion, local knowledge, and visions of colonization and empire. Credit will not be given for both HI 486 and HI 586.

Prerequisite: 3 hours of History
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

HI 488/HI 588 Family and Community History (3 credit hours)
Theory and research in family history, local history, and community studies, as well as application to public history presentation and community development. Students cannot receive credit for both HI 488 and HI 588.

Typically offered in Fall only

HI 491 Seminar in History (3 credit hours)
Detailed investigation of selected topics in history. Consult Department of History for specific topics.

Prerequisite: HI 300 and 18 hours of History
Typically offered in Fall and Spring

HI 495 Honors Research in History I (2 credit hours)
Preparation of the honors thesis. Topics and procedures to be determined by the student and the supervising faculty member. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be

Prerequisite: Senior in History Honors Program
Typically offered in Fall and Spring

HI 496 Honors Research in History II (4 credit hours)
Completion of the honors thesis. Topics and procedures to be determined by the student and the supervising faculty member. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be

Prerequisite: HI 495, Senior in History Honors Program
Typically offered in Fall, Spring, and Summer

HI 498 Independent Study in History (1-6 credit hours)
Extensive readings on predetermined topics focused around a central theme. Permission of the department is required. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be

Prerequisite: 3 hours of History

HI 499 Special Topics in History (1-3 credit hours)
Timely topical courses or experimental course offerings in advanced historical study.

Prerequisite: 3 hours of History
Typically offered in Fall and Spring

HI 500/HI 400 Civilization of the Ancient Near East (3 credit hours)
The civilization of Mesopotamia and Egypt from earliest times to the fall of Babylon in 539 B.C. Credit for both HI 400 and HI 500 is not allowed

Prerequisite: 3 hours of History
Typically offered in Fall only

HI 502/REL 502 Early Christianity to the Time of Eusebius (3 credit hours)
Growth and diffusion of early Christianity from the end of the first century up to the time of Eusebius and the conversion of Constantine (early fourth century); Christianity in its Greco-Roman environment; Roman policy towards Christianity; heterodox C

Prerequisite: Gradate standing
Typically offered in Fall only

HI 503/HI 403 Ancient Greek Civilization (3 credit hours)
The history of the Hellenes from the Minoan civilization through Alexander's legacy, with readings in Herodotus and Thucydides. Credit will not be given for both HI 403 and HI 503.

Typically offered in Spring only

HI 504/HI 404 Rome to 337 A.D. (3 credit hours)
The development of ancient Rome from its origins in Italy, through the rise as an Empire embracing the entire Mediterranean World and Western Europe, to Constantine, Christianity and the foundation of Constantinople. Examines critically the political achievement of a people who rose from an obscure Italian city to a world empire, with emphasis on the analysis of primary sources. Credit will not be given for both HI 404 and HI 504

P: 3 hrs. of History

HI 505/HI 405 History and Archaeology of the Roman Empire (3 credit hours)
Analysis of Rome's rule over the Mediterranean World in the first four centuries A.D. through the use of literary and archaeologic sources. Special emphasis on imperial army and frontier security. Credit will not be given for both HI 405 and HI 505

P: 3 hrs. of History

HI 506/HI 406 From Roman Empire to Middle Ages (3 credit hours)
Late Antiquity and the early Middle Ages. The transition from classical civilization to the basis of modern civilizations; the fall of Rome, the Germanic kingdoms, Byzantium, the establishment of Christianity, the birth and growth of Islam. Credit will not be given for both HI 406 and HI 506

P: 3 hrs. of History

HI 507/REL 507 Islamic History to 1798 (3 credit hours)
The history of the Islamic Near East to 1798. Topics include the East Mediterranean before Islam, Muhammad and the development of Islam, sources of Muslim civilization, Islamic law, science, philosophy, art and architecture, Islam in Spain, India, Asia and Africa, the Crusades, the Ottomans, Islam and Europe. Credit will not be given for both REL/HI 407 and REL/HI 507

Prerequisite: Graduate Standing
Typically offered in Fall only
HI 508/REL 508  Islam in the Modern World  (3 credit hours)
Evolution of modern Islam from 17th century to the present. Primary emphasis on North Africa, the Middle East and South Asia. Pre-modern Islamicate empires, reform and revival. Historical origins of current issues in the Islamic world. Students cannot receive credit for both REL/HI 408 and REL/HI 508.
Prerequisite: Graduate Standing
Typically offered in Fall only

HI 509/HI 409  The High Middle Ages  (3 credit hours)
Medieval culture from 10th through 13th centuries: revival of the Roman Empire, monastic and papal reform, rise of universities, evolution of representative bodies, the Gothic style, troubadour and goliardic poetry, scholasticism, and revival of Roman law. Credit will not be given for both HI 409 and HI 509
P: 3 hrs. of History

HI 511/HI 411  Trials of Faith: Religious Reformation in Early-Modern Europe  (3 credit hours)
Examination of the great disruption in European civilization associated with the Protestant and Catholic Reformations. The course considers the new religious ideas and practices associated with the Reformations and transformation they produced in European political and economic life; the violence they provoked; the new thinking about families and gender roles they encouraged, the spread of European religions around the globe with European voyages of discovery and conquest, and the beginning of ideas about religious toleration. Credit will not be given for both HI 411 and HI 511.
P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 512/HI 412  The Sexes and Society in Early-Modern Europe  (3 credit hours)
Examination of changes in gender relations; ideas about the sexes, femininity, and masculinity; the roles of women and men in political, religious, economic, scientific, and family life in Europe between the late Middle Ages and the French Revolution. Credit for HI 412 and HI 512 is not allowed.
P: 3 hrs. of History
GEP Global Knowledge

HI 514/HI 414  From Kings to Revolution: The History of Early-Modern France  (3 credit hours)
Examination of the most politically powerful and culturally dominant kingdom in early-modern Europe, which dissolved into a revolution that destroyed its monarchy while establishing ideas about democracy and equality. From the glories of the Versailles palace to the misery of peasant villages, topics include the beginnings of the French state and nation in the warfare and religious conflicts of 1500s, political and economic developments, the growth of an internationally influential French culture, religious change, controversies over gender roles, and the origins of the French Revolution. Credit will not be given for both HI 414 and HI 514.
P: 3 hrs. of History
GEP Global Knowledge

HI 515/HI 415  The French Revolution  (3 credit hours)
Broadly based analysis of France's first revolutionary era; the enlightenment and its impact, the causes and character of the Revolution in France; impact of these events in France and Europe. Credit will not be given for both HI 415 and HI 515
P: 3 hrs. of History
GEP Global Knowledge

HI 518/HI 418  Fascist Italy and Nazi Germany  (3 credit hours)
Fascism as a theoretical concept, rise of fascism in Italy and Germany, seizure of power by Mussolini and Hitler, organization of the economy, churches, military, women, youth, and culture under the dictatorships. Students will not receive credit for both HI 418 and HI 518
P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 519/HI 419  Modern European Imperialism  (3 credit hours)
Historical background of European overseas expansion; its impact on the economics, politics and culture of both Europe and the colonized world; the significance of imperialism and anti-colonial nationalism in shaping the modern world. Credit will not be given for both HI 419 and HI 519
P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Spring only

HI 521/HI 421  European Intellectual History: The Eighteenth Century  (3 credit hours)
Historical examination of some of the major figures of the European Enlightenment, beginning with Locke and ending with Kant. Credit will not be given for both HI 421 and HI 521
P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 522/HI 422  European Intellectual History: The 19th Century  (3 credit hours)
Historical examination of some of the major figures of European thought during the 19th century, beginning with the enthusiasm of the period of the French Revolution and ending with the disillusionment of the fin de siecle. Credit will not be given for both HI 422 and HI 522
P: 3 hrs. of History
GEP Global Knowledge

HI 523/HI 423  Women in European Enlightenment  (3 credit hours)
Historical analysis of feminist thought and action during the Enlightenment of the 1700s. Topics include women's role in the development of Western knowledge and science, historical construction of the gendered "nature" of women, education and political resources available to women, and their strategies for emancipation. Credit will not be given for both HI 423 and HI 523.
P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Spring only
HI 525/HI 425 Tudor and Stuart England (3 credit hours)
British history from the Reformation through the Civil War. Emphasis on key developments in social, political and economic life: The development of a new concept of kingship, the growing independence of Parliament, the search for religious uniformity and the changing status of the aristocracy and gentry. Credit will not be given for both HI 425 and HI 525
P: 3 hrs. of History
GEP Global Knowledge

HI 530/HI 430 Modern France (3 credit hours)
French history from the downfall of Napoleon I to the present, with a short introductory survey of the Old Regime and the French Revolution. Cultural, social and economic developments and political trends. Credit will not be given for both HI 430 and HI 530
P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 533 Theory and Practice of Oral History (3 credit hours)
Examines the theory of oral history. Examines historical works drawn primarily from oral sources. Teaches students to design and implement oral history projects based on independent research.
Typically offered in Spring only

HI 534/HI 434 Theory and Practice of Digital History (3 credit hours)
Introduces students to the theory and practice of digital history. Students will examine theoretical scholarship on digital practices in history, learning how to acquire, edit, process, analyze, and present humanistic data. Students will critique examples of digital history including digital archives, exhibits, scholarship, and teaching resources, and then apply conceptual knowledge in the creation of their own digital history projects. The course is geared to students without prior knowledge of GIS. Credit will not be given for both HI 434 and HI 534.
R: Graduate Standing or PBS
Typically offered in Fall only

HI 535 Spatial History (3 credit hours)
Examines the transformation of American constitutional thought after the Civil War; the triumph of nationalism and the evolution of a new federal theory; the rise and fall of federal protections of civil rights. Explores key concepts such as civil liberties, judicial activism and judicial restraint; analyzes procedural and substantive due process, liberty of contracts and entrepreneurial liberty; evaluates Japanese internment, privacy, gender equality, free speech, religious freedom, civil liberties. Credit not given for both HI 444 and 544
Prerequisite: Graduate standing
Typically offered in Spring only

HI 539 History Of the Soviet Union and After (3 credit hours)
History of the Soviet state and society from the 1917 Revolution, including post-Soviet situation. Political disarray and resistance to the Bolshevik regime, 1917-21; industrialization, urbanization and application of coercive techniques of rule; popular reconciliation with Party state and great power status during World War II and after; fate of non-Russian nationalities; de-Stalinization, stagnation and failed attempt at Party renewal after 1985. Credit for both HI 439 and HI 539 is not allowed
P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

HI 540/HI 440 American Environmental History (3 credit hours)
Interactions between humans and their environments in America; environmental focus on themes in American history such as colonial settlement, industrialization, progressivism, the New Deal, the 1960s. Credit will not be given for both HI 440 and HI 540.
Prerequisite: 3 hours of History
GEP Interdisciplinary Perspectives
Typically offered in Spring only

HI 541/HI 441 Colonial and Revolutionary U.S. (3 credit hours)
Origins of the English colonies in America to the American Revolution. European background to colonization, merging of different cultures, effects of mercantile doctrine, causes of revolution. Credit will not be given for both HI 441 and HI 541
P: 3 Hours of History

HI 543/HI 443 U.S. Constitutional History to 1883 (3 credit hours)
This course examines the origins and development of the U.S. Constitution from the Articles of Confederation to 1883. The course specifically looks at the federal Convention of 1787, the national bank debate and early constitutional interpretation; the constitution and its interaction with politics, economics, and society; the powers of Congress—taxation, contracts, commerce and war. The course also examines sovereignty, slavery and civil rights. It ends with an analysis of the Civil War Amendments and the transformation in American constitutionalism. Credit for both HI 443 and HI 543 is not allowed
P: 3 hrs. of History
Typically offered in Fall only

HI 544 US Constitutional History Since 1870 (3 credit hours)
Examines the transformation of American constitutional thought after the Civil War; the triumph of nationalism and the evolution of a new federal theory; the rise and fall of federal protections of civil rights. Explores key concepts such as civil liberties, judicial activism and judicial restraint; analyzes procedural and substantive due process, liberty of contracts and entrepreneurial liberty; evaluates Japanese internment, privacy, gender equality, free speech, religious freedom, civil liberties. Credit not given for both HI 444 and 544
Prerequisite: Graduate standing
Typically offered in Spring only

HI 545/HI 445 Early American Borderlands (3 credit hours)
Examines the social, political, and cultural development of the eastern American frontiers between the early seventeenth and mid-nineteenth centuries. Addresses the relationships between settlers and environments, settlers and Native Americans. Explores the structure and life of pioneer families, the development of new institutions, the role of governments in regulating settlements, and the evolution of the “frontier myth.” Credit cannot be given for both HI 445 and HI 545.
P: 3 hrs. of History
GEP Interdisciplinary Perspectives
Typically offered in Spring only
HI 546/HI 446  Topics in Civil War and Reconstruction  (3 credit hours)
Examination of the historiography of the American Civil War and Reconstruction. Topics include the origins of the war, military strategy, the northern and southern homefront, nationalism and citizenship, slavery and freed labor, changing gender roles and ideologies, struggles over racial inequality, and conservatism and radicalism during Reconstruction. Credit will not be given for both HI 446 and HI 546.

Prerequisite: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

HI 547/WGS 547/HI 447/WGS 447  Women in America: From Contact to the Civil War  (3 credit hours)
The historical experience of women in America from Native American and European contact through the colonial period to the immediate post-Civil-War years (to 1890). Topics include the history of women’s work, education, legal and political status, religious experience, and sex roles, with consideration of age, class, race, sexual preference, and region as significant variables in women’s experience in America. Credit will not be given for both HI (WGS) 447 and HI (WGS) 547.

P: 3 hours of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

HI 548/WGS 548/HI 448/WGS 448  American Women in the Twentieth Century  (3 credit hours)
Women’s historical experience in America, 1890-1990. Changes in women’s work, education, legal and political status, and sex roles, age, class, race, sexual preference and region as significant variables in women’s experience. Credit will not be given for both HI (WGS) 448 and HI (WGS) 548.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

HI 549/HI 449  U.S. Labor to 1900  (3 credit hours)
This course explores the history of work, workers, and working-class life and labor in the United States from the founding of the first European colonies to the beginning of the twentieth century; bound and free labor in colonial America, the transformation of urban worklife in the decades preceding the Civil War, slavery and class formation in the antebellum South, the effects of immigration on American workers, and the impact of race and gender on workers’ solidarity. Credit will not be given for both HI 449 and HI 549.

P: 3 hrs. of History
GEP U.S. Diversity

HI 550  U. S. Labor Since 1900  (3 credit hours)
This course explores the history of work, workers, and working-class organizations in the twentieth century United States; with particular attention to three core issues in twentieth-century American labor history: whether the US South has a particular form of labor history; the historical struggle for workers’ rights to collectively act and protest; and the intersections between race, ethnicity, immigration and labor in the twentieth-century US. Credit for both HI 450 and HI 550 is not allowed.

Prerequisite: Graduate standing

HI 551/HI 451  The Vietnam War  (3 credit hours)
The Vietnam War in Vietnamese historical context. A study of major works on the legacy of French colonialism; the growth of Vietnamese radicalism and communism; World War II and the Vietnamese Revolution; the French Indochina War and political division

Prerequisite: 3 hours of History
Typically offered in Spring only

HI 552/HI 452  Recent America  (3 credit hours)
Examination of contemporary opinions and historical interpretations of major problems in American life since 1939, including World War II, its social and economic consequences; Korea and the Cold War, big business and labor; civil rights and feminist movements; countercultures, Vietnam and Watergate. Credit will not be given both for HI 452 and HI 552

P: 3 Hours of History

HI 553/HI 453  United States-Latin American Relations Since 1823  (3 credit hours)
Critical analysis of the last two centuries of relations between the US and Latin America. Exploration of major policies using primary sources and declassified CIA documents. Major themes include US economic, political, and military influence, covert and overt US interventions, and response by Latin American governments. Historical perspectives on contemporary inter-American problems such as drugs, environment, debt crisis, human rights abuses, and the impact of the Latino population in the U.S. Credit will not be given both for HI 453 and HI 553.

Prerequisite: 3 hrs. of History
Typically offered in Spring only

HI 554  History Of U. S. Foreign Relations, 1900-Present  (3 credit hours)
American diplomatic history since 1900; the expansion of American economic and cultural relations; the evolution of the American foreign policy bureaucracy; and the historical forces and personalities that shaped American relations with other nations. C

Typically offered in Fall only

HI 555/AFS 555/HI 455/AFS 455  History of the Civil Rights Movement  (3 credit hours)
The black revolution; stages and leaders of the movement; successes and failures in the fight for desegregation, the vote, and economic opportunity; impact of Civil Rights movement on the United States. Credit will not be given both for AFS/HI 455 and AFS/HI 555.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity

HI 559/HI 459  The Early American Republic  (3 credit hours)
Examines the social, political, and cultural development of the Early Republic, the period in American history roughly from the Revolutionary War through the Administration of John Quincy Adams. Employs the life of Thomas Jefferson—the quintessential American, as the foundation for delving into the historical problems, interpreting primary sources, and analyzing secondary sources. Encourages graduate students to analyze the ways in which historiographic debates complicate our understanding of the Early American Republic. Credit will not be given for both HI 459 and HI 559.

Prerequisite: 3 hrs. of History
HI 561/HI 461 Civilization of the Old South  
Typically offered in Spring only
The distinctive features of the Old South as part of the regional development of United States history. Consideration of colonial factors in the making of the South, development of the plantation system and slavery, Southern social order, intellectual and cultural life, economic development, and rise of Southern nationalism. Credit will not be given for both HI 461 and HI 561.

Prerequisite: 3 hours of History

GEP Humanities, GEP U.S. Diversity

Typically offered in Fall and Spring

HI 562/HI 462 Southern History since the Civil War  
Typically offered in Fall, Spring, and Summer
Exploration of many American "Souths" from Reconstruction to the present. How race/ethnicity, gender, class, geography, sexuality, and culture inform "Southern" identity; major political and economic changes; and the region's relationship to the nation and the world. Credit will not be given for HI 462 and HI 562.

Prerequisite: 3 hours of History

GEP Humanities, GEP U.S. Diversity

Typically offered in Fall and Spring

HI 563/HI 463 Topics in History and Memory  
Typically offered in Fall and Spring
Explores how "collective memory" develops. Examines how memory is represented through public speeches, civic celebrations, monuments and memorials, and other forms of popular and political culture. Analyzes what is recalled, what is forgotten, and who decides. Asks why memory is made public. May be repeated once for credit when offered with a different topic. Credit will not be given for both HI 463 and HI 563.

HI 566 Readings in Native American History  
Typically offered in Fall, Spring, and Summer
Readings in the varied historical experiences of nations native to North America from the first migrations of peoples into the continent until the present, including the variety and diversity of native cultures and experiences; native resistance to colonialism, expansion, and U.S. federal policies; and the survival and continuity of native cultures and peoples through more than four centuries of contact, conquest, and change.

HI 568/HI 468 Slavery in the Americas  
Typically offered in Spring only
Exploration of the development of chattel slavery throughout the Americas. Analysis of the emergence and development of New World slavery in ways that encourage students to think critically about the historical processes of abolition, emancipation, and freedom across the Atlantic world. The lectures and readings seek to dislodge the notion that the "history of slavery" only pertains to the United States. The course, instead, emphasizes commonalities and differences in ways that challenge assumptions that the institution was exceptional in any given region. Credit will not be given for both HI 468 and HI 568.

Prerequisite: 3 Hours of History and Junior Standing

GEP Global Knowledge

Typically offered in Spring only

HI 569/HI 469 Latin American Revolutions in the Twentieth Century  
Typically offered in Spring only
Comparative analysis of causes, participants, process, and outcome of revolutions in Mexico, Bolivia, Cuba, and Central America. Credit for both HI 469 and HI 569 will not be given

P: 3 hrs. of History

GEP Global Knowledge

Typically offered in Spring only

HI 570/HI 470 Exploring World History  
Typically offered in Spring only
Introduction to the methods, themes, and narratives of world history. As a distinct approach to historical study, world history focuses on dynamic connections and relationships among regions of the world and the variety of global processes - related to trade, religion, production, consumption, migration, imperialism, disease, and technologies - that connected them. The course is a suggested elective for future teachers who will teach world history in high school, as well as an ideal course for History majors and graduate students who want to explore the connections among all the regionally specific upper division courses they have taken. Credit will not be given for both HI 470 and HI 570.

Prerequisite: 3 hours of History

GEP Global Knowledge

Typically offered in Fall only

HI 571/HI 471 Revolutionary China  
Typically offered in Fall only
China 1900 to present. Examination of political, cultural, and socio-economic revolutionary phases of China's 20th-century transformation from traditional empire to communism. Particular attention to post-1949 problems of nation-building. Credit will not be given for both HI 471 and HI 571.

P: 3 hrs. of History

GEP Global Knowledge

Typically offered in Fall only

HI 572 The Rise of Modern Japan, 1850-Present  
Typically offered in Spring only
Japan's emergence as a modern nation and world power. Topics include nation-state formation; modernization and its dislocations; democratization and authoritarianism; imperialism, international politics, and war; postwar reforms; changing gender relations; popular culture; and social problems. Credit will not be given for both HI 472 and HI 572.

Prerequisite: Graduate standing

Typically offered in Spring only

HI 573/HI 473 Japan's Empire in Asia, 1868-1945  
Typically offered in Fall only
Advanced survey of Japanese relations with Asia in the nineteenth and twentieth centuries. Structures and ideologies of imperialism and colonialism; modernization, nationalism and social change; migration and mobility; resistance and collaboration; and legacies of empire. Credit will not be given for both HI 473 and HI 573.

P: 3 hrs. of History

GEP Global Knowledge

Typically offered in Fall only

HI 575/AFS 575/HI 475/AFS 475 History of the Republic of South Africa  
Typically offered in Fall and Spring
Evolution of the Republic of South Africa's society, with emphasis on the interaction of diverse peoples and cultures. Particular attention is given to the period since 1870. Credit will not be given for both HI (AFS) 475 and HI 575.

Prerequisite: 3 hours of History

GEP Global Knowledge

Typically offered in Fall and Spring
HI 576/AFS 576/Hi 476/AFS 476 Leadership in Modern Africa (3 credit hours)
Recent sub-Saharan African political history (excluding South Africa). Overview of concepts, vocabulary, historical trends. Detailed examination of specific African countries as case studies, such as Ghana, Nigeria, Zimbabwe, Tanzania. Credit will not be given for both Hi (AFS) 476 and Hi 576.

Prerequisite: 3 hours of History
GEP Global Knowledge

HI 578 Islam and Christianity in Sub-Saharan Africa since the 19th Century (3 credit hours)
Expansion and interaction of Islam and Christianity in sub-Saharan Africa in the nineteenth and twentieth centuries, and their influence and impact on the economy, politics, and society. Topics include missionary activity, resistance to imperial authority, the role of the churches, and the influence of religion on leadership, education, nationalism, and post-colonialism. Credit will not be given for both HI 478 and HI 578; graduate standing for HI 578.

Typically offered in Fall only

HI 579/AFS 579/Hi 479/AFS 479 Africa (sub-Saharan) in the Twentieth Century (3 credit hours)
Developments in sub-Saharan Africa during the colonial period, from the end of the nineteenth century to the advent of decolonization in the early 1960s. Interplay of political, social, economic and cultural factors in the experiences of African peoples during this period. Credit will not be given for both HI (AFS) 479 and HI 579

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Spring only

HI 581/Hi 481 History of the Life Sciences (3 credit hours)
Historical context of the individuals, ideas, scientific practices, and social goals that created the core concepts of the modern biological sciences, from Renaissance medicine to molecular biology, with a focus on interconnections of the scientific knowledge and perspective of the life sciences with other aspects of culture, including other sciences, views about nature and life, religious belief, medical practice, and agriculture. Topics include the development of biological experiments; theories of ecology and evolution; the chemical understanding of health, food, and drugs; and the modern molecular revolution. Credit will not be given for both HI 481 and HI 581.

P: 3 hrs. of History
GEP Interdisciplinary Perspectives
Typically offered in Spring only

HI 582/Hi 482 Darwinism in Science and Society (3 credit hours)
Scientific development of Darwinism and its reception by the scientific community and the general public. Social impact of theories of evolution as reflected in Social Darwinism, eugenics, sociobiology, and relationship of sciences to ethics and religion. Credit will not be given both for HI 482 and HI 582

P: 3 hrs. of History
GEP Interdisciplinary Perspectives
Typically offered in Spring only

HI 583/Hi 483 Science and Religion in European History (3 credit hours)
Are science and religion inherently in conflict with each other? Historical analysis of the idea of the “warfare between religion and science,” treating their complex relationship and respective cultural authority before 1800, including the relationship of science and religion in Europe during periods of the Reformation, the creation of early modern states, and the Enlightenment of the 1700s. Topics include visions of nature and utopias, the creation of mechanistic science in the 1600s, and natural theology. Credit will not be given for both HI 483 and HI 583.

P: 3 hrs. of History
GEP Global Knowledge, GEP Interdisciplinary Perspectives

HI 584/Hi 484 Science in European Culture (3 credit hours)
The role of science in shaping early modern European identity, culture and polity in the 1600s and 1700s. Drawing on documents and material culture, topics include the meaning of natural wonders, explorations, travel literature, instruments and mapping, colonies and empire, and universal expos. Credit will not be given for both HI 484 and HI 584.

P: 3 hrs. of History
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall only

HI 585/Hi 485 History of American Technology (3 credit hours)
Technology in American history: the ideological, social, economic, and institutional contexts of technological change from the 1760’s to the present. Impacts of new technological systems. Credit will not be given for both HI 485 and HI 585.

Prerequisite: 3 hours of History
GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HI 586/Hi 486 Science and Empire (3 credit hours)
The development of European science in the context of world exploration, global commercial expansion, local knowledge, and visions of colonization and empire. Credit will not be given for both HI 486 and HI 586.

Prerequisite: 3 hours of History
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

HI 587/ANT 587 Cultural Resource Management (3 credit hours)
Theoretical and practical overview of U.S. federal and state laws, institutions, and practices related to the inventory, evaluation, preservation, protection, and overall management of cultural resources; history and philosophical bases of Cultural Resource Management (CRM); professional ethics; indigenous and other stakeholder interests in CRM; and comparative national regulations outside the U.S. and the international heritage management and organizations. Graduate standing in history required.

Typically offered in Spring only

HI 588/Hi 488 Family and Community History (3 credit hours)
Theory and research in family history, local history, and community studies, as well as application to public history presentation and community development. Students cannot receive credit for both HI 488 and HI 588.

Typically offered in Fall only
HI 589 Interpretation in Historic Sites and Parks (3 credit hours)
Methodologies of interpreting history at historic sites and parks; training in
interactive tools linking historiography and research methodology
with real places for presentation to the public; considerations of practical
application. Five day trips required.
Requisite: NCSU Graduate Students (MR or DR), NDS Students Only
Typically offered in Spring only

HI 591 Museum Studies (3 credit hours)
Organization and operation of museums as historical agencies. Role of
museums in historical research and education. Graduate standing or
NDS.
Typically offered in Fall only

HI 593 Material Culture (3 credit hours)
Current theories of material culture analysis and their application to
history museums. Graduate standing or NDS.
Typically offered in Spring only

HI 594 Cultural Heritage (3 credit hours)
Use of the past and its cultures in reinforcing identities. Global
development of heritage preservation, cultural resource management,
and heritage tourism. Role of heritage professionals in identification,
study, assessment, preservation, interpretation, management, and
promotion of historic and cultural resources. Law and regulations that
protect and preserve cultural resources. Graduate standing or NDS.
Typically offered in Fall only

HI 595 Special Topics in History (1-6 credit hours)
Topical courses or experimental course offerings in advanced historical
study.
Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

HI 596 Introduction To Public History (3 credit hours)
Historical origins of public history, applications of history to public life,
historiography and major paradigms in the field, and debates about the
public role of historians. Graduate standing in History.
Typically offered in Fall only

HI 597 Historiography and Historical Method (3 credit hours)
Major steps in development of historical investigation; analysis of
elements of historical research; discussion of methodology and archival
materials used by contemporary scholarly historian.
Typically offered in Fall only

HI 598 Historical Writing (3 credit hours)
Critical studies in the methods and practice of contemporary historical
writing.
Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

HI 599 Independent Study (1-3 credit hours)
Individualized study conducted under supervision of graduate faculty.
Course of study, assigned readings, course projects or papers, and
methods of evaluating work to be detailed in writing and approved by
department head.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

HI 642 Internship In Public History (3 credit hours)
Supervised internship experience with a public or private historical
agency or institution or local, regional, or national significance. Graduate
standing in History.
Typically offered in Fall, Spring, and Summer

HI 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the
student in planning for the teaching assignment, observe and provide
feedback to the student during the teaching assignment, and evaluate the
student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Spring only

HI 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member
of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

HI 695 Master's Thesis Research (1-9 credit hours)
Thesis Research
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

HI 696 Summer Thesis Research (1 credit hour)
For graduate students whose programs of work specify no formal course
work during a summer session and who will be devoting full time to thesis
research.
Prerequisite: Master's student
Typically offered in Summer only

HI 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-
time enrollment for the master's degree and are writing and defending
their thesis. Credits Arranged
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

HI 787 African American Public History (3 credit hours)
Issues in public history practice as they relate to the collection,
preservation, and interpretation of African American cultural history.
Graduate standing in history required.
Typically offered in Spring only

HI 788 Native American Public History (3 credit hours)
Issues in public history practice as they relate to the collection,
preservation, and interpretation of Native American history. Graduate
standing in history required.
Typically offered in Fall only

HI 789 Public History in International Context (3 credit hours)
Global public history since 1945, including functions of historical memory
as they relate to global economics of public history, world heritage, and
the transnational contexts for the work of historians.
Typically offered in Spring only
HI 791 Colloquium in Public History (3 credit hours)
Advanced historiographical readings on major topics in public history. 
Graduate standing only.

Typically offered in Spring only

HI 792 Colloquium in History (3 credit hours)
Advanced historiographical readings on major topics in history. May be 
repeated for credit with different topic. Graduate standing in History only.

Typically offered in Fall and Spring

HI 795 Special Topics (1-6 credit hours)

HI 799 Independent Study (1-3 credit hours)
Independent Study

Typically offered in Fall only

HI 885 Doctoral Supervised Teaching (1-3 credit hours)

HI 889 Doctoral Dissertation Seminar (1 credit hours)
Development of a solid dissertation structure, research strategy and 
drafting of framing chapters, preparation of dissertation proposal and 
proposal presentation, strategies for revision of dissertation. Three 
consecutive semesters beginning in semester of exams. Graduate 
standing in history only.

Typically offered in Fall and Spring

HI 895 Doctoral Dissertation Research (1-9 credit hours)

HI 896 Summer Dissert Res (1 credit hours)

HI 899 Doctoral Dissertation Preparation (1-3 credit hours)

History of Art (HA)

HA 201 History of Art from Caves to the Renaissance (3 credit 
hours)
Art from prehistory through Ancient Greece and Rome through Italian 
Renaissance. Major art forms of painting, sculpture, and architecture, and 
how they reflect their historical context.

GEP Visual and Performing Arts
Typically offered in Fall only

HA 202 History of Art From the Renaissance Through the 20th 
Century (3 credit hours)
Art from the Northern Renaissance in Europe through the 20th century in 
Europe and America: painting, sculpture and architecture recent mixed 
media techniques such as collage, and trottle.

GEP Visual and Performing Arts
Typically offered in Spring only

HA 203 History of American Art (3 credit hours)
A history of American Art (painting, sculpture and architecture) from the 
Colonial Period through the 20th century.

GEP Visual and Performing Arts
Typically offered in Fall and Spring

HA 240/Hi 240 Introduction to Visual Culture (3 credit hours)
Introduction to the role of visual cultural production in the nineteenth 
and twentieth centuries in expressing and shaping both individual and 
collective identities. Case studies of imperialism, gender, and war draw 
from different regional histories and utilize a variety of visual genres - 
such as photography, popular posters, painting, advertising, and film stills - 
to study how visual culture can be used as evidence to understand the 
past, using the approaches of the disciplines of History and Art History.

Prerequisite: Sophomore standing
GEP Global Knowledge, GEP Humanities, GEP Interdisciplinary 
Perspectives
Typically offered in Fall only

HA 298 Special Topics in Art History (3 credit hours)
Special topics in art history with emphasis on chronological periods such 
as 20th-century art of the Italian Renaissance or on fields of art such as 
paintings, sculpture, photography, or architecture.

Typically offered in Fall, Spring, and Summer

HA 395 History of Art: Study Abroad (3 credit hours)
Topical History of Art courses taught in NC State Study Abroad programs. 
(Current listings available in History Department, Study Abroad Office and 
CHASS Dean's Office.)

Typically offered in Fall, Spring, and Summer

HA 401 19th Century European Art from Revolution to Post-
Impressionism (3 credit hours)
From the politically charged art of the French Revolution, through 
Neo-classicism, Romanticism, Realism, Impressionism and Post-
Impressionism, this course examines styles, subject matter and cultural 
context of the many, rapid artistic changes in the long 19th century.

Prerequisite: HA 201 or HA 202
GEP Visual and Performing Arts

HA 404 Italian Renaissance Art and Material Culture (3 credit 
hours)
From villas to teaspoons, this course investigates daily life in 
Renaissance Italy, 1300-1550, through the architecture, painting, 
sculpture, and art objects that people commissioned and used. Works 
of art will be analyzed in terms of style, subject matter, and historical 
context.

Prerequisite: 3 hrs. of HA 
GEP Visual and Performing Arts

HA 410 History of the Art of Photography (3 credit hours)
History of and the interaction between art and photography from the 
invention of photography to the present.

Prerequisite: 3 Hours of History of Art, Film, History, or Literature 
GEP Visual and Performing Arts

Typically offered in Spring only

HA 498 Independent Study in History of Art (1-6 credit hours)
Directed independent study of topics in the History of Art. Individualized/ 
Independent Study and Research courses require a "Course Agreement 
for Students Enrolled in Non-Standard Courses" be completed by the 
student and faculty member prior to regis

Prerequisite: 3 hours History of Art
Typically offered in Fall and Spring
Honors (HON)

HON 202 Inquiry, Discovery, and Literature (3 credit hours)
A study of works of literature that treats the themes of inquiry and discovery--its risks, its creativeness, its ambiguities and complexities, and its moral dilemmas--through selected works from literature and other media, including theater, music, visual arts, and film. Analysis of each work in terms of its historical context and internal structure as well as its treatment of the nature of inquiry and discovery.

Prerequisite: HON student
GEP Humanities
Typically offered in Fall and Spring

HON 290 Honors Special Topics - Humanities/US Diversity (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GEP requirements in Humanities and US Diversity co-requisite. Interdisciplinary in character and often team-taught.

Restricted to students in the University Honors Program. Other students upon approval.
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall and Spring

HON 291 Honors Special Topics - Mathematics (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in mathematics, interdisciplinary in character and often team-taught.

Prerequisite: HON student
GEP Mathematical Sciences
Typically offered in Fall and Spring

HON 292 Honors Special Topics - Natural Sciences (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in the natural sciences, interdisciplinary in character and often team-taught.

Prerequisite: HON student
GEP Natural Sciences
Typically offered in Fall and Spring

HON 293 Honors Special Topics - Interdisciplinary Perspectives/Global Knowledge (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in Interdisciplinary Perspectives and Global Knowledge co-requisite. Interdisciplinary in character, and often team-taught.

Restricted to students in the University Honors Program. Other students upon approval.
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HON 294 Honors Special Topics - Humanities (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in the Humanities, and interdisciplinary in character.

Prerequisite: HON student
GEP Humanities
Typically offered in Fall and Spring

HON 295 Honors Special Topics - Social Science (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in the social sciences, interdisciplinary in character, and often team-taught.

Prerequisite: HON student
GEP Social Sciences
Typically offered in Fall and Spring

HON 296 Honors Special Topics - Interdisciplinary Perspectives (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in Interdisciplinary Perspectives.

Prerequisite: HON student
GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HON 297 Honors Special Topics - Interdisciplinary Perspectives/US Diversity (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in Interdisciplinary Perspectives and US Diversity co-requisite. Interdisciplinary in character and often team-taught.

Restricted to students in the University Honors Program. Other students upon approval.
GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Fall and Spring

HON 298 Honors Research/Independent Study (1-3 credit hours)
Research/Independent Study for University Honors Program students. Repeatable if content differs. Research or independent study under supervision of faculty members. Project approval by the Honors Program Advisory Committee necessary prior to register

Typically offered in Fall and Spring

HON 299 Honors Special Topics - Visual and Performing Arts (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in Visual and Performing Arts, interdisciplinary in character and often team-taught.

Prerequisite: HON student
GEP Visual and Performing Arts
Typically offered in Fall and Spring

HON 300 Race, Membership, and Eugenics (3 credit hours)
Theories of race are linked to eugenics, a belief and practice of improving the genetic quality of the human population that drove much of American social policy in the early 20th century. The practice and science that supports it has historical roots in the US and in particular for poor people and people of color. This course will examine race, membership, and eugenics and the impact on American society, as well as explore the scientific and social trends that supported the movement. Course restricted to University Honors Program Students; others by permission of the UHP.

R: University Honors Program Students; others by permission of the University Honors Program
GEP U.S. Diversity
Typically offered in Fall and Spring
HON 310  The Creative Process in Science: Realities, Comparisons, and Culture Perceptions  (3 credit hours)
What is creativity in the context of the sciences? How does the creative process in science differ from and how it is similar to the creative process in other fields? This interdisciplinary perspectives course helps students to develop an understanding of scientific creativity through readings in history and philosophy of science, in the psychology of creativity, in original scientific papers, in biography and in memoirs. Student will analyze representations of scientific creativity in films and literature, conduct interviews with scientists, artists, musicians, and humanists, and analyze the social and institutional context of creativity.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Spring only

HON 311  Words through Space and Time  (3 credit hours)
Cultures differentiate and frame events in various ways. At the heart of conceptual events are WORDS: an inventory of the ways a particular group of people depict and understand the interactions they have with each other and with the world around them. Through a detailed examination of lexical phenomena in cultures around the world, we will become familiar with the ways in which language and culture interact, the extent to which these surface in our everyday lives and the explanations proposed by various fields for their existence.

GEP Global Knowledge, GEP Interdisciplinary Perspectives

HON 312  Outbreak  (3 credit hours)
Students will evaluate disease outbreaks from multiple different perspectives, including the biology of the infectious agent, clinical implications, and social/economic/political factors contributing to the spread of the disease or that were impacted by a major epidemic/pandemic. This course will be inquiry-guided. The instructor will not generally be "presenting material", but rather providing the structure in which students will be guided to investigate the issues from multiple perspectives through the use of case studies, primary and secondary literature, student-driven research and presentations, and concept mapping.

GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

HON 313  Reading Machines  (3 credit hours)
This course invites first-year students into a historically ranging, critically intensive, and hands-on learning environment about the technologies by which humans transmit our cultural inheritance and ideas. "Reading Machines" takes a long view of how we got to now, from the history of manuscripts and books to the electronic platforms of the digital present. These are all machines of reading; in turn, this class will "read" those machines as objects of study. The course proposes that 1) then and now, our technologies for sharing text, image, and data crucially shape the ideas which they convey, and 2) these contexts can help students plan and execute new mechanisms for communication in the present. The course's modules offer critical frameworks of background readings and discussions, a lab-like experience with the materials or skills involved, and applied projects for students to experiment with and study.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HON 340  Religion and Freedom  (3 credit hours)
For a variety of reasons, "religion" is one of the most controversial subject matters in contemporary cultures. Beyond sensationalism and outrage, though, modern societies have taken shape in part through complex debates about the role (or lack thereof) of religion in public life. At the core of these considerations are clashing understandings of the relation between religion and freedom, two broad categories with a range of different meanings. This course will explore these differing understandings by considering: legal arguments proposing freedom of religion, and the challenges of religious pluralism; arguments urging freedom from religion, in defense of secular public life; and invocations of freedom through religion, via human creative expression, social activism, ritual, or cosmology. We will examine not just scholarly writings about religion but literature, films, and other media that have shaped the ongoing conversation.

R: University Honors Program Students; others by permission of the University Honors Program
GEP Interdisciplinary Perspectives
Typically offered in Fall only

HON 341  Time Travel  (3 credit hours)
A study of contemporary metaphysics organized around the topic of time travel. David Lewis, perhaps the foremost contemporary metaphysician, argues that time travel is possible. His argument is based on ingenious positions about three central topics of metaphysics, personal-identity, causation, and free will. Students will consider each of these topics in some detail, always with an eye to their implications for time travel.

Prerequisite: HON student
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

HON 344  Kantian Ethics  (3 credit hours)
In this course students will be introduced to foundations of morality by exploring one of the most significant moral theories in the history of philosophy, Kantian ethics. The course will focus on Kant's ideas about morality and discuss his proof of the fundamental principles of ethics. Students will be introduced to some of the enduring moral questions, such as What ought I to do? What can I hope? Are there universal moral principles and whether I ought to follow them? They will learn a variety of approaches to ethical issues and their reflection in social and political reality.

GEP Humanities

Typically offered in Spring only

HON 345  On the Human  (3 credit hours)
Students in this seminar course actively explore human singularity: the properties, if any, that distinguish persons from animals and machines. Do we have souls? To what extent can we give physical explanations of our thoughts and actions? What, if anything, do scientific experiments tell us about our differences from chimps and artificial intelligences? What are the ethical implications of new biotechnologies? Should we be allowed to use genetic and neural engineering to change human nature? Students read articles, watch videos, stimulate class discussions with prepared questions, write short essays and a final paper, and participate in a 60-minute team presentation.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring
HON 347 Freedom and the Self (3 credit hours)
This course explores the complex and interrelated concepts of freedom and the self. The bulk of our time will be devoted to a close reading of several philosophical texts in which these concepts loom large. The course ends with a careful examination of three novels that, in various ways, take up the central themes of the class. Our intention in doing so is to reflect on the way that imaginative novelists treat these themes. This will enable us to ask broader and more interesting questions about freedom and selfhood.
R: University Honors Program Students; others by permission of the University Honors Program
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HON 348 Emotion and Reason (3 credit hours)
Consider the range of emotions that one experiences in a lifetime, from the joy of being with your loved ones to the fear of losing them, from the thrill of success to the sadness of defeat. Pleasant or aversive, emotions play a central role in our lives. Despite their obvious importance, emotions have been considered by many philosophers to be inferior to another distinctive faculty in human beings, namely reason. The idea that emotions are primitive, irrational and dangerous and thus to be controlled and constrained by reason has been embraced by eminent thinkers from Plato and the Stoics to Kant. In this course, we will focus on the relationship between reason and emotion in moral cognition and cognition more generally, and we will investigate how to what extent reason can be said to be distinct from and superior to emotion.
Restriction: University Honors Program students. Open to other students by permission of the UHP.
GEP Interdisciplinary Perspectives
Typically offered in Fall only

HON 352 Self, Schooling, and the Social Order: A Critical Examination (3 credit hours)
What is the purpose of schooling? What role does it play in producing particular types of citizens and social structures? Theorists have imagined education as a space for democracy, as a way to cultivate identity, or as a method to train workers. All of these imaginaries attempt to understand interrelationships between the self, schooling, and the social order. This course will survey major social theories and, within the context of those theories, encounter texts which examine how schooling serves to maintain or subvert the social order. Course restricted to University Honors Program students; others by permission of the UHP.
GEP Social Sciences, GEP U.S. Diversity

HON 353 Code Breakers: Unlocking the Mysteries of One Human Language (3 credit hours)
This course will introduce you to the architecture of one language. Students will work from scratch with a speaker of a language that none of us know, with the goal of unlocking the mysteries of that language at all levels - sound system, word formation, sentence structure, semantics and pragmatics. You will learn how to elicit field data through direct questioning and gathering of texts, how to organize field data, how to prepare entries in a field dictionary, and how to organize and write grammar. Course restricted to University Honors Program students; others by permission of the UHP.
GEP Global Knowledge, GEP Social Sciences

HON 354 GEP Interdisciplinary Perspectives

HON 356 Music and Oppression (3 credit hours)
Music and Oppression will examine how people use music both as a tool of oppression and a method of resisting oppression. Course topics will include the use of western classical music by colonial powers; music and torture; music during World War II (including the use of music in concentration camps and as propaganda in Allied and Axis countries); music in Indian Boarding Schools; music in the American Civil Rights Movement; and hip hop as the music of oppressed populations in Europe and the United States. Reading assignments will come from a wide range of sources and disciplinary perspectives including scholarly articles, book chapters, and personal memoirs. We will listen to and discuss music from multiple genres including hip hop, pop, jazz, folk, and the western classical tradition. No previous musical experience as a performer is required to be successful in this class.
R: Honors or Scholars
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HON 390 Music and the Celtic World (3 credit hours)
In this course, students explore the diverse musics of the Celtic world, from cultural practices of the ancient Celts to folk and popular traditions of Ireland, Scotland, Wales, Brittany, Galicia, Cape Breton, and the United States. They investigate the origin and meanings of “Celtic music,” and study its diverse instrumental, vocal, and dance traditions, and its varied performance practices, occasions, and purposes. Through history, literature, poetry, spirituality, and mythology, students examine the realities and fictions of the ancient and modern Celtic world. Through live and recorded music and dance performance, they consider the continuities of Celtic culture across time and space, and the significance of Celtic music today in terms of cultural identity, tradition, and globalization.
R: University Honors Program
GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Visual and Performing Arts
Typically offered in Spring only

HON 395 Honors Cooperative Education (3 credit hours)
Experimental work in government or industry for Honors Program students with two semesters completed in Honors. Typically students work 40 hrs/week with salary. Work supervisor, faculty adviser and Honors Program Director must sign HON 395 Honors Cooperative Ed contract. NC State cooperative Education requires paper work; student must pay fee rate for a 0-5 credit hour course. No other courses permitted along with HON 395. Student report of the independent project is required.
Prerequisite: Two semester full time in University Honors Program
Typically offered in Fall and Spring

HON 397 Honors Extension and Engagement (1-6 credit hours)
Opportunity for significant hands-on involvement in extension and engagement research/project as mentored by NC County Extension employees often in cooperation with community employers/executives, local and government officials, and county citizens. Approved plan of work required with significant independent research/project including a reflective journal, a final paper and presentation at the NC State Undergraduate Research Symposium or a venue appropriate to the discipline. Students must provide their own transportation.
Prerequisite: One semester good standing in University Honors Program
Typically offered in Fall and Spring
HON 398 Honors Special Topics (1-6 credit hours)
A seminar or other learning experience within an academic framework that may be on- or off-campus. Enables the development of new HON courses outside the GER list.

GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

HON 496 Honors Capstone Seminar (3 credit hours)
Honors Seminars open to Juniors and Seniors in all disciplinary Honors Programs, and others with permission of the University Honors Program. Repeatable if content differs. A series of seminars with differing subjects, interdisciplinary in character and sometimes team-taught, allowing advanced students to explore topics from a multidisciplinary perspective and to apply their knowledge to issues and problems in the present world. Permission of the University Honors Program

Prerequisite: HON student
Typically offered in Fall and Spring

HON 498 Honors Research/Creative Project 1 (3 credit hours)
Opportunity for hands-on faculty mentored research/creative project. Course may be stand-alone project completed in one semester/summer, or serve as part of a two semester project that is completed at the end of Honors Research/Creative Project 2 (HON 499). Approved plan of work required with significant independent research/creative project culminating with final paper and presentation at the NC State Undergraduate Research Symposium or other venues appropriate to the discipline. Research within or outside the student's discipline may fulfill experience. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: One semester in good standing in University Honors Program, UHP student
Typically offered in Fall and Spring

HON 499 Honors Research/Creative Project 2 (3 credit hours)
Opportunity for hands-on faculty mentored research/creative project. Course serves as final part of a two-semester project that began with Honors Research/Creative Project 1 (HON 498) or approved disciplinary research experience. Approved plan of work

Prerequisite: One semester in good standing in University Honors Program, UHP student
Typically offered in Fall, Spring, and Summer

Horticulture Science (HS)

HS 101 Introduction to Ornamentals and Landscape Technology (1 credit hours)
Introduction to the collegiate experience, academic skills of successful students, and scope, purpose, and objectives of the Agricultural Institute with an emphasis on areas related to the ornamental and landscape plants industry. Students will explore college and departmental resources, academic policies and procedure, the green industry, career opportunities, and current trends and issues in horticulture.

Prerequisite: Agricultural Institute Only
Typically offered in Fall only

HS 111 Plant ID (3 credit hours)
Identification, adaptation, culture, and use of ornamental trees, shrubs, vines, ground covers and herbaceous plants.

Requisite: Agricultural Institute Only
Typically offered in Fall only

HS 115 Plant Growth and Development (3 credit hours)
Examination of how plants grow and respond to environmental and cultural stimuli. Topics include: cell growth; flower, fruit, seed, shoot, and root development and functions; anatomy of stems, roots and leaves; hormonal regulation of growth; adaptations for survival; plant responses to temperature, light and gravity; photosynthesis, transpiration, and absorption of water and nutrients.

Requisite: Agricultural Institute Only
Typically offered in Fall only

HS 121 Plant Propagation (3 credit hours)
Principles and practices involved in sexual (seed) and asexual (vegetative) propagation of a variety of plants. Methods of asexual propagation include cuttings, layering, budding and grafting, division, separation, and micropropagation (tissue culture). Emphasis on factors affecting the regeneration of species by particular techniques.

Requisite: Agricultural Institute Only
Typically offered in Spring only

HS 131 Fruit & Vegetable Production (3 credit hours)
The objective of this course is to give students a fundamental and practical understanding of small-scale fruit & vegetable production in North Carolina. Agricultural Institute students only.

Requisite: Agricultural Institute Only
Typically offered in Spring only

HS 141 Greenhouse Crop Production (3 credit hours)
Production of greenhouse crops. Emphasis on greenhouse construction and environmental manipulation of crop growth. Site selection, construction materials, greenhouse design. Specific flowering crops as models to demonstrate potted flowering plant, cut flower, and bedding plant production systems. Hands-on crop production experience plus trips to commercial floriculture production and marketing facilities.

Typically offered in Spring only

HS 144/PP 144 Weeds & Diseases of Ornamentals (3 credit hours)
The objective of this course is to give students a fundamental and practical understanding of weed, disease, and pesticide management in the ornamental industries in North Carolina. Agricultural Institute students only.

Requisite: Agricultural Institute Only
Typically offered in Fall only

HS 151 Nursery Production (3 credit hours)
Total aspects of field and container nursery stock production including site selection and development, propagation, growing procedures, harvesting, marketing, shipping and labor management practices.

Requisite: Agricultural Institute Only
Typically offered in Spring only
HS 162 Landscape Maintenance (3 credit hours)
A study of the maintenance of landscaped areas including plant material selection, installation, pruning, fertilization, and pest control of trees, shrubs, lawns, flower beds, and interior plants.

Requisite: Agricultural Institute Only
Typically offered in Fall only

HS 171 Landscape Construction (3 credit hours)
This course will provide students a fundamental and practical understanding of landscape construction techniques and equipment. AGI students only.

Requisite: Agricultural Institute Only
Typically offered in Spring only

HS 175 Horticulture Entrepreneurial Skills for Local Markets (3 credit hours)
This course is structured to introduce students to entrepreneurship, startups and the basic principles of business administration and management with focus in the horticulture industry in local markets. The class will give students the opportunity to learn pragmatic skills and tools to start their own business or to be successful managers in local horticulture industries. Students will describe and discuss the following topics: marketing, management, accounting, finance, and the issues involved with starting and managing a small horticultural business.

Typically offered in Spring only

HS 200 Home Horticulture (3 credit hours)
Introduction and review of home horticulture as it relates to the horticultural enthusiast. A general understanding of plant growth, structure, and development; house plant selection and care, selecting trees, shrubs, and flowers for the home landscape, and other related topics.

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

HS 201 The World of Horticulture: Principles and Practices (3 credit hours)
Principles of plant growth and development relating to production and utilization of fruit, vegetable, floricultural, and ornamental crops. Historical, economic, and global importance of horticultural crops and services.

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

HS 202 Home Plant Identification (3 credit hours)
An introductory course developed in conjunction with Longwood Gardens on plant taxonomy, identification, characteristics, and use in the home landscape. A palette of 150 plants will be covered including identification by scientific and common names and aspects of their cultivation. Not for Horticultural Science Majors [SH, THG, THL].

Typically offered in Spring only

HS 203 Home Plant Propagation (3 credit hours)
Not for Horticultural Science Majors (SH, THG, THL). Substitution of HS 203 for HS 301 are not allowed. An introduction to the basic principles of sexual and asexual plant propagation, including seeds, cuttings, layering, Grafting, and Division.

GEP Natural Sciences
Typically offered in Spring only

HS 204 Home Landscape Maintenance (3 credit hours)
An understanding of the basic principles of landscape maintenance including, but not limited to, soil fertility and management, tree biology, pruning, turfgrass maintenance, plant selection, irrigation management and waterwise gardening, integrated pest management, and hardscape construction. Not for Horticultural Science majors (SH, THG, THL).

Prerequisite: HS 200 or HS 201
GEP Natural Sciences
Typically offered in Fall and Spring

HS 205 Home Food Production (3 credit hours)
Home food production will play an important role in increasing the sustainability of the world's food systems for the foreseeable future. The goal of this course is to familiarize students with the scientific knowledge and tried-and-true practices needed to successfully produce food at home, even in small-scale environments such as decks and patios. On-campus students will be required to participate in two Saturday field trips to visit local home gardens. Distance education students will be required to visit two home gardens in their area. Not for Horticultural Science Majors (SH, THG, THL).

GEP Natural Sciences
Typically offered in Fall only

HS 215/ANS 215 Agricultural Genetics (3 credit hours)
To provide an introduction to the science of genetics as applied to agriculture. Emphasis is given to qualitative and quantitative genetics. By the end of this course, students should be able to apply genetic concepts to efficiently solve problems and make predictions necessary for "real-life" agricultural situations.

Prerequisite: BIO 183 or equivalent or instructor's consent
GEP Natural Sciences
Typically offered in Fall only

HS 242 Introduction to Small Scale Landscape Design (3 credit hours)
Landscape Horticulture is concerned with the small-scale design and use of plants and other materials to help humans relate better to the land. In this course, we will pursue an understanding of this relationship and explore the social, environmental, and economic implications of landscape design and the processes by which this understanding can be employed to design residential landscapes. There are an infinite number of design possibilities for each project, so it's a designer's responsibility and challenge to develop a creative and functional design that accommodates the needs of the users and is appropriate for a specific site.

GEP Visual and Performing Arts
Typically offered in Spring only

HS 250 Home Landscape Design: Creating Garden Spaces (3 credit hours)
Home landscape design is a 3-credit hour course for non-landscape design majors. Students will be introduced to the various issues associated with landscape design at the residential level. Through a series of Power Point lectures, on-line discussions, and small projects/ exercises, students will gain an understanding of landscape graphics. Skills in design, and develop landscape plans and other forms of landscape graphics. Students will use all of their learned skills to develop a design for a given site using provided design software.

Typically offered in Summer only
**HS 252 Landscape Graphic Communication**  (2 credit hours)
This class is an introduction to the basic graphic skills necessary to develop and communicate creative ideas in landscape design. In the design process, we use graphic skills to communicate our ideas, starting with analysis, moving on to concept, then to design development, and finally to illustrative renderings. The design process will be introduced and serve as a backdrop for incrementally introducing graphic skills. The class will become confident in the use of manual drawing skills, and will be introduced to the use of computer drafting skills. Graphics supplies, with an estimated expense of $120.00, are required for the course.

Prerequisite: Horticultural Science Majors
Typically offered in Spring only

**HS 272 Landscape Design/Build**  (6 credit hours)
This course will consist of the development of design and construction projects, which will incorporate the entire design process culminating with a complete set of construction documents, cost predictions and built projects. Critical and creative thinking strategies are incorporated in teaching and learning activities. Course materials and experiences will prepare the student for further design/build experiences as well as the NC Landscape Contractor's Licensing Exam.

Prerequisite: HS 201 and HS 242
Typically offered in Fall only

**HS 280 Hands-On-Horticulture**  (3 credit hours)
This course will provide students a fundamental and practical understanding of applied techniques in horticulture. Students will learn basic landscape construction, basic wooden landscape structure construction, vegetable harvest, propagation of perennial plants, principles of irrigation installation, safe and efficient use of landscape equipment including arboriculture, and professional certification and licensing. Pesticide Licensing Fee of $75 required.

Typically offered in Summer only

**HS 290 Horticulture: Careers and Opportunities**  (1 credit hours)
Introduction and orientation to programs in horticultural science. Discussion of current status of horticulture, extension and research. Emphasis on undergraduate program management, internships, graduate education, and career planning. Guest lectures, career opportunities and qualifications for employment in horticulture and related fields.

Typically offered in Spring only

**HS 301 Plant Propagation**  (4 credit hours)
Theoretical basis and techniques for successful asexual and sexual propagation of seed plants and ferns. Influence of heredity, phytopathological infection, and environmental conditions on success and quality of propagules. Recent developments and innovations in propagation techniques and methodologies.

Prerequisite: BIO 181 or BO 200
GEP Natural Sciences
Typically offered in Fall only

**HS 302 Gardening with Herbaceous Perennials**  (3 credit hours)
Examination of the use of herbaceous perennials in the home garden and commercial landscapes. Topics include: general plant characteristics, culture and management, garden attributes, design usage, horticultural history, propagation, use of exotic (nonnative) species in the garden, heirloom roses and ornamental grasses.

Prerequisite: BIO 183 or BO 200
Typically offered in Spring only

**HS 303 Ornamental Plant Identification I**  (3 credit hours)
Identification, distribution, growth, characteristics, adaptation, and usage of ornamental plants. Emphasis on bedding plants, trees and gymnosperms.

Prerequisite: BIO 181
GEP Natural Sciences
Typically offered in Spring only

**HS 304 Ornamental Plant Identification II**  (3 credit hours)
Identification, distribution, growth, characteristics, adaptation, and usage of ornamental plants. Emphasizes shrubs, ground covers, and vines.

Prerequisite: BIO 181
GEP Natural Sciences
Typically offered in Fall only

**HS 357 Landscape Grading and Drainage**  (4 credit hours)
This course is an introduction to landforms, site grading and drainage, and the manipulations of such landforms necessary to create built landscapes. Site design, site development, and site engineering all refer to the process of grading and drainage. Grading and drainage are processes used to reshape the earth's surface and to convey surface water runoff.

Prerequisite: Landscape Horticulture (11HORTTHL) students, HS 242 and 252
Typically offered in Spring only

**HS 400 Residential Landscaping**  (6 credit hours)
Equips students with the necessary skills to create functional, aesthetic, and humanistic designs for residential and other small scale projects. Aspects of problem identification, project organization, design, execution, and evaluation. Required field trip with fee.

Prerequisite: HS 242, HS 252, HS 303, HS 304, and HS 357
Typically offered in Spring only

**HS 410/CS 410 Community Food Systems**  (3 credit hours)
This course explores the economic, socio-cultural, policy and health perspectives of community food systems using a multidisciplinary and systems-level framework. Students will use a systems framework to critically examine local and global food challenges related to food insecurity, food justice and food sovereignty, food waste and sustainable approaches to addressing food challenges. Novel aspects of this course include student experiential learning opportunities that include service learning with community partners addressing local food challenges, team building through group work and in-class discussion and development of personal food ethic provocative proposition.

Prerequisite:Junior or senior standing
Typically offered in Fall only

**HS 411 Nursery Management**  (3 credit hours)
Principles and practices of production, management, and marketing of field-grown and container-grown nursery plants. One of three scheduled weekend field trips required at students' expense.

Prerequisite: BIO 181, SSC 200, Junior standing
Typically offered in Fall only
HS 416/HS 516  Planting Design  (4 credit hours)
Developing and cultivating a design process for creating meaningful and compelling ornamental planting designs through the study and practice of spatial articulation (form, enclosure, permeability), physical properties of plants (line, form, texture, color), client/site analysis and program development, visual journaling, garden narrative, presentation skills, utilizing principles of visual composition, design communication, and understanding and resolving technical and horticultural issues in contemporary planting design.
Prerequisite: Landscape Horticulture (11HORTTHL) concentration, HS 400
Typically offered in Fall only

HS 418  Digital Media Graphic for Landscape Designers  (3 credit hours)
Digital media is used in the landscape design profession as a tool with analytic, expressive, and representational abilities. The course focuses on introducing landscape design students to digital representational tools used to communicate design ideas for small scale landscape design projects. Students will be introduced to techniques used in AutoCAD, Photoshop, Illustrator, InDesign, and Sketch Up modeling programs. Digital representation will be used to develop the variety of images necessary to explore and communicate design intentions. Materials for this course will cost approximately $50.
Prerequisite: HS 242 and HS 400
Typically offered in Fall only

HS 420/HS 520  Green Infrastructure  (3 credit hours)
Green infrastructure is defined as the interconnected networks of natural and constructed ecological systems within and in-between urban areas. When implemented in a holistic way, green infrastructure can provide benefits at the residential, neighborhood, community levels providing for greater health and well-being, an improved functional environment, and a thriving dynamic economy. Well-designed urban landscapes offer significant economic and social benefits that directly improve the urban environment for people, plants and animals- from increasing real estate value and reducing energy costs, to enhancing health and food security, and providing habitat for a diverse population of animals and plants. Since addressing environmental issues requires a multidisciplinary approach, this course is designed for any student with interests in horticulture, biological engineering, landscape architecture, environmental sciences, urban forestry, and any others who care about the sustainability of their communities.
Typically offered in Fall only

HS 421/HS 521  Temperate-Zone Tree Fruits: Physiology and Culture  (3 credit hours)
Physiology and culture of the major temperate-zone tree fruit and nut crops of the United States. Fundamental principles underlying woody plant growth as applied to the culture of specific tree-fruit crops with emphasis on crops of commercial importance.
Prerequisite: BIO 181 or B0 200
Typically offered in Spring only

HS 422  Small Fruit Production  (3 credit hours)
Importance and economic value of blackberries, blueberries, cranberries, grapes, raspberries, strawberries and minor small fruit crops in the agricultural economy of the USA and the world. Cultural requirements of these crops and manipulation of their known morphological and physiological traits for successful production. Six all afternoon field trips are required.
Prerequisite: BIO 181, SSC 200, HS 201
Typically offered in Spring only

HS 423/HS 523  Viticulture  (3 credit hours)
A presentation of the commercial importance, distribution, anatomy, physiology, and production of Genus Vitis (grapes) including cultivars, propagation, canopy management, diseases, weed control, physiology, anatomy, irrigation, wine production, climates and soils. This course will not require students to provide their own transportation. Non-scheduled class time for field trips or out-of-class activities IS required for this class.
Prerequisite: Junior standing or Senior standing
Typically offered in Spring only

HS 428/SSC 428  Service-Learning in Urban Agriculture Systems  (1 credit hours)
Course provides students a hands-on experience in urban agriculture with under-served youth in the Raleigh area. Students partner with a community gardening organization to provide knowledge and experience in soil science and agriculture to youth with the goals of increasing urban food security and developing student leadership skills. Particular emphasis is places on reflecting on course activities and deepening of skills related to extension, outreach, and working with diverse populations. Course designed to be taken as a companion course to SSC 427, however can be taken as a stand-alone course.
Prerequisite: SSC 200 or equivalent, BIO 181 or 183, and CH 101
GEP U.S. Diversity
Typically offered in Spring only

HS 431  Vegetable Production  (4 credit hours)
Principles and practices of production and marketing of seventeen vegetable crops grown in the U.S. Additional topics include pest management, seed technology, food safety, sustainable agriculture, use of genetically engineered crops, and consumer issues.
Prerequisite: BIO 181, SSC 200
Typically offered in Fall only

HS 432/HS 532  Introduction to Permaculture  (3 credit hours)
Permaculture means "permanent culture," and "is the conscious design and maintenance of cultivated ecosystems that have the diversity, stability, and resilience of a natural ecosystem." [Bill Mollison] This course will explore a design/thinking methodology that seeks to provide our essential physical needs, food, water, shelter, energy, etc., while doing so in an environmentally friendly, sustainable manner. The three weekend field trips are required. This course is restricted to upper level undergraduate, graduate, or matriculated continuing education students. STUDENTS MAY NOT RECEIVE CREDIT FOR BOTH HS 432 AND HS 532.
Typically offered in Fall and Summer
HS 433/HS 533 Public Garden Administration (3 credit hours)
This course addresses the practices, programs, and professional skills that are critical to the successful management of public gardens. The aim of the course is to better prepare graduate students and upper-level undergraduates for potential careers in public garden administration. Topics will include a brief history, impact, and current trends of public gardens in the United States; plant collections; managing staff, volunteers, and boards, and the visiting public; finances and fund raising; educational programming; visitor services; and careers in public gardens. Two Saturday off-campus field trips are required.

Typically offered in Fall only

HS 440 Greenhouse Management (3 credit hours)
Perspective of greenhouse systems management. Selection of greenhouse site, construction, heating, cooling and production systems. Emphasis on greenhouse operations, cost accounting and analysis. Other topics: root substrates, sanitation, water, fertilization, chemical growth regulation, temperature, light and marketing. Hands-on experience in greenhouse operations plus trips to commercial greenhouses and markets.

Prerequisite: SSC 200 and HS 201
Typically offered in Fall only

HS 442 Floriculture Crop Production (3 credit hours)
Production of floricultural crops. Emphasis on environmental manipulation and scheduling of crop growth and development for targeted market periods. Specific flowering crops as models to demonstrate potted flowering plant, cut flower, and bedding plant production systems. Hands-on crop production experience plus field trips to commercial floriculture production and marketing facilities.

Prerequisite: SSC 200, HS 201
Typically offered in Fall only

HS 451/HS 551 Plant Nutrition (3 credit hours)
An understanding of the basic mineral nutrient requirements, nutritional monitoring procedures, and fertilizer application methods in horticultural production systems including those for fruits, field vegetables, fruits and vegetables under plasticulture, nursery crops, landscapes, greenhouse flowers and vegetables, interior plantscapes, hydroponics, and organic farming.

Prerequisite: SSC 200
Typically offered in Spring only

HS 452/HS 562/FS 462 Postharvest Physiology (3 credit hours)
Preharvest and postharvest factors that affect market quality of horticultural commodities with an emphasis on technologies to preserve postharvest quality and extend storage life of fruits, vegetables and ornamentals.

Prerequisite: PB 421
Typically offered in Spring only

HS 471 Landscape Ecosystem Management (4 credit hours)
Well-designed, installed, and maintained urban/suburban ecosystems offer significant economic and social benefits that directly improve the environment for people, plants and animals. Learn how to select, install and maintain plants as part of a sustainable landscape. This course provides students with the tools to understand and implement landscape ecosystem management techniques that include, but are not limited to plant selection and maintenance, soil maintenance and renovation, thoughtful application of common landscape chemistry and IPM, urban/suburban wildlife conservation (including plant pollinators), and installation and promotion of green infrastructure practices.

Prerequisite: SSC 200
Typically offered in Fall only

HS 475 Horticulture Entrepreneurship (3 credit hours)
This course is structured to introduce students to entrepreneurship, startups and the basic principles of business administration and management with focus in the horticulture industry in a global context. The goal of this class is to give students pragmatic knowledge and tools to start their own business or to be successful managers in the horticulture industry. Students will describe and discuss the entrepreneurial thinking process and as they analyze the following business topics: marketing, management and leadership, accounting, and finance.

Typically offered in Fall only

HS 476/HS 576 Crop Physiology and Production in Controlled Environments (3 credit hours)
This course focuses on plant eco-physiological responses to different environmental factors such as: light intensity, quality, duration and penetration; CO2 diffusion; thermodynamic properties of moist air; root environment; air dynamics; water relations; and canopy energy balance. In addition, the course emphasizes the application of controlled environment technologies to manipulate crop responses. The laboratory is designed to optimize the production of edible crops in greenhouses and vertical farms by applying the foundational knowledge of plant eco-physiology in combination with advance controlled environment technologies.

Prerequisite: PB 321 or PB 421 and either MA 114 or MA 121 or MA 131 or MA 141
Typically offered in Spring only

HS 480/CS 480 Sustainable Food Production (capstone) (1 credit hours)
This course introduces students to the process of developing a project for presentation in the area of sustainable food production and food systems. Students are to synthesize and integrate knowledge acquired in previous course work and other learning experiences to develop a comprehensive food system project.

Prerequisites: Senior standing and CS 430
Typically offered in Fall only
HS 491 Sustainable Agriculture Entrepreneurship Study Abroad (3 credit hours)
This course provides an international perspective on entrepreneurship and sustainability in agricultural and life sciences while examining one of three unique, Spanish-speaking locations (Oaxaca, Mexico; Valencia, Spain; and Queretaro, Mexico. The course is led by three instructors who speak Spanish, have very close ties to the communities visited, and are experts in the fields of sustainability and entrepreneurship. The different components of sustainability: increase in production, efficient use of non-renewable resources, ecological stewardship, economic improvement, and increase in quality of life will be experienced. The practice of entrepreneurship will be identified through examples of the implementation of these sustainable motivators as they then analyze different businesses' strengths and constraints. This course intends to give an intimate look into an international location with the intent of getting students out of their comfort zone, challenging their mindsets, and providing the opportunity to experience cultural and agricultural diversity.

Typically offered in Summer only

HS 492 Horticulture Internship (1-3 credit hours)
A learning experience in Horticultural Science where a student can gain real-world experience relevant to their academic and career goals. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience (135 hours = 3 credits). The experience must be arranged by the student and approved by the Department of Horticultural Science prior to the start of the experience. To gain approval, a student must submit the completed HS 492 contract and have it approved by their experience supervisor and the undergraduate coordinator. In addition to the work described in the contract, a student will complete two reflective assignments.

Typically offered in Fall, Spring, and Summer

HS 493 Research Experience in Horticultural Science (1-3 credit hours)
A learning experience in Horticultural Science where a student can gain research experience relevant to their academic and career goals. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience (135 hours = 3 credits). The experience must be arranged by the student and approved by the undergraduate coordinator prior to the start of the experience. To gain approval, a student must submit the completed HS 493 contract and have it approved by their research experience supervisor and the undergraduate coordinator. In addition to the work described in the contract, a student will complete two reflective assignments.

Typically offered in Fall, Spring, and Summer

HS 494 Teaching Experience in Horticultural Science (1-3 credit hours)
A learning experience in Horticultural Science where a student can gain teaching experience relevant to their academic and career goals. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience (135 hours = 3 credits). The experience must be arranged by the student and approved by the undergraduate coordinator prior to the start of the experience. To gain approval, a student must submit the completed HS 494 contract and have it approved by their experience supervisor and the undergraduate coordinator. In addition to the work described in the contract, a student will complete two reflective assignments.

Typically offered in Fall, Spring, and Summer

HS 495 Experimental Courses in Horticultural Science (1-6 credit hours)
Offering of new courses on a trial basis. Topic varies based on offering. Repetition with different course content acceptable up to 2 times and total of 6 units.

Typically offered in Fall, Spring, and Summer

HS 502/PP 502/CS 502 Plant Disease: Methods & Diagnosis (2 credit hours)
Introduction to the basic principles of disease causality in plants and the methodology for the study and diagnosis of plant diseases caused by fungi. Identification of plant-pathogenic fungi. Research project, disease profiles and field trips are required.

Prerequisite: PP 315
Typically offered in Fall only

HS 516/HS 416 Planting Design (4 credit hours)
Developing and cultivating a design process for creating meaningful and compelling ornamental planting designs through the study and practice of spatial articulation (form, enclosure, permeability), physical properties of plants (line, form, texture, color), client/site analysis and program development, visual journaling, garden narrative, presentation skills, utilizing principles of visual composition, design communication, and understanding and resolving technical and horticultural issues in contemporary planting design.

Prerequisite: Landscape Horticulture (11HORTTHL) concentration, HS 400
Typically offered in Fall only

HS 520/HS 420 Green Infrastructure (3 credit hours)
Green infrastructure is defined as the interconnected networks of natural and constructed ecological systems within and in-between urban areas. When implemented in a holistic way, green infrastructure can provide benefits at the residential, neighborhood, community levels providing for greater health and well-being, an improved functional environment, and a thriving dynamic economy. Well-designed urban landscapes offer significant economic and social benefits that directly improve the urban environment for people, plants and animals- from increasing real estate value and reducing energy costs, to enhancing health and food security, and providing habitat for a diverse population of animals and plants. Since addressing environmental issues requires a multidisciplinary approach, this course is designed for any student with interests in horticulture, biological engineering, landscape architecture, environmental sciences, urban forestry, and any others who care about the sustainability of their communities.

Typically offered in Fall only

HS 521/HS 421 Temperate-Zone Tree Fruits: Physiology and Culture (3 credit hours)
Physiology and culture of the major temperate-zone tree fruit and nut crops of the United States. Fundamental principles underlying woody plant growth as applied to the culture of specific tree-fruit crops with emphasis on crops of commercial importance.

Prerequisite: BIO 181 or B0 200
Typically offered in Spring only
Typically offered in Fall only

HS 532/HS 432 Introduction to Permaculture (3 credit hours)
Permaculture means "permanent culture," and ..."is the conscious design and maintenance of cultivated ecosystems that have the diversity, stability, and resilience of a natural ecosystem." [Bill Mollison] This course will explore a design/thinking methodology that seeks to provide our essential physical needs, food, water, shelter, energy, etc., while doing so in an environmentally friendly, sustainable manner. The three weekend field trips are required. This course is restricted to upper level undergraduate, graduate, or matriculated continuing education students. STUDENTS MAY NOT RECEIVE CREDIT FOR BOTH HS 432 AND HS 532.

Typically offered in Fall and Summer

HS 533/HS 433 Public Garden Administration (3 credit hours)
This course addresses the practices, programs, and professional skills that are critical to the successful management of public gardens. The aim of the course is to better prepare graduate students and upper-level undergraduates for potential careers in public garden administration. Topics will include a brief history, impact, and current trends of public gardens in the United States; plant collections; managing staff, volunteers, and boards, and the visiting public; finances and fund raising; educational programming; visitor services; and careers in public gardens. Two Saturday off-campus field trips are required.

Typically offered in Fall only

HS 541/CS 541 Plant Breeding Methods (3 credit hours)
Overview of plant breeding methods for advanced undergraduate and beginning graduate students. Covers principles and concepts of inheritance, germplasm resources, pollen control, measurement of genetic variances, and heterosis. Special topics include heritability, genotype-environment interaction, disease resistance, and polyploidy. In-depth coverage on methods for breeding cross-pollinated and self-pollinated crops. Prepares students for advanced plant breeding courses.

Prerequisite: ST 511, Corequisite: ST 512
Typically offered in Fall only

HS 550 Environmental Nursery Production (3 credit hours)
The course focuses on the impacts of the nursery industry on the environment and environmentally sound nursery practices. Exploration of the major challenges facing the nursery industry that drive decision making during production. Evaluation of past

Prerequisite: HS 411, Nursery Management, or an equivalent course.
Typically offered in Fall only

HS 551/HS 451 Plant Nutrition (3 credit hours)
An understanding of the basic mineral nutrient requirements, nutritional monitoring procedures, and fertilizer application methods in horticultural production systems including those for fruits, field vegetables, fruits and vegetables under plasticiculture, nursery crops, landscapes, greenhouse flowers and vegetables, interior plantscapes, hydroponics, and organic farming.

Prerequisite: SSC 200
Typically offered in Spring only

HS 562/FS 562/FS 462/HS 462 Postharvest Physiology (3 credit hours)
Preharvest and postharvest factors that affect market quality of horticultural commodities with an emphasis on technologies to preserve postharvest quality and extend storage life of fruits, vegetables and ornamentals.

Prerequisite: PB 421
Typically offered in Spring only

HS 576/HS 476 Crop Physiology and Production in Controlled Environments (3 credit hours)
This course focuses on plant eco-physiological responses to different environmental factors such as: light intensity, quality, duration and penetration; CO2 diffusion; thermodynamic properties of moist air; root environment; air dynamics; water relations; and canopy energy balance. In addition, the course emphasizes the application of controlled environment technologies to manipulate crop responses. The laboratory is designed to optimize the production of edible crops in greenhouses and vertical farms by applying the foundational knowledge of plant eco-physiology in combination with advance controlled environment technologies.

Prerequisite: PB 321 or PB 421 and either MA 114 or MA 121 or MA 131 or MA 141
Typically offered in Spring only

HS 583 Advanced Floral Crop Production and Handling (3 credit hours)
Principles and commercial practices for producing floral potted crops and cut flowers emphasizing the physical responses of plants to their environment and post-harvest physiology. Lab will be conducted at the student's home location and students will document plant growth with photos or video. Some live plants will be mailed to the student; however, the student will be required to purchase some plants (e.g. African violet). Course is restricted to graduates students only.

Typically offered in Spring only

HS 590 Special Problems in Horticultural Science (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in horticultural science.

Typically offered in Fall, Spring, and Summer

HS 601 Professional Presentation Skills in Horticultural Science (2 credit hours)
The purpose of this course is to familiarize the students with the professional presentation skills they need to be successful. These skills include speaking, writing, poster and website development, based on the student's proposed research/project and literature review.

Typically offered in Fall only
HS 610 Special Topics in Horticultural Science (1-6 credit hours)
Investigation of special theoretical problems at 600 level in horticultural science not related to a thesis problem; new 600-level courses during developmental phase.

*Typically offered in Fall, Spring, and Summer*

HS 615 Advanced Special Topics (1-6 credit hours)
Investigation of theoretical problems at the 600 level in horticultural science not related to a thesis problem; new 600-level courses during the development phase.

*Typically offered in Fall, Spring, and Summer*

HS 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's in Horticultural Science

*Typically offered in Fall, Spring, and Summer*

HS 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's in Horticultural Science

*Typically offered in Fall and Spring*

HS 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's in Horticultural Science

*Typically offered in Fall and Spring*

HS 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's in Horticultural Science

*Typically offered in Fall, Spring, and Summer*

HS 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's in Horticultural Science

*Typically offered in Fall, Spring, and Summer*

HS 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's in Horticultural Science

*Typically offered in Fall, Spring, and Summer*

HS 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's in Horticultural Science

*Typically offered in Summer only*

HS 699 Master's Thesis Preparation (1-9 credit hours)
Original research on specific problems in fruit, vegetable and ornamental crops.

Prerequisite: Master's in Horticultural Science

*Typically offered in Fall, Spring, and Summer*

HS 701 Plant Metabolism (1 credit hours)
A brief introduction to various aspects of metabolism in plants including the basic biochemical processes including the syntheses, utilization and roles of amino acids, lipids, carbohydrates and secondary metabolites in plant growth, development and response to the environment. This course is taught as a 5-week mini course.

Prerequisite: (CH 223 or CH 227) and PB 421

*Typically offered in Fall only*

HS 702 Biology of Plant Hormones (1 credit hours)
Recent developments and current literature on the physiology, biochemistry, molecular biology, and practical applications of the primary plant hormones. The biosynthesis, signal transduction pathways, and biological functions of specific plant hormones will be examined. Taught as a five-week minicourse.

Prerequisite: BO 421, (GN 411 or BCH 451)

*Typically offered in Fall only*

HS 703 Breeding Asexually Propagated Crops (1 credit hours)
Principles and problems associated with breeding clonally propagated crops and techniques used in overcoming these problems. Taught third five weeks of semester. Drop date is by last day of 3rd week of minicourse.

Prerequisite: CS 413

*Typically offered in Fall only*

HS 704 Plant Nomenclature (1 credit hours)
A practical foundation in plant nomenclature and nomenclatural references. Emphasis on the evolution of international rules for naming plant taxa and their application in both wild and cultivated plants. Nomenclature applications used in patents, cultivar releases and journal articles. Taught mid-semester. Taught five weeks of semester.

Prerequisite: PB 421

*Typically offered in Spring only*

HS 705 Physiology Of Flowering (1 credit hours)
Examination of physiological basis of flowering in plants such as: floral initiation, transition to reproductive growth; floral development; plant response to light, temperature, nutrition, water supply; plant age; chemical growth regulation and in vitro flowering. Taught first five weeks of fall semester. Drop date is by last day of 3rd week of minicourse.

Prerequisite: PB 421

*Typically offered in Fall only*
HS 706 Fruit Development and Postharvest Physiology (1 credit hours)
Theories of plant senescence, both physiological and biochemical, and postharvest changes in all types of plant parts. Emphasis on physiological principles underlying current postharvest handling and storage techniques. A study of fruit development from fruit set to senescence. Taught third five weeks of semester. Drop date is by last day of 3rd week of minicourse.

Prerequisite: PB 421
Typically offered in Fall only

HS 707 Environmental Stress Physiology (1 credit hours)
Physiology of plant responses to environmental stresses, with emphasis on current research in selected physiological, molecular, and biochemical mechanisms for tolerance to environmental stresses such as temperature extremes, drought, salt, pathogens and other plants.

Prerequisite: CS 414
Typically offered in Fall only

HS 716/CS 716 Weed Biology (3 credit hours)
This course analyzes the interactions between human disturbance and dynamics of weed populations and communities. Emphasis is given to factors that drive weed control actions and the ecological and evolutionary processes by which weeds survive and adapt

Prerequisite: CS 414
Typically offered in Spring only

HS 717/CS 717 Weed Management Systems (1 credit hours)
Weed management systems including integration of cultural, biological, mechanical and chemical methods for vegetables, fruits, ornamentals, turf, small grains, corn, tobacco, cotton, peanuts, aquatic and non-cropland settings. Taught second 5 weeks of semester. Drop date is by last day of 3rd week of minicourse.

Prerequisite: CS 414
Typically offered in Fall only

HS 720/GN 720 Molecular Biology In Plant Breeding (3 credit hours)
Theory and principles of molecular biology applied to plant breeding. Experimental approaches to induce genetic change, cytoplasmic recombination, haploid utilization and potentials of molecular techniques for solving breeding problems.

Prerequisite: CS(GN,HS) 741, GN 701, GN 702, GN 703
Typically offered in Spring only

HS 725/SSC 725/TOX 725/CS 725 Pesticide Chemistry (1 credit hours)
Chemical properties of pesticides including hydration and solvation, ionization, volatilization, lipophilicity, molecular structure and size, and reactivity and classification according to chemical description, mode of action or ionizability. Taught during the first 5 weeks of semester. Drop date is last day of 3rd week of the minicourse.

Prerequisite: (CH 201 or CH 203) and (CH 221 or CH 225)
Typically offered in Fall only

HS 727/SSC 727/TOX 727/CS 727 Pesticide Behavior and Fate In the Environment (2 credit hours)
Sorption/desorption, soil reactivity, movement, volatilization, bioavailability, degradation and stability of pesticides in the environment. Taught during the last 10 weeks of semester. Drop date is last day of 3rd week of the minicourse.

Prerequisite: CS(HS,SSC,TOX) 725, SSC 200
Typically offered in Fall only

HS 729/CS 729 Herbicide Behavior In Plants (2 credit hours)
Chemical, physiological and biochemical actions of herbicides in plants including uptake, translocation, metabolism and mechanism of action.

Prerequisite: BO 751 and BO 752 and CS(HS,SSC) 725
Typically offered in Spring only

HS 745/CS 745/GN 745 Quantitative Genetics In Plant Breeding (1 credit hours)
Theory and principles of plant quantitative genetics. Experimental approaches of relationships between type and source of genetic variability, concepts of inbreeding, estimations of genetic variance and selection theory.

Prerequisite: CS(GN, HS) 541, ST 712, course in quantitative genetics recommended
Typically offered in Spring only

HS 746/CS 746/GN 746 Cytogenetics in Plant Breeding (2 credit hours)
Theory and principles of plant breeding methodology including population improvement, selection procedures, genotypic evaluation, cultivar development and breeding strategies.

Typically offered in Spring only

HS 757/GN 757/ST 757 Quantitative Genetics Theory and Methods (3 credit hours)
The essence of quantitative genetics is to study multiple genes and their relationship to phenotypes. How to study and interpret the relationship between phenotypes and whole genome genotypes in a cohesive framework is the focus of this course. We discuss how to use genomic tools to map quantitative trait loci, how to study epistasis, how to study genetic correlations and genotype-by-environment interactions. We put special emphasis in using genomic data to study and interpret general biological problems, such as adaptation and heterosis. The course is targeted for advanced graduate students interested in using genomic information to study a variety of problems in quantitative genetics.

Prerequisite: ST 511
Typically offered in Fall only

HS 790 Special Problems in Horticultural Science (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in horticultural science.

Typically offered in Fall, Spring, and Summer

HS 815 Advanced Special Topics (1-6 credit hours)
Investigation of theoretical problems at 600 level in horticultural science not related to a thesis problem; new 600-level courses during development phase.

Typically offered in Fall, Spring, and Summer
HS 860/CS 860/GN 860 Plant Breeding Laboratory (1 credit hours)
Visitation of plant breeding projects in the Depts. of CS and HS at NC State, along with commercial seed companies. Discussion and viewing of breeding objectives, methods and equipment and teaching and practice of hybridization methods.
Prerequisite: CS(GN,HS)741
Typically offered in Spring only

HS 861/CS 861/GN 861 Plant Breeding Laboratory (1 credit hours)
Visitation of plant breeding projects in the Depts. of CS and HS at NC State, along with commercial seed companies. Discussion and viewing of breeding objectives, methods and equipment and teaching and practice of hybridization methods.
Prerequisite: CS(GN,HS)741
Typically offered in Fall only

HS 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Typically offered in Fall, Spring, and Summer

HS 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

HS 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

HS 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

HS 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Summer only

HS 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Humanities and Social Sciences (HSS)

HSS 120 Introduction to Humanities & Social Sciences (2 credit hours)
Introduction to humanities and social science disciplines by comparing methods of inquiry and perspectives on a social/cultural issue. The course will also facilitate exploration of college and university resources, opportunities, and policies, and address skills for academic, personal, and career success. First-year entering Humanities and Social Sciences majors only.
R: New Freshmen with majors in the College of Humanities and Social Sciences only
GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HSS 392/COM 392 International and Crosscultural Communication (3 credit hours)
Patterns and problems of verbal and non-verbal forms of crosscultural communication. Avoidance and management of cultural conflict arising from awareness of characteristics and crosscultural communication. Impact on communication of differing cultural perspectives.
GEP Global Knowledge, GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Summer

Humanities (HUM)

HUM 295 Humanities Special Topics (3 credit hours)
Special topics course offering for the general education Humanities category.
GEP Humanities
Typically offered in Fall, Spring, and Summer

Humanities and Global Knowledge (HUMG)

HUMG 295 Humanities and Global Knowledge Special Topics (3 credit hours)
Special topics course offering for the general education Humanities and Global Knowledge categories. This course may be used for the Global Knowledge (GK) co-requisite and/or for the Humanities (HUM) requirement.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

Humanities and U.S. Diversity (HUMU)

HUMU 295 Humanities and U.S. Diversity Special Topics (3 credit hours)
Special topics course offering for the general education Humanities and U.S. Diversity categories. This course may be used for the U.S Diversity (USD) co-requisite and/or for the Humanities (HUM) requirement.
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer
Immunology (IMM)

IMM 595 Special Topics (1-6 credit hours)
Typically offered in Fall only

IMM 705 Immunotoxicology (2 credit hours)
Concepts in the study of adverse effects of chemicals on the immune system, including allergic responses, autoimmunity and immunosuppression. Significance of immunotoxic effects resulting from environmental or workplace exposure. Role of immunotoxicity in risk assessment.

Prerequisite: TOX 701
Typically offered in Spring only

IMM 751/MB 751 Immunology (3 credit hours)
Introduction to mechanisms of immunity in man and animals. Emphasis on interactions between cells of the immune system in production of immune responses and the molecules in control of these interactions.

Prerequisite: BCH 451, GN 411, MB 351
Typically offered in Spring only

IMM 757/PO 757 Comparative Immunology (3 credit hours)
Compare and contrast the immune system structure and function of animal species of agricultural and veterinary significance with that of humans and traditional biomedical model organisms. Discuss key evolutionary differences, how different species use different mechanisms to achieve the same outcomes, and the clinical implications for these differences.

Prerequisite: MB 751 or MB 441 or BIO 414
Typically offered in Spring only

IMM 783/MB 783/CBS 783 Advanced Immunology (3 credit hours)
In depth study of the basic cellular and molecular mechanisms of immunity, including antigen processing and presentation, T cell development, initiation of the immune response, effector mechanisms, and immunological memory. The course is designed for advanced graduate students who wish to focus on the current concepts in immunology.

Prerequisite: MB (IMM) 751
Typically offered in Fall only

IMM 795 Special Topics (1-6 credit hours)
Typically offered in Fall only

Industrial and Systems Engineering (ISE)

ISE 135 Computer-Based Modeling for Engineers (3 credit hours)
Introductory course in computer-based modeling and programming using Python for Engineering Applications. Emphasis on algorithm development and engineering problem solving. Methodical development of Python scripts to link with Microsoft Excel using xlwings plugin through proper specifications; documentation, style; control structures; data types and data abstraction; graphical user interface design. Projects: design problems from industrial engineering systems. Functional relationships will be given and programs will be designed and developed from a list of specifications.

Prerequisite: E 115, Corequisite: MA 141
Typically offered in Fall and Spring

ISE 215 Foundations of Design & 3D Modeling for Engineers (1 credit hours)
This is an 8 week course. An introductory engineering graphics course which builds on the foundations of computer-aided 2D sketching and 3D modeling for industrial engineers. Students will develop and refine their ability to communicate designs via modeling techniques prolific in industry. The concurrent nature of ideation, engineering analysis and manufacturing will be emphasized as students review case studies and develop their own models. Constraint-based design will drive strategies that accurately reflect design intent and promote part family relationships and automation. Students will work in small teams to create a mechanism that must achieve certain functional criteria. ISE majors have priority registration for this course.

Prerequisite: E115 and Corequisite: ISE216
Typically offered in Fall and Spring

ISE 216 Product Development and Rapid Prototyping (3 credit hours)
Introduction to product development and prototyping. Team-based development of a new product during the semester. Specific topics are voice of the customer, product specification and parameter specification, Quality Function Deployment and the House of Quality, concept generation, concept selection, detailed design using SolidWorks, prototyping, design for assembly, design for the environment, and intellectual properties and patents. Team presentations of a functional prototype of their product at the end of the semester.

Corequisite: ISE 215
Typically offered in Fall and Spring

ISE 216 Product Development and Rapid Prototyping (3 credit hours)
Introduction to product development and prototyping. Team-based development of a new product during the semester. Specific topics are voice of the customer, product specification and parameter specification, Quality Function Deployment and the House of Quality, concept generation, concept selection, detailed design using SolidWorks, prototyping, design for assembly, design for the environment, and intellectual properties and patents. Team presentations of a functional prototype of their product at the end of the semester.

Corequisite: ISE 215
Typically offered in Fall and Spring

ISE 311 Engineering Economic Analysis (3 credit hours)

Prerequisite: Grade of C or better in MA 141
Typically offered in Fall, Spring, and Summer

ISE 315 Introduction to Computer-Aided Manufacturing (1 credit hours)
This is an 8 week course. Introduction to the principles of modern-day multi-axis machine tool control, using computer-aided manufacturing (CAM) software tools. Emphasis is placed on transferring part geometry from CAD to CAM, for the development of CNC-ready programs. Industry file formats, machining strategies, G & M-code generation, optimization and verification techniques will also be investigated. Upon successful completion of this course, students will be able to demonstrate proficiency in the use of industry-relevant CAD/CAM software and will be able to extend that knowledge to practice through exercises and projects. Use of CNC machine tools will be introduced and demonstrated in the department's physical lab spaces. ISE majors have priority registration for this course.

Prerequisite: ISE 215 and Co-requisite: ISE 316
Typically offered in Fall, Spring, and Summer
ISE 316 Manufacturing Engineering I - Processes (3 credit hours)
Analytical study and design of manufacturing engineering with emphasis on mfg. and processes. Addresses the interaction of design, materials, and processing. Laboratory instruction and hands-on experience in metrology, machining, process planning, economic justification, and current mfg. methodologies.
Prerequisite: MSE 200 and ISE 216; Co-requisite: ISE 315
Typically offered in Fall, Spring, and Summer

ISE 352 Fundamentals of Human-Machine Systems Design (3 credit hours)
Introduction to work methods and ergonomics. Coverage of methods to improve operator performance and production process efficiency. Techniques include project evaluation and review, operator-machine ratios, line balancing, work sampling, time study, wage payment, and pre-determined time systems. Ergonomics component includes workstation and hand-tool design, and methods for designing cognitive work and work environment.
Prerequisite: C- or better in ST 371; C or better in ISE 135
Typically offered in Fall and Spring

ISE 361 Deterministic Models in Industrial Engineering (3 credit hours)
Introduction to mathematical modeling, analysis techniques, and solution procedures applicable to decision-making problems in a deterministic environment. Linear programming models and algorithms associated with services. Students will be exposed both to classical and contemporary examples of challenges and opportunities that arise when working in the service sector.
Prerequisite: (MA 303 or MA 341) and C or better in ISE 135
Typically offered in Fall and Spring

ISE 362 Stochastic Models in Industrial Engineering (3 credit hours)
Introduction to mathematical modeling, analysis, and solution procedures applicable to uncertain (stochastic) production systems. Methodologies covered include probability theory and stochastic processes. Applications relate to design and analysis of problems, capacity planning, inventory control, waiting lines, and system reliability and maintainability.
Prerequisite: C or better in ISE 135 and (MA 303 or MA 341) and C- or better in ST 370
Typically offered in Fall and Spring

ISE 408 Design and Control of Production and Service Systems (3 credit hours)
This course focuses on understanding the behavior of manufacturing plants and service systems through a thorough, generalizable and fundamental understanding of the factors affecting their behavior.
Prerequisite: ISE 135, ISE 362, and C- or better in ST 371
Typically offered in Fall and Spring

ISE 411/ISE 511 Supply Chain Economics and Decision Making (3 credit hours)
This course introduces students to the principles of microeconomic analysis applied to decision-making in supply chains. Emphasis will be put on strategic interactions between different decision makers in the supply chain, including suppliers, manufacturers, retailers, and consumers. Topics include classical demand and production theory, pricing and revenue management, competition between firms, and cooperation between and within firms under information asymmetry.
Typically offered in Fall only

ISE 413/ISE 513 Humanitarian Logistics (3 credit hours)
This course provides a comprehensive treatment of humanitarian logistics (HumLog) from an operations research perspective, focusing on the use of quantitative modeling for decision making and best practices in disaster management. Background and overview on disaster management will be covered. The four phases of the disaster management cycle are introduced as well as the types of decisions that are made in each phase. Mathematical models are presented for typical humanitarian logistics decisions, such as inventory prepositioning, facility location, transportation, routing and capacity planning.
Prerequisite: ISE 361
Typically offered in Spring only

ISE 416 Manufacturing Engineering II - Automation (3 credit hours)
Integration of design and mfg. through computer aided/automated process planning, concurrent engineering, and rapid prototyping. Fixed and programmable automation in mfg. and service. Autonomous mfg. systems such as computer numerical control (CNC), industrial robotics, automated inspection, electronics manufacturing and assembly.
Prerequisite: ISE 316
Typically offered in Fall only

ISE 417 Database Applications in Industrial & Systems Engineering (3 credit hours)
Rapid applications development (RAD) tools to design and implement database-based applications. The SQL database query language, a standard RAD environment and how to access information in a database from it, use of Visual Basic for Applications, and how to integrate these tools together to design and build engineering applications. Examples will be from manufacturing and production systems.
Prerequisite: C or better in ISE 135
Typically offered in Fall and Spring

ISE 433/ISE 533/OR 433/OR 533 Service Systems Engineering (3 credit hours)
This course intends to provide a comprehensive treatment on the use of quantitative modeling for decision making and best practices in the service industries. The goal of this class is to teach students to able to identify, understand, and analyze services; and acquire the quantitative skills necessary to model key decisions and performance metrics associated with services. Students will be exposed both to classical and contemporary examples of challenges and opportunities that arise when working in the service sector.
Prerequisite: ISE 361
Typically offered in Spring only
ISE 435/ISE 535 Python Programming for Industrial & Systems Engineers  (3 credit hours)
The objective of this course is to build on your knowledge of computing and data analysis by focusing on programming using the Python language. In particular, you will learn more about the Python and its ecosystem of libraries, how to use data structures in Python programs, conduct File I/O operations, and perform numerical and scientific computing within Python. This course is designed for senior undergraduate and graduate students to get the basics of the Python language and learn to use it to perform scientific computing within Python with two of its most popular packages in use for heavy data intensive analysis - Numpy and SciPy. Several engineering examples from physics, industrial engineering core courses and general engineering will be used to contextualize the programming examples.

Prerequisites: ST 370 OR ST 371 and ISE/TE 110 OR CSC 111 OR CSC 113 OR CSC 116 or ST 307 OR ST 308 OR ECE 209. Restrictive Statement: Department Approval Required Typically offered in Fall only

ISE 437 Data Analytics for Industrial Engineering  (3 credit hours)
In this course undergraduate students will learn to integrate statistical and mathematical modeling tools they learned in their previous classes to be able to design, develop and implement comprehensive advanced analytics solutions to address real industry problems. All class modules will be illustrated through real applications in Media, Financial, Retail and Manufacturing industries.

Prerequisites: (ST 370 OR ST 371) and (ISE 135 OR CSC 111 OR CSC 113 OR CSC 116 or ST 307 OR ST 308 OR ECE 209) Restrictive Statement: Department Approval Required Typically offered in Spring only

ISE 441 Introduction to Simulation  (3 credit hours)
Discrete-event stochastic simulation for the modeling and analysis of systems. Programming of simulation models in a simulation language. Input data analysis, variance reduction techniques, validation and verification, and analysis of simulation output. Random number generators and random variate generation.

Prerequisite: MA 242, ST 372, C or better in ISE 110 Typically offered in Fall and Spring

ISE 443 Quality Design and Control  (3 credit hours)

Prerequisite: ST 372 Restriction: ST 435 cannot be used as a substitute for this course. Typically offered in Fall and Spring

ISE 447/ISE 547 Applications of Data Science in Healthcare  (3 credit hours)
Health professional are capable of collecting massive amounts of data and look for best strategies to use this information. Healthcare analytics have the potential to reduce costs of treatment, predict outbreaks of epidemics, avoid preventable diseases and improve the quality of life in general. This course will explore some of the frequently used data science methods in healthcare and examine a compilation of the most recent academic journal articles on the subject. Students are expected to have a strong background in optimization and stochastic modeling.

Prerequisite: ISE 362 Typically offered in Fall only

ISE 452 Advanced Human-Machine Systems Design  (3 credit hours)
Advanced concepts in human-machine systems design. Consideration of anatomical and physiological bases for design of work systems. Advanced biomechanical analysis and modeling for manual material handling design. Physiological and psychological capabilities and limitations as related to work systems design and human performance. Coverage of human information processing and performance theories and models, including pipe-line, signal detection theory, information theory, and motor control theory. Additional topics include human factors experimentation and neuroergonomics (brain and behavior).

Prerequisite: CE 214 and ISE 352 Typically offered in Spring only

ISE 453 Modeling and Analysis of Supply Chains  (3 credit hours)
This course presents an overview of the basic issues and strategies involved in operating today's global supply chains, from the design of the supply chain network through the management and location of inventories to the design and operation of the logistics systems that distribute goods from their source to the consumer.

Prerequisite: ST 371 (C- or better), ISE 135, ISE 361, ISE 362 Typically offered in Fall and Spring

ISE 462 Advanced Stochastic Models in Industrial Engineering  (3 credit hours)
Advanced topics related to mathematical modeling, analysis, and solution procedures applicable to uncertain (stochastic) production systems. Methodologies covered include economic analysis under uncertainty, discrete and continuous time stochastic processes. Applications relate to design, analysis and control relating to capacity planning, inventory control, waiting lines, and system reliability and maintainability.

Prerequisite: ISE 362 Typically offered in Fall only

ISE 489 Special Topics in Industrial and Systems Engineering  (1-3 credit hours)
Directed coursework in Industrial and Systems Engineering with an emphasis on special topics and emerging areas of interest within the discipline.

Typically offered in Fall, Spring, and Summer
ISE 498 Senior Design Project (3 credit hours)
Individual or group design projects requiring problem definition and analysis, synthesis, specification and presentation of a designed solution. Students work under faculty supervision either on actual industrial engineering problems posed by local industrial, service and governmental organization or on emerging research issues.
Prerequisite: ISE 408 and ISE 441 and ISE 453
Typically offered in Fall and Spring

ISE 501/OR 501 Introduction to Operations Research (3 credit hours)
OR Approach: modeling, constraints, objective and criterion. Problems of multiple criteria, optimization, model validation and systems design. OR Methodology: mathematical programming; optimum seeking; simulation, gaming; heuristic programming. Examples. OR Applications: theory of inventory; economic ordering under deterministic and stochastic demand. Production smoothing problem; linear and quadratic cost functions. Waiting line problems: single and multiple servers with Poisson input and output. Theory of games for two-person competitive situations. Project management through PERT-CPM.
Prerequisite: MA 421 or ST 421 or ST 371 and ST 372
Typically offered in Fall and Spring

ISE 505/OR 505/MA 505 Linear Programming (3 credit hours)
Introduction including: applications to economics and engineering; the simplex and interior-point methods; parametric programming and post-optimality analysis; duality matrix games, linear systems solvability theory and linear systems duality theory; polyhedral sets and cones, including their convexity and separation properties and dual representations; equilibrium prices, Lagrange multipliers, subgradients and sensitivity analysis.
Prerequisite: MA 405
Typically offered in Fall only

ISE 510 Applied Engineering Economy (3 credit hours)
Engineering economy analysis of alternative projects including tax and inflation aspects, sensitivity analysis, risk assessment, decision criteria. Emphasis on applications.
Prerequisite: Undergrad. courses in engineering economics and ST
Typically offered in Spring only

ISE 511/ISE 411 Supply Chain Economics and Decision Making (3 credit hours)
This course introduces students to the principles of microeconomic analysis applied to decision-making in supply chains. Emphasis will be put on strategic interactions between different decision makers in the supply chain, including suppliers, manufacturers, retailers, and consumers. Topics include classical demand and production theory, pricing and revenue management, competition between firms, and cooperation between and within firms under information asymmetry.
Typically offered in Fall only

ISE 513/ISE 413 Humanitarian Logistics (3 credit hours)
This course provides a comprehensive treatment of humanitarian logistics (HumLog) from an operations research perspective, focusing on the use of quantitative modeling for decision making and best practices disaster management. Background and overview on disaster management will be covered. The four phases of the disaster management cycle are introduced as well as the types of decisions that are made in each phase. Mathematical models are presented for typical humanitarian logistics decisions, such as inventory prepositioning, facility location, transportation, routing and capacity planning.
Prerequisite: ISE 361
Typically offered in Spring only

ISE 515 Manufacturing Process Engineering (3 credit hours)
Manufacturing process engineering, primary, secondary, finishing and assembly processes. Traditional and non-traditional manufacturing processes, group technology, manufacturing analyses and application of economic analyses. Graduate standing in Engineering.
Typically offered in Fall and Spring

ISE 519 Database Applications in Industrial and Systems Engineering (3 credit hours)
Rapid application development (RAD) tools to design and implement database-based applications. This includes: SQL query language, Visual Basic for Applications in database application construction, a standard RAD environment and how to access information in a database, entity/attribute modeling of the database structure, anomalies of database structures that create problems for applications, modeling of application system’s functionality, and integrating these tools together to design and implement engineering applications. Examples from manufacturing and production systems. Restricted to advanced undergraduates and graduate students.
Prerequisite: ISE 110
Typically offered in Fall and Spring

ISE 520 Healthcare Systems Performance Improvement I (3 credit hours)
Methods used to improve the performance of health care delivery systems with emphasis on patient care cost, access, and quality. Adaptation of lean and six-sigma to rapid and continuous health care systems improvement through organizational and process transformation. Fundamentals of scheduling, staffing, and productivity in health systems employing simulation and optimization. Health care policy and management.
Prerequisite: ST 372, ISE 352, ISE 361, and ISE 441
Typically offered in Fall only

ISE 521 Healthcare Systems Performance Improvement II (3 credit hours)
Continuation of ISE 520 with a concentration on the completion of a healthcare systems process improvement project at the sponsoring health care institution. Project must employ the tools and techniques of healthcare systems process improvement. The project is done in conjunction with a diverse and multi-disciplinary team from the healthcare institution. The student must serve as a facilitator and coach, resulting in a project with measured success. Success will be determined by the improvement in patient care as quantified in cost, quality, and access.
Prerequisite: ISE 520
Typically offered in Spring only
ISE 533/OR 433/OR 533/ISE 433 Service Systems Engineering (3 credit hours)
This course intends to provide a comprehensive treatment on the use of quantitative modeling for decision making and best practices in the service industries. The goal of this class is to teach students to be able to identify, understand, and analyze services; and acquire the quantitative skills necessary to model key decisions and performance metrics associated with services. Students will be exposed both to classical and contemporary examples of challenges and opportunities that arise when working in the service sector.
Prerequisite: ISE 361
Typically offered in Spring only

ISE 535/ISE 435 Python Programming for Industrial & Systems Engineers (3 credit hours)
The objective of this course is to build on your knowledge of computing and data analysis by focusing on programming using the Python language. In particular, you will learn more about the Python and its ecosystem of libraries, how to use data structures in Python programs, conduct File I/O operations, and perform numerical and scientific computing within Python. This course is designed for senior undergraduate and graduate students to get the basics of the Python language and learn to use it to perform scientific computing within Python with two of its most popular packages in use for heavy data intensive analysis - Numpy and SciPy. Several engineering examples from physics, industrial engineering core courses and general engineering will be used to contextualize the programming examples.
Prerequisites: ST 370 OR ST 371 and ISE/TE 110 OR CSC 111 OR CSC 113 OR CSC 116 or ST 307 OR ST 308 OR ECE 209. Restrictive Statement: Department Approval Required
Typically offered in Fall only

ISE 537 Data Science for Industrial and Systems Engineers (3 credit hours)
In this course, graduate students will learn basic data science methodologies. Examples of the methodologies include linear regression, generalized linear models, regularization and variable selection, and dimensionality reduction. In addition, students will also learn how to use these methods to solve real-world Industrial Engineering-related problems by analyzing industrial datasets and projects.
Prerequisite: ST 370: "Probability and Statistics for Engineers" or equivalent
Typically offered in Fall only

ISE 540/PSY 540 Human Factors In Systems Design (3 credit hours)
Introduction to problems of the systems development cycle, including human-machine function allocation, military specifications, display-control compatibility, the personnel sub-system concept and maintainability design. Detailed treatment given to people as information processing mechanisms.
Prerequisite: IE 452 or PSY 340, Corequisite: ST 507 or 515
Typically offered in Spring only

ISE 541 Occupational Safety Engrg (3 credit hours)
Typically offered in Spring only

ISE 543 Musculoskeletal Mechanics (3 credit hours)
Anatomy, physiology and biomechanics of musculoskeletal system including muscle bone, tendon, ligament, cartilage, nerve. Modeling of tissue and joints with special emphasis on spine and upper extremity. Physical, mathematical, optimization and finite element modeling techniques as applied in biomechanics research.
Prerequisite: BIO 125 or BAE(BIO) 235 or Graduate standing

ISE 544 Occupational Biomechanics (3 credit hours)
Prerequisite: Graduate standing
Typically offered in Fall only

ISE 546/CSC 546 Management Decision and Control Systems (3 credit hours)
Planning, design, and development and implementation of comprehensive computer-based information systems to support management decisions. Formal information systems principles; information requirements analysis; knowledge acquisition techniques; information modeling. Information resource management for quality operational control and decision support; system evaluation, process improvement and cost effectiveness.
Prerequisite: CSC 423 or BUS 541
Typically offered in Fall only

ISE 547/ISE 447 Applications of Data Science in Healthcare (3 credit hours)
Health professional are capable of collecting massive amounts of data and look for best strategies to use this information. Healthcare analytics have the potential to reduce costs of treatment, predict outbreaks of epidemics, avoid preventable diseases and improve the quality of life in general. This course will explore some of the frequently used data science methods in healthcare and examine a compilation of the most recent academic journal articles on the subject. Students are expected to have a strong background in optimization and stochastic modeling.
Prerequisite: ISE 362
Typically offered in Fall only
ISE 552 Design and Control of Production and Service Systems (3 credit hours)
Basic terminology and techniques for the control of production and service systems including economic order quantity models; stochastic inventory models; material requirements planning; Theory of Constraints; single and mixed model assembly lines; and
Prerequisite: ST 371 or ST 372
Typically offered in Fall only

ISE 553 Modeling and Analysis of Supply Chains (3 credit hours)
Basic issues in operating supply chains, using state of the art modeling tools available for their analysis. Emphasis on using engineering models to develop insights into the behavior of these systems.
Prerequisite: ISE 361 and ST 372
Typically offered in Spring only

ISE 560/OR 560 Stochastic Models in Industrial Engineering (3 credit hours)
ISE/OR 560 will introduce mathematical modeling, analysis, and solution procedures applicable to uncertain (stochastic) production and service systems. Methodologies covered include probability theory and stochastic processes including discrete and continuous Markov processes. Applications relate to design and analysis of problems, capacity planning, inventory control, waiting lines, and service systems.
Typically offered in Fall only

ISE 562/TE 562/OR 562 Simulation Modeling (3 credit hours)
This course concentrates on design, construction, and use of discrete/continuous simulation object-based models employing the SIMIO software, with application to manufacturing, service, and healthcare. The focus is on methods for modeling and analyzing complex problems using simulation objects. Analysis includes data-based modeling, process design, input modeling, output analysis, and the use of 3D animation with other graphical displays. Object-oriented modeling is used to extend models and enhance re-usability.
Typically offered in Spring only

ISE 589 Special Topics In Industrial Engineering (1-6 credit hours)
Special developments in some phase of industrial engineering using traditional course format. Identification of various specific topics and prerequisites for each section from term to term.
ISE 601 Seminar (1 credit hours)
Seminar discussion of industrial engineering problems for graduate students. Case analyses and reports.
Typically offered in Fall and Spring

ISE 610 Special Topics in Industrial Engineering (3-6 credit hours)
Special developments in some phase of industrial engineering using traditional course format. Identification of various specific topics and prerequisites for each section from term to term.

ISE 637 Directed Study in Industrial Engineering (1-3 credit hours)
Independent study providing opportunity for individual students to explore topics of special interest under direction of a member of faculty.
Typically offered in Fall and Summer

ISE 639 Advanced Directed Study in Industrial Engineering (1-3 credit hours)
Independent study providing an opportunity for individual graduate students to explore advanced topics of special interest under the direction of a member of the faculty.
Typically offered in Fall, Spring, and Summer

ISE 677 Industrial Engineering Projects (1-6 credit hours)
Investigation and written report on assigned problems germane to industrial engineering. Maximum of six credits to be earned for MIE degree.
Prerequisite: MIE candidates
Typically offered in Fall, Spring, and Summer

ISE 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment. Observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ISE 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ISE 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ISE 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ISE 695 Master's Thesis Research (1-9 credit hours)
Thesis research.
Typically offered in Fall, Spring, and Summer

ISE 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master's student
Typically offered in Summer only
ISE 699 Master's Thesis Preparation (1-9 credit hours)
For student who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ISE 707 Real-Time Control of Automated Manufacturing (3 credit hours)
Concepts and application of real-time control of automated manufacturing systems. Development of prototype manufacturing control applications involving introductions to following topics: computer architecture; real-time, multi-tasking operating systems; data modeling; multi-processing systems; local area networks; inter-task communication; and development of multi-tasking control systems. Design development of control system.
Typically offered in Fall only

ISE 708/MA 708/OR 708 Integer Programming (3 credit hours)
General integer programming problems and principal methods of solving them. Emphasis on intuitive presentation of ideas underlying various algorithms rather than detailed description of computer codes. Students have some "hands-on" computing experience.
Prerequisite: MA 405, OR (MA,IE) 505, Corequisite: Some familiarity with computers (e.g., CSC 112)
Typically offered in Spring only

ISE 709/OR 709 Dynamic Programming (3 credit hours)
Introduction to theory and computational aspects of dynamic programming and its application to sequential decision problems.
Prerequisite: MA 405, ST 421
Typically offered in Spring only

ISE 711 Capital Investment Economic Analysis (3 credit hours)
Analysis of economic merits of alternatives including interest and income tax considerations. Risk and sensitivity exploration techniques. Introduction to analytical techniques for multiple objectives or criteria. Use of mathematical programming and comp.
Prerequisites: ISE 311 and ST 371
Typically offered in Fall only

ISE 712 Bayesian Decision Analysis For Engineers and Managers (3 credit hours)
The Bayesian approach to decision making, with numerous applications in engineering and business. Expected value maximization, decision trees, Bayes' theorem, value of information, sequential procedures and optimal strategies. Axiomatic utility theory and controversies, utility of money, theoretical and empirical determination of utility functions and relationship to mean-variance analysis. Brief introduction to multi-attribute problems, time streams and group decisions.
Prerequisite: ST 371 or ST 421
Typically offered in Spring only

ISE 714 Product Manufacturing Engineering for the Medical Device Industry (3 credit hours)
Product development course targeted toward the medical device industry. Product design and development, concept generation and selection, parametric feature-based CAD, design for manufacturability (DFM) and assembly (DFA), tolerancing, rapid prototyping, tool design, tool fabrication, and medical device fabrication.
Prerequisite: ISE 515
Typically offered in Spring only

ISE 715 Manufacturing Process Engineering (3 credit hours)
Manufacturing process engineering, primary, secondary, finishing and assembly processes. Concurrent engineering, process planning, group technology, manufacturing analyses and application of economic analyses.
Typically offered in Spring only

ISE 716 Automated Systems Engineering (3 credit hours)
General principles of operation and programming of automated systems. Automated assembly, automated manufacturing, and inspection systems. Control of automated manufacturing. Industrial logic systems and programmable logic controllers. Computer numerical control, industrial robotics, and computer integrated manufacturing.
Typically offered in Spring only

ISE 718 Micro/Nano-Scale Fabrication and Manufacturing (3 credit hours)
Introduction to physical theory, process design, analysis, and characterization of micro/nano scale fabrication and manufacturing. The main focus of the course is on the fabrication/manufacturing of important types of microstructures used in micro/nano devices and the techniques and tools used to fabricate and characterize them.
Prerequisite: ISE 316 or graduate standing in the college of engineering
Typically offered in Spring only

ISE 723 Production Planning, Scheduling and Inventory Control (3 credit hours)
An analysis of Production-Inventory systems. Discussion of commonly used planning and scheduling techniques. Introduction to use of math modeling for solution of planning and scheduling problems. Interface with quality control and information systems.
Prerequisite: OR 501 and ST 511
Typically offered in Fall and Spring

ISE 726 Theory of Activity Networks (3 credit hours)
Introduction to graph theory and network theory. In-depth discussion of theory underlying (1) deterministic activity networks (CPM); optimal time-cost trade offs; the problem of scarce resources; (2) probabilistic activity networks (PERT); critical evaluation of underlying assumptions; (3) generalized activity networks (GERT, GAN); applications of signal flow graphs and semi-Markov process to probabilistic branching; relation to the theory of scheduling.
Prerequisite: OR 501, OR(E,MA) 505
Typically offered in Spring only
ISE 731 Multi-Attribute Decision Analysis  (3 credit hours)  
Specification of attributes/criteria/objectives for complex decisions.  
Determination of alternatives, attribute weights and decision-making process. Graphical and weighted evaluation techniques. Multi-attribute utility, multi-objective/goal programming and analytic hierarchy process methodologies. Computer applications and case studies.

Typically offered in Spring only

ISE 740/PSY 740 Engineering Psychology of Human-computer Interaction  (3 credit hours)  
Exploration of usability of computer technology. Theory and practice of user-centered design for HCI applications. Course focuses on current usability paradigms and principles, psychology of users, iterative and participatory design processes, system requirements specification, prototyping, user support systems, usability evaluation and engineering, interface design guidelines and standards. Application domains include, universal design, virtual reality, and scientific data visualization.

Prerequisite: IE(PSY) 540 or CSC 554

ISE 741 Systems Safety Engineering  (3 credit hours)  
Systems safety engineering. Course familiarizes students with techniques for identifying and recognizing potential safety hazards and the concept of risk assessment. Preliminary Hazard Analysis, Failure Modes and Effects Analysis, System and Subsystem Hazard Analysis, Fault Tree Analysis, Process Safety Management (29CFR1910.119) are explored together with applications to hazard analysis and control. Industrial situations and case studies are employed to illustrate usefulness of various system safety techniques.

Typically offered in Fall only

ISE 742 Environmental Stress, Physiology and Performance  (3 credit hours)  

Typically offered in Spring only

ISE 743/PSY 743 Ergonomic Performance Assessment  (3 credit hours)  
Fundamentals of ergonomic performance measurement used to assess the effects of environment and system design on human performance. Treatment of topics such as workload measurement, measurement of complex performance, simulator studies, measurement of change, task taxonomies, criterion task sets and statistical methods of task analysis. Problems of laboratory and field research, measurement of change and generalizability of findings.

Prerequisite: PSY 200, ST 507 and 508

Typically offered in Fall only

ISE 744 Human Information Processing  (3 credit hours)  
Fundamentals of human information processing basic to skilled operator performance and the design of displays, controls and complex systems. Treatment of topics such as channel capacity, working memory, long-term memory, decision making, attention and process monitoring. Problems of display and control design and evaluation, evaluation of textual material, and human-computer interaction.

Prerequisite: PSY 200, ST 507 and 508

Typically offered in Spring only

ISE 745/PSY 745 Human Performance Modeling  (3 credit hours)  

Prerequisite: ST 507 or 515 or equivalent; IE (PSY) 540, CSC 554 or IE (PSY) 744

ISE 747/OR 747 Reliability Engineering  (3 credit hours)  
Introduction to basic concepts of reliability engineering. Application of probability and statistics to estimate reliability of industrial systems; development of reliability measures; analysis of static and dynamic reliability models; development and a

Prerequisite: ST 511

Typically offered in Fall only

ISE 748 Quality Engineering  (3 credit hours)  
Introduction to basic concepts of quality engineering. Statistical process control (SPC) methods, acceptance sampling techniques, concept of parameter design and statistical as well as analytical techniques for its implementation, tolerance analysis and design, components of cost of poor quality and an introduction to quality management.

Prerequisite: OR 501, ST 511

Typically offered in Fall only

ISE 754 Logistics Engineering  (3 credit hours)  
Elements of logistics networks. Supply chain design: facility location and allocation; great-circle distances; geocoding. Multi-echelon production and inventory systems; sourcing decision systems. Vehicle routing: exact, approximation, and heuristic procedures; traveling salesman problem; basic vehicle routing problem and extensions; backhauling; mixed-mode transportation system design.

Prerequisite: ISE 453

Typically offered in Spring only
ISE 760/OR 760  Applied Stochastic Models in Industrial Engineering  (3 credit hours)
Formulation and analysis of stochastic models with particular emphasis on applications in industrial engineering; univariate, multivariate and
conditional probability distributions; unconditional and conditional
expectations; elements of stochastic processes; moment-generating
functions; concepts of stochastic convergence; limit theorems;
homogeneous, nonhomogeneous and compound Poisson processes;
basic renewal theory; transient and steady-state properties of Markov
processes in discrete and continuous time.
Prerequisite: MA 303, ST 371
Typically offered in Fall only

ISE 761/OR 761  Queues and Stochastic Service Systems  (3 credit hours)
Introduction of general concepts of stochastic processes. Poisson
processes, Markov processes and renewal theory. Usage of these in
analysis of queues, from with a completely memoryless queue to one with
general parameters. Applications to many engineering problems.
Typically offered in Spring only

ISE 762/CSC 762/OR 762  Computer Simulation Techniques  (3 credit hours)
Basic discrete event simulation methodology: random number
generators, simulation designs, validation, analysis of simulation output.
Applications to various areas of scientific modeling. Simulation language
such as SLAM and GPSS. Computer assignments and projects.
Prerequisite: ST 512 and a scientific programming language
Typically offered in Fall only

ISE 766/MA 766/OR 766  Network Flows  (3 credit hours)
Study of problems of flows in networks. These problems include the
determination of shortest chain, maximal flow and minimal cost flow in
networks. Relationship between network flows and linear programming
developed as well as problems with nonlinear cost functions, multi-
commodity flows and problem of network synthesis.
Prerequisite: OR(IE,MA) 505
Typically offered in Fall only

ISE 767 Upper Extremity Biomechanics  (3 credit hours)
Gross and functional anatomy of upper extremity; properties of tendons
and synovial fluid; epidemiology; disorders of shoulder, elbow, wrist,
hand, finger; biomechanical modeling; personal factors affecting
cumulative trauma disorder (CTD) risk, diagnosis and treatment of upper
extremity CTDs; wrist splints; workplace ergonomics to alleviate upper
extremity CTDs.
Typically offered in Fall only

ISE 768 Spine Biomechanics  (3 credit hours)
Gross and fine anatomy of spine, mechanism of pain, epidemiology,
in vitro testing, psychophysical studies, spine stability models,
bioinstrumentation: intradiscal pressure, intra-abdominal pressure
and electromyography. Biomechanics of lifting and twisting, effects of
vibration, effects of posture/lifting style, lifting belts, physical models,
optimization models, mathematical models, muscle models, finite element
models, current trends in medical management and rehabilitation,
chiropractic.
Typically offered in Fall only

ISE 772/OR 772  Stochastic Simulation Design and Analysis  (3 credit hours)
Advanced topics in stochastic system simulation, including random
generation, output estimation for stationary and non-stationary
models, performance optimization techniques, variance reduction
approaches. Student application of these techniques to actual
simulations. A current topic research paper required.
Prerequisite: (CSC, ECE, IE, OR) 762 and ST 516
Typically offered in Spring only

ISE 779 Advanced Special Topics In Industrial Engineering  (3-6
credit hours)
Advanced topics in some phase of industrial engineering using traditional
course format. Identification of various specific topics and prerequisites
for each section from term to term.
Typically offered in Fall and Spring

ISE 790/MA 790  Advanced Special Topics System Optimization  (1-6
credit hours)
Advanced topics in some phase of system optimization using traditional
course format. Identification of various specific topics and prerequisites
for each section from term to term.
Typically offered in Fall only

ISE 794 Advanced Problems in Ergonomics  (3 credit hours)
Exploration in depth of a problem area of contemporary interest involving
man-machine-environment interface. Class discussion and analysis of
research and theory, with special focus on human factors aspects of
systems design and operation.
Typically offered in Fall only

ISE 796 Research Practicum in Human-Systems Engineering  (3 credit hours)
Human-systems engineering research topic development, literature
evaluation, experimental design, use of research instrumentation, data
collection, basic data interpretation, statistical analysis, manuscript
preparation.
Typically offered in Spring only

ISE 801 Seminar  (1 credit hours)
Seminar discussion of industrial engineering problems for graduate
students. Case analyses and reports.
Typically offered in Fall and Spring

ISE 812/MA 812  Special Topics in Mathematical Programming  (1-6
credit hours)
Study of special advanced topics in area of mathematical programming.
Discussion of new techniques and current research in this area. The
faculty responsible for this course select areas to be covered during
semester according to their preference and interest. This course not
necessarily taught by an individual faculty member but can, on occasion,
be joint effort of several faculty members from this university as well
as visiting faculty from other institutions. To date, a course of Theory
of Networks and another on Integer Programming offered under the
umbrella of this course. Anticipation that these two topics will be repeated
in future together with other topics.
Prerequisite: IE(OR,MA) 505
Typically offered in Spring only
ISE 816/MA 816 Advanced Special Topics Sys Opt (1-6 credit hours)
Advanced topics in some phase of system optimization. Identification of
various specific topics and prerequisite for each section from term to
term.
Typically offered in Fall and Spring

ISE 837 Directed Study in Industrial Engineering (1-3 credit hours)
Independent study providing opportunity for individual students to explore
topics of special interest under direction of a member of faculty.
Typically offered in Fall, Spring, and Summer

ISE 839 Advanced Directed Study in Industrial Engineering (1-3 credit hours)
Independent study providing an opportunity for individual graduate
students to explore advanced topics of special interest under the direction
of a member of the faculty.
Typically offered in Fall, Spring, and Summer

ISE 861 The Design of Production Systems (3 credit hours)
The structure and operation of production planning, scheduling and
control systems; emphasis on system structure, capacity planning,
master production scheduling, shop loading and supply chain;
investigation of current trends.
Typically offered in Fall only

ISE 877 Industrial Engineering Projects (1-6 credit hours)
Investigation and written report on assigned problems germane to
industrial engineering. Maximum of six credits to be earned for MIE
degree.
Prerequisite: MIE candidates
Typically offered in Fall, Spring, and Summer

ISE 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the
student in planning for the teaching assignment, observe and provide
feedback to the student during the teaching assignment, and evaluate the
student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ISE 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral
preliminary exams.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ISE 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member
of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ISE 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ISE 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course
work during a summer session and who will be devoting full time to thesis
research.
Prerequisite: Doctoral student
Typically offered in Summer only

ISE 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time
enrollment, preliminary examination, and residency requirements for the
doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Industrial Design (ID)

ID 102 Basic Industrial Design Studio (6 credit hours)
This course is a continuation of the work introduced in D104 with a
focus on the industrial design discipline. This studio course examines
the techniques and attitudes for dealing with exploration, identification,
prototyping, evaluation and communication of problems and solutions
arising from the design of physical artifacts in the natural and product
environment. The design studio process includes the acquisition of
languages and skills appropriate to creativity, design thinking, industrial
design vocabulary and disciplined work habits.
Prerequisite: D104 and ID 110 Corequisites: ID 210 and ID216
Typically offered in Spring only

ID 110 Introduction to Digital Techniques (3 credit hours)
Introduction to the computer as a design tool for generating and
manipulation of two-dimensional raster and vector imagery; techniques
in two-dimensional concept rendering; 2D applications for design and
production of presentation documentation; and an introduction to basic
3D digital techniques. Industrial design majors, department approved
minor, and department approved elective for all other college of design
majors.
Corequisite: D 104
Typically offered in Fall only

ID 201 Industrial Design Studio I (6 credit hours)
This course is an introduction to the theories, methods, and language of
industrial design; elementary problems in form and function; transitional
implications of hand-crafted and mass-produced objects in various
materials. Industrial Design majors, and department approved elective
(“swing”) studio for all other College of Design majors.
Prerequisite: D 104 and ID 102 and ID 210 and ID 216; Corequisite:
ID 310 and ID 316
Typically offered in Fall only

ID 202 Industrial Design Studio II (6 credit hours)
Introduction to the fundamentals of product development and design
with emphasis on analytical and intuitive approaches to problem solving,
technical skills, manufacturing and structural considerations in design of
simple products/systems.
Prerequisite: ID 201 and ID 310 and ID 316; Corequisite: ID 255 and
ID 240
Typically offered in Spring only
ID 210 Intermediate Digital Techniques  (3 credit hours)
Progression of digital experiences that expand upon and combine the intellectual and conceptual skills required for digital 3D design visualization. Emphasis on solving design problems through development and manipulation of 3D form within the virtual
Prerequisite: ID 110 and D 104; Corequisite: ID 102 and ID 216
Typically offered in Spring only

ID 216 Visualization I  (3 credit hours)
This course is an introduction to the ideation process of conceiving, developing and recording ideas two-dimensionally.
Prerequisite: D 104 and ID 110; Corequisite: ID 102 and ID 210
Typically offered in Spring only

ID 240 Human-Centered Design  (3 credit hours)
Introduction to the spectrum of human physical and cognitive capabilities as they relate to user interaction with designed products and environments. Industrial Design Majors and Department approved Elective for all other College of Design Majors with J
Junior standing or above
Typically offered in Spring only

ID 244 History of Industrial Design  (3 credit hours)
This survey class focuses on the history of modern design from the world of Art Nouveau in 1900 to Contemporary Design. The emphasis falls squarely on the development of mass production and its alignment with the Modern movement, with elements drawn from the history of architecture and the fine arts. The Bauhaus (1919-1933) is examined in detail as is the growth of the industrial design profession in the US between 1927 and 1944, when the Society of Industrial Designers was formed. Postwar styling and consumerism in the US are examined in conjunction with the development of human factors, its early investigations and influence on design since 1955. Material culture issues are examined through visits to the Gregg Museum of Art & Design and its growing collection of industrial design. Postmodernism, Universal Design, and User Experience Design are examined in the contexts of their emergence and relevance to design today.
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

ID 255 Contemporary Manufacturing Processes I  (3 credit hours)
Introduction to mass production processes and their influences on design. Wood, paper and metal manufacturing processes utilized in quantity production. Emphasis on materials comparison and process selection in relation to product function, form, safety, human factors and manufacturability. Field trips required. Industrial Design majors, department approved minor, and department approved elective for all other College of Design majors.
Prerequisite: ID 201 and ID 315; Corequisite: ID 202
Typically offered in Spring only

ID 256 Contemporary Manufacturing Processes II  (3 credit hours)
Second course in mass production processes and their influences on design. Emphasis on material search and process selection in relation to form, function, human factors, finishes, and joining methods. Plastics and rubber and their specific manufacturing processes utilized in mass production. Industrial Design Majors and Department approved Elective for all other College of Design Majors.
Prerequisite: ID 255
Typically offered in Fall only

ID 262 Professional Practice in Industrial Design  (3 credit hours)
Issues and situations encountered in a design practice. Topics include patents, trademarks, contracts, basic marketing skills within corporations and in design consultancies.
Typically offered in Spring only

ID 292 Special Topics in Industrial Design  (1-3 credit hours)
Topics of current interest in Industrial Design. Normally used to develop new courses.
Typically offered in Fall, Spring, and Summer

ID 301 Industrial Design Studio III  (6 credit hours)
This course provides individual and team-oriented design experiences that expand upon and combine intellectual and manual skills required for the practice of industrial design. Intermediate level integration of computer technology, including 3D digital modeling, rapid prototyping, interactive virtual product visualization. Emphasis on identifying and solving design problems through manipulation of design theory, ecological/environmental concerns, advanced materials and manufacturing techniques.
Prerequisite: ID 202 and ID 255 and ID 240; Corequisite: ID 340
Typically offered in Fall only

ID 302 Industrial Design Studio IV  (6 credit hours)
This course provides individual and team-oriented design experiences that expand upon and combine intellectual and manual skills required for the practice of industrial design. Continuity and increased complexity of project categories from the previous semester, developed through advanced use of digital technology. Emphasis is placed on identifying and solving design problems through manipulation of design theory, application of human factors, product safety awareness, universal design principles and digital presentation of concepts.
Prerequisite: ID 301; Corequisite: ID 440
Typically offered in Spring only

ID 310 Advanced Digital Techniques  (3 credit hours)
Methods and techniques for developing 3D digital models and animations that are compelling, unique, and relevant in the creative process of Industrial Design. Students begin to strategically integrate 3D digital technology as part of the larger curriculum relative to studios and support classes and are encouraged to look beyond current conventions to find new means of creating digital artifacts.
Prerequisite: ID 210
Typically offered in Fall only

ID 316 Visualization II  (3 credit hours)
This course expands the ideation process of conceiving, developing and recording ideas two-dimensionally, placing greater emphasis on the creative development and recording of the design process.
Prerequisite: ID 216; Corequisite: ID 310
Typically offered in Spring only

ID 340 Research Methods in Industrial Design  (3 credit hours)
This class provides an overview of the role of human centered design research throughout the stages of the design process. Students will use primary and secondary sources to place people at the center of the design inquiry process and gain insights about
Prerequisite: ID 240 and ID 202; Corequisite: ID 301
Typically offered in Fall only
**ID 401 Advanced Industrial Design Studio I** (6 credit hours)
This course is an advanced studio experience that expands upon the intellectual, digital, and practical skills required of an industrial design practitioner. Emphasis on identifying and solving design problems through manipulation of design theory, application of human factors, product safety awareness, appropriate combination of materials and manufacturing techniques, and presentation of concepts.

Prerequisite: ID 302 and ID 440
Typically offered in Fall only

**ID 402 Advanced Industrial Design Studio II** (6 credit hours)
This course is the second advanced studio that expands upon and combine the intellectual, digital, and practical skills required of an industrial design practitioner. This is a capstone experience where the outcomes, in the form of product proposals, reflect synthesis of design research, problem framing, and solution of complex design problems. Students achieve these outcomes through as mastery and manipulation of design theory, the application of human factors, an awareness of product safety, and appropriate combination of materials and manufacturing techniques. An emphasis is placed on the presentation and communication of processes and concepts.

Prerequisite: ID 401
Typically offered in Spring only

**ID 440 Experience Design for ID** (3 credit hours)
This course explores the theory and practice of the user-experience (UX) development process in the context of Industrial Design (ID). Students will clearly identify principles and professional processes for research, development, documentation and implementation of various stages of work, including requirements analysis, user needs analysis, prototyping, mockups, and production as these relate to industrial design best practices.

Prerequisite: ID 301 and ID 340; Corequisite: ID 302
Typically offered in Spring only

**ID 490 Industrial Design International Studio** (6 credit hours)
Define industrial design problems and develop design solutions in an international setting. Studio projects related to design, culture, and traditional and contemporary limited and mass produced products. Focus on artifact making through directed studies. Industrial Design Majors, and Department approved Elective (“swing”) Studio for all other College of Design Majors with Junior or Graduate standing in Major.

Prerequisite: Junior standing in Major, Approval of Study Abroad Office
Typically offered in Summer only

**ID 492 Special Topics in Industrial Design** (1-3 credit hours)
Topics of current interest in Industrial Design. Normally used to develop new courses. Industrial Design Majors, and Department approved Elective for all other College of Design Majors with Junior, Senior or Graduate standing in Major.

Junior standing or above
Typically offered in Fall, Spring, and Summer

**ID 494 Internship in Industrial Design** (1-6 credit hours)
Supervised field experience in product design offices, galleries, museums and other related organizations. Maximum of 6 credit hours. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: Junior standing, 3.0 GPA or better. Instructor Consent.
Typically offered in Fall, Spring, and Summer

**ID 495 Independent Study in Industrial Design** (1-3 credit hours)
Special projects in industrial design developed under the direction of a faculty member on a tutorial basis. Maximum 6 credit hours - May be repeated. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolle

Prerequisite: Junior standing in Industrial Design and 3.0 GPA or better. Instructor Consent.
Typically offered in Fall, Spring, and Summer

**ID 500 Advanced Industrial Design (Series)** (6 credit hours)
Advanced studies in industrial design. Special emphasis given to problem identification, program formulation and application of advanced design methods. All problems of an individual nature leading to a synthesis of previous design experience.

Prerequisite: Portfolio review
Typically offered in Fall and Spring

**ID 511 Industrial Design Materials and Processes I** (3 credit hours)
Analysis of paper, wood, metal and manufacturing processes utilized in production of mass-produced products. Advanced studies in mass production processes and their influence on design and development of products. Emphasis on material search and process selection in relation to product safety, cost, function, human factors, form, finishes and joining methods.

Prerequisite: Graduate standing
Typically offered in Spring only

**ID 512 Industrial Design Materials and Processes II** (3 credit hours)
Analysis of plastics and rubber and related manufacturing processes utilized in production of mass-produced products. Advanced studies in mass production processes and their influence on design and development of products. Emphasis on material search and process selection in relation to cost, product safety, function, human factors, form, finishes and joining methods.

Prerequisite: Graduate standing
Typically offered in Fall only

**ID 581 Industrial Design Project Preparation** (3 credit hours)
A seminar course designed to assist students in preparing groundwork for the final project to be conducted in design studio.

Prerequisite: Graduate standing
Typically offered in Fall only

**ID 582 Special Topics In Industrial Design** (1-6 credit hours)
F.S. Topics of current interest to program/option offered by faculty in the School. Subjects offered under this number normally used to test and develop new courses.

Prerequisite: Graduate standing
Typically offered in Fall and Spring
Integrated Manufacturing Systems (IMS)

IMS 675 Manufacturing Systems Engineering Project (1-6 credit hours)
Individual or team project work in integrated manufacturing systems engineering resulting in an engineering report. Required of all degree candidates in IMSE master's program. Forms the basis for IMSE student's final oral examination.

Prerequisite: Graduate standing in IMSE
Typically offered in Fall, Spring, and Summer

IMS 680 Master's Directed Study (1-3 credit hours)
Independent study providing opportunity for individual students to explore topics of special interest under direction of a member of faculty.

Prerequisite: Graduate standing in IMSE
Typically offered in Fall, Spring, and Summer

IMS 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

IMS 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

IMS 696 Summer Project Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to project research.

Typically offered in Summer only

Interdisciplinary Perspectives (IPGE)

IPGE 295 Interdisciplinary Perspectives Special Topics (2-3 credit hours)
Special Topics course offered on a trial basis for the General Education Interdisciplinary perspectives category. Offered for a letter grade.
Interdisciplinary Perspectives and Global Knowledge (IPGK)

IPGK 295 Interdisciplinary Perspectives and Global Knowledge Special Topics (2-3 credit hours)
Special topics course offering for the general education Interdisciplinary Perspectives and Global Knowledge categories. This course may be used for the Global Knowledge (GK) co-requisite and/or for the Interdisciplinary Perspectives (IP) requirement.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

Interdisciplinary Perspectives and U.S. Diversity (IPUS)

IPUS 295 Interdisciplinary Perspectives and U.S. Diversity Special Topics (2-3 credit hours)
Special topics course offering for the general education Interdisciplinary Perspectives and U.S. Diversity categories. This course may be used for the U.S. Diversity (USD) co-requisite and/or for the Interdisciplinary Perspectives (IP) requirement.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

Interdisciplinary Studies (IDS)

IDS 201 Environmental Ethics (3 credit hours)
Interdisciplinary consideration of ways in which field of study coupled with personal/cultural values contribute towards either solving or compounding environmental problems; provides framework for process of making ethical decisions.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

IDS 210 Introduction to American Studies (3 credit hours)
Introduction to the interdisciplinary study of American culture through exploration of questions asked and methods used in the field of American Studies. Will incorporate historical, literary, anthropological, and cultural studies approaches and methods for studying culture through texts, objects, and people. Topics to be considered include literary and popular texts, music, clothing, and historical and contemporary American experiences and cultures. Includes one field trip for which students will need to provide their own transportation.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Spring only

IDS 211 Eating through American History (3 credit hours)
Examination of cultural and scientific forces that have shaped our relationship with food. Science and politics of dietary recommendations. Influence, over time, of economic, social and political conditions on food preparation, preference and nutritional knowledge. Role of religion, family, tradition and personal experience in shaping eating attitudes and behaviors. Roles played only by women in American food culture.

GEP Interdisciplinary Perspectives
Typically offered in Fall only

IDS 220 The Science and Art of Happiness (3 credit hours)
Interdisciplinary inquiry into the nature of happiness; why it matters, how to promote it, and what harms it. The relevance of the body-mind connection for one's happiness. Current scientific insights into happiness from physiology, neuroscience, and psychology, as well as their connections to Aristotelian ethics and to the concept of suffering in Buddhism. Experiential component of the course consisting of scientifically supported techniques for daily practice for deepening the understanding of course materials and discussions.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Summer only

IDS 295 Special Topics in Interdisciplinary Studies (1-12 credit hours)
Detailed investigation of an interdisciplinary topic. Topic and mode of study to be determined by faculty member and/or teach team.

Typically offered in Fall, Spring, and Summer

IDS 303/NR 303 Humans and the Environment (3 credit hours)
Interactions among human populations in the biophysical system and the environment. Emphasis on current issues, ecological principles and their relationships to basic biophysical processes; considers food, population dynamics, public land and common resources, renewable natural resources, pollution, water resources, energy and non-renewable resources.

GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

IDS 310 Animals in the Global Community (3 credit hours)
A lecture/seminar exploring the interdisciplinary field of Human Animal Studies in a global context, examining cultural, economic, ethical, ecological, geographical, political, and psychological aspects of human/nonhuman interactions using readings, films, and guest lectures. E.g. what are global ecological/political ramifications of treating cattle as sacred versus breeding them for beef? Why are there more tigers in captivity than in the wild? What are our ethical obligations to the Great Apes? Concepts such as place and placelessness, boundaries, animals as refugees, and interspecies justice will be explored. Course includes team work, and a research project focusing on personal area of interest. Junior Standing or higher.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall only

IDS 490 Interdisciplinary Methods and Issues (3 credit hours)
Capstone seminar for students in the IDS self-design major. Intensive study of student's area of concentration, leading to a major research paper.

Prerequisite: Interdisciplinary Studies Self-Design Majors, Senior standing
Typically offered in Fall and Spring

IDS 495 Special Topics in Interdisciplinary Studies (1-12 credit hours)
Examination of selected topics of an interdisciplinary nature.

Typically offered in Fall and Spring
International Studies (IS)

IS 200 Introduction to International Studies (3 credit hours)
Introductory analysis of the diverse processes of globalization, and an interdisciplinary survey of the social, political, economic, and cultural patterns reflected in the interrelations between various regions of the world. Emphasis on the historical and cultural contexts of debates in current global issues. A foundation course for students preparing an International Studies major or minor.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

IS 250 Globalizing North Carolina (3 credit hours)
Examines from an anthropological and historic perspective the impact of transnational and global forces on specific communities in North Carolina post World War II. Emphasis placed on studying the consequences of urban growth and economic shifts away from the agricultural and manufacturing industries and toward financial services, scientific and technological research, and the knowledge-based industries. Consequences include increased infrastructural demands, environmental issues, increased income and educational inequalities, food production, socio-cultural clashes, and migration and immigration concerns. Course requires students to visit 1 to 2 museums outside of class times.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

IS 393 Theories of Globalization (3 credit hours)
This course offers an in-depth and interdisciplinary examination of various aspects of globalization including economics, human dimensions of environmental change, culture, ethics and power. The course aims to build student understanding of the relationship between theory and application in the field of international studies. This course is designed for international studies minors, as well as majors who are expected to bridge between introductory materials and capstone coursework. Restriction: Minimum of 45 credit hours complete; IS majors and minors only

Prerequisite: IS 200
Typically offered in Fall and Spring

IS 395 Special Topics in International Studies (1-3 credit hours)
Typically offered in Fall, Spring, and Summer

IS 471/IS 571/ANT 571/ANT 471 Understanding Latino Migration (3 credit hours)
This collaborative, hands-on class examines what ultimately drives migration and how families, communities, and policy-makers respond to migration in ways that can keep the process going. Focusing on emigration from Mexico, Guatemala, Honduras, and El Salvador, the course reviews the historical foundation for today's migration with attention to migration to North Carolina.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Social Sciences
Typically offered in Summer only

IS 491 Senior Seminar in International Studies (3 credit hours)
An intensive study of selected international issues, global dimensions and implications, leading to a major research paper.

Prerequisite: IS 393
Typically offered in Fall and Spring

IS 571/ANT 571/IS 471 Understanding Latino Migration (3 credit hours)
This collaborative, hands-on class examines what ultimately drives migration and how families, communities, and policy-makers respond to migration in ways that can keep the process going. Focusing on emigration from Mexico, Guatemala, Honduras, and El Salvador, the course reviews the historical foundation for today's migration with attention to migration to North Carolina.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Social Sciences
Typically offered in Summer only

International Studies (MIS)

MIS 598 Special Topics in International Studies (1-6 credit hours)
In-depth investigation of a contemporary topic in the field of international studies in a class context. Topic and mode of instruction to be determined by faculty member. May be taken for up to six hours of credit.

Prerequisite: Advanced Undergraduate standing, PBS status, or Graduate standing
Typically offered in Fall, Spring, and Summer

MIS 601 Colloquium in International Studies (3 credit hours)
Selected topics in international studies required for writing and oral presentation of MIS capstone paper.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

MIS 630 Independent Study (1-3 credit hours)
Investigation of topics of particular interest to advanced students under faculty direction on a tutorial basis. Credits and content vary with student/faculty discretion and needs.

Restricted: MIS Students Only
Typically offered in Fall, Spring, and Summer
MIS 651 Internship in International Studies (1-6 credit hours)  
Exposure of student to value systems and technological environment of cultures other than his/her own through a supervised work experience. Application of technological knowledge to development problems. Required technical paper summarizing and analyzing.

Prerequisite: MIS standing
Typically offered in Fall, Spring, and Summer

MIS 685 Master's Supervised Teaching (1-3 credit hours)  
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

MIS 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)  
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall and Spring

MIS 690 Master's Examination (1-9 credit hours)  
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall and Spring

Landscape Architecture (LAR)

LAR 200 Landscape Architecture Introductory Studio (6 credit hours)  
Small scale landscape architectural design. Site observation exercises and visits, physical design projects, reading and discussion. Basic skills in landscape architecture, discerning the environmental issues in design, understanding design process, drawing and verbally communicating issues, and idea conceptualization and realization.

Prerequisite: Design Majors and D 104
Typically offered in Fall only

LAR 210 Digital Drawing for Landscape Architecture (3 credit hours)  
Digital modeling and computer aided design in landscape architecture. Integration of digital data in visualization of past, existing and future designs.

Prerequisite: LAR Majors
Typically offered in Fall only

LAR 211 Digital Design Media for Landscape Architecture (3 credit hours)  
Principles and practices related to the use of digital applications in landscape architectural design. Includes two-dimensional raster imaging, vector graphics, photo simulation, and three-dimensional modeling.

Prerequisite: LAR Majors
Typically offered in Spring only

LAR 221 Introduction to Environment and Behavior for Designers (3 credit hours)  
Integration of behavioral and environmental systems related to design. Exploration of humane, ecologically sound design alternatives.

GEP Humanities
Typically offered in Summer only

LAR 222 Perception and Behavior for Designers (3 credit hours)  
Perceptual systems, linkages among them, and linkages between them and language and culture as these affect the design process.

Typically offered in Spring only

LAR 292 Special Topics in Landscape Architecture (1-3 credit hours)  
Topics of current interest in Landscape Architecture. Normally used to develop new courses.

Typically offered in Fall, Spring, and Summer

LAR 400 Landscape Architecture Studio (6 credit hours)  
Projects cover small scale design, urban landscapes, community design, and environmental management. Design process stressed, including attention to project organization, design synthesis and realization.

Prerequisite: D 105, LAR 200; or Departmental Head Approval
Typically offered in Spring only

LAR 430 Site Planning (3 credit hours)  
Technical operations and environmental landscape controls for site development. Site analysis, grading and drainage, earthwork, horizontal and vertical control for road alignment. Graphic exercises.

Prerequisite: LAR 400 or LAR 501
Typically offered in Spring only

LAR 444 History of Landscape Architecture (3 credit hours)  
The history of designed landscapes. Environmental, social and cultural factors which influence human made landscapes presented with history and art of landscape architecture.

GEP Visual and Performing Arts
Typically offered in Fall only

LAR 457 Landscape Construction Materials, Methods and Documentation (3 credit hours)  
Materials, standards, and construction methods used to implement landscape architectural designs. Development of construction documents.

Prerequisite: LAR 400 or LAR 501
Typically offered in Spring only

LAR 465 Landscape Architecture International Studio (6 credit hours)  
Define landscape architectural problems and develop design solutions in an international setting. Exercises and projects related to design, culture and the physical environment of the host country. Focus on landscape architecture, gardens and urbanism studied through sketching and documentation, discussion, site investigation, historical context, current design examples and design applications.

Prerequisite: Junior Standing in the College of Design and Approval of the International Study Abroad Office.
Typically offered in Spring only
LAR 492 Special Topics in Landscape Architecture (1-3 credit hours)
Topics of current interest in Landscape Architecture. Normally used to develop new courses.

**Typically offered in Fall, Spring, and Summer**

LAR 495 Independent Study in Landscape Architecture (1-3 credit hours)
Individual projects in landscape architecture developed under the direction of a faculty member on a tutorial basis. Individualized/Independent Study and Research courses require a “Course Agreement for Students Enrolled in Non-Standard Courses” be c

Prerequisite: Junior standing in Landscape Architecture 3.0 GPA or better

**Typically offered in Fall, Spring, and Summer**

LAR 500 Landscape Design Studio (6 credit hours)
Application of information and skills developed in course work to environmental design problems. Process of site selection, activity programming, site planning and program evaluation followed employing creation of interactive communication systems between designer, clients and users. Goals include design of satisfying new landscapes as well as conservation and design strategies for existing culturally important landscapes and townscapes.

Prerequisite: Graduate standing

**Typically offered in Fall and Spring**

LAR 501 Landscape Architecture Introduction Design Studio (6 credit hours)
Introduction to landscape architectural design thinking processes and applications that include: site analysis, post occupancy user studies, programming, site planning, graphic representation (drawing, model making, digital graphics), verbal communication, and criticism and reflection.

**Typically offered in Fall only**

LAR 502 Site Design and Environmental Planning Studio (6 credit hours)
Strategies, principles, and methods for designing and evaluating resilient ways and means to fit an intensive development program(s) on environmentally challenging, regionally specific sites. This design studio is integrally linked with courses LAR 527- Landform, Grading and Environmental Site Systems and LAR 520- Environment and Culture.

Prerequisite: LAR 501

**Typically offered in Spring only**

LAR 503 Landscape Architecture Design Development & Construction Documentation Studio (6 credit hours)
Site planning design refinement from conceptual schematic design through to the preparation of technical landscape architectural construction plans and details.

Prerequisite: LAR 501 and LAR 502 or permission of Department Head of DGP

**Typically offered in Fall only**

LAR 504 Landscape Architecture International Design Studio (6 credit hours)
Application of design thinking processes in landscape architectural design situations resident within a host international urban venue. This is a studio course for Landscape Architecture students studying abroad.

Prerequisite: LAR 501 and LAR 502 and LAR 503 or department head or DGP consent.

**Typically offered in Fall only**

LAR 505 Landscape Architecture Final Project Studio (6 credit hours)
Individual semester long projects demonstrating capabilities in a full range of design and production skills.

**Typically offered in Fall and Spring**

LAR 506 Landscape Architecture Design + Build Studio (6 credit hours)
Design and construction implementation of sustainable construction practices for a low impact landscape system installation that responds to degraded environmental conditions.

Prerequisite: LAR 501 and LAR 502 and LAR 503 or department head or DGP consent.

**Typically offered in Spring only**

LAR 507 Advanced Topics Studio in Landscape Architecture and Environmental Planning (6 credit hours)
Advanced engagement, emphasizing research, development and application of experimental and best practices, on current and emerging landscape architectural and environmental planning topics of increased complexity. Advanced Topics Studios in LA and Env Plng integrate, apply, and reinforce materials including history and theory, site works, modeling and representation, research methods, environmental analysis, and professional practice delivered in LAR subject area courses.

Prerequisite: LAR 501 and LAR 502 and LAR 503 or department head or DGP consent.

**Typically offered in Fall and Spring**

LAR 508 Landscape Architecture Design Research Project (6 credit hours)
Independent research in a specific area of landscape architectural design with the requirement that the research be integrated and applied within a landscape architectural design context; provides opportunities for a student or team of students (up to 4 people) to engage in independent inquiry leading to the completion of a definitive scholarly, research-oriented landscape architectural design project. Requires consent of department head or DGP.

Prerequisite: LAR 507 and LAR 541 and LAR 697 or department head consent.

**Typically offered in Fall, Spring, and Summer**

LAR 509 Landscape Architecture Design Fundamentals (3 credit hours)
Introduction to the language, topics, and processes associated with landscape architectural design and the means used to envision and transform ideas into physical form in the landscape.

**Typically offered in Summer only**
LAR 510 Introduction to Landscape Architectural Drawing Applications (3 credit hours)
Introduction to fundamental drawing principles and methods utilized in landscape architectural design and representation applications. Topics covered include: freehand sketching, field observation diagrams and sketches, freehand and constructed perspectives, plan and section view drawings, shade and shadow, color, design process drawings, and presentation layout.

Typically offered in Summer only

LAR 513 Landscape Architecture Digital Media 1 (3 credit hours)
Introduction to the principles and practices related to the use of 2D and 3D digital media in landscape architectural design representation and communication applications.

Typically offered in Summer only

LAR 514 Landscape Architecture Digital Design Media 2 (3 credit hours)
Digital modeling and representation methods, applications and production using two and three-dimensional digital design media; this course is integrally linked with LAR 501, Landscape Architecture Introduction Design Studio.

Prerequisite: LAR 513 or instructor or department head, or DGP consent

Typically offered in Fall only

LAR 515 Advanced Landscape Architecture Digital Design Media (3 credit hours)
Advanced digital media tools and techniques to create and refine routines used in landscape architectural modeling and representation applications.

Prerequisite: LAR 513 and LAR 514 or consent of Department Head or DGP.

Typically offered in Fall only

LAR 517/GIS 517 GIS Applications in Landscape Architecture and Environmental Planning (3 credit hours)
Introduction to the methods and applications of geographic spatial modeling technology in landscape architecture and environmental planning.

Typically offered in Fall only

LAR 520 Environment and Culture (3 credit hours)
An integrative approach to human and natural systems, specifically the dynamic social and ecological forces that act upon, modify, and give meaning to landscapes.

Typically offered in Fall only

LAR 521 Values, Theory and Methods of Landscape Architecture (3 credit hours)
Radical change in profession of landscape architecture in the past decade. New and emerging roles for landscape architect include regional analysis, landscape assessment, land development, urban planning, recreation planning, etc. Development of core values and theories from which each emerged and survey of the techniques and methods of their development.

Prerequisite: Graduate standing

Typically offered in Fall only

LAR 523 Landscape Architecture Plant Identification (2 credit hours)
Introduction to the vocabulary and methods necessary to identify ornamental and native plants in the built and natural landscape. The course is structured around the understanding of the taxonomic tools necessary to identify plants.

Typically offered in Summer only

LAR 524 Planting Design Applications in Landscape Architecture (2 credit hours)
Introduction to theories, practices, and implications associated with the diverse uses of plants in landscape architectural design applications considerate of functional, ecologic, aesthetic, economic, maintenance, health, safety, welfare, and other factors.

Prerequisite: LAR 501 and LAR 502 or permission of Department Head of DGP.

Typically offered in Summer only

LAR 525 Landscape Architecture Field Studies (3 credit hours)
On-site observation and assessment of constructed landscape architectural projects focused on historic and contemporary design practices that promote environmental health, safety, wellbeing, and beauty through industry defined practices.

Typically offered in Fall only

LAR 527 Landform, Grading, and Environmental Site Systems (3 credit hours)
Introduction to landform representation, grading, environmental site systems, and best practices required in landscape architectural site design and environmental planning applications.

Prerequisite: LAR 501 and LAR 513 or consent of instructor or department head or DGP.

Typically offered in Spring only

LAR 528 Landscape Architecture Construction Materials and Methods (3 credit hours)
Introduction to landscape architectural construction materials, methods, documentation, and implementation practices including best professional practices, and current and emerging technologies.

Prerequisite: LAR 501 and LAR 502 and LAR 527 or permission of department head or DGP.

Typically offered in Summer only

LAR 534 Landscape Architecture Theory and Criticism (3 credit hours)
Introduction to the pervasive principles, concepts, movements, and applications influencing landscape architectural planning and design.

Prerequisite: LAR 501 and LAR 502 and LAR 520 or consent of Department Head or DGP.

Typically offered in Fall only

LAR 535 Environmental Social Equity and Design (3 credit hours)
Principles of environmental justice and social equity in the context of design and community engagement; focus on the trends affecting environmental and human health in the built environment.

Typically offered in Spring only
LAR 540 Research Methods in Landscape Architecture and Environmental Planning (3 credit hours)
An overview of the role of research in landscape architecture and environmental planning with introductions to systematic inquiry that help to understand the complex relationships between people and their environment. The course explores different tools.

Typically offered in Fall only

LAR 542 Human Use of the Urban Landscape (3 credit hours)
Urban environment-behavior field research methods at site planning scale (behavior and cognitive mapping, interview and survey methods, archival research), suitable for application in practice. Methods of integrating user needs into design programming using participatory approaches. Evidence-based design applied to residential neighborhood, health, education, and recreation settings. Research activities conducted in small groups. No required texts. Overnight, weekend field trip at student expense.

R: Masters students at NCSU, UNC-CH, or Duke University. Upper level undergraduate students are allowed with permission of the instructor.

Typically offered in Spring only

LAR 543 Landscape Performance and Metrics (3 credit hours)
Concepts, tools and methods, and research to measure and integrate considerations of landscape performance including environmental, economic/life cycle, management, social, and aesthetic factors in landscape architectural applications.

Typically offered in Spring only

LAR 544 Contemporary Issues in Landscape Preservation (3 credit hours)
An examination of how local governments organize themselves to deal with the conservation and protection of areas of acknowledged cultural value or scenic/aesthetic character as well as the respective roles of federal, state, and local governments in these efforts. Particular attention will be given to understanding the recent past in preservation efforts.

Typically offered in Fall only

LAR 545 City Planning and Design - Building Great Communities (3 credit hours)
This course explores the history and heritage of city planning and design in an ever-urbanizing world, the legal underpinning and practice of the tools of planning in the US - comprehensive planning, zoning, infrastructure planning and design guidelines, environmental and social challenges for an urban planet, and the procurement of planning and design services, both from the perspective of the hiring entity as well as from that of the consultant.

Typically offered in Spring only

LAR 546 The Landscape Imperative (3 credit hours)
Exposure to the complex interrelationships of demographics, resource stewardship and land development in terms of the issues, questions, challenges and opportunities for landscape architects and urban designers.

Typically offered in Spring only

LAR 547 Greenway Planning and Design (3 credit hours)
Exposure to complex interrelationships in the planning, design, development and operations of greenway corridors and systems, including natural systems evaluation, community planning, public engagement, preparation of construction documents, construction administration, business practices, regulatory issues, legal framework, programming and funding.

Typically offered in Fall only

LAR 550 Landscape Architecture Professional Practice (3 credit hours)
Exposure to the range of practice opportunities in landscape architecture with an overview of career opportunities in the public (Federal, State, and Local) and private sectors as well as in non-traditional and emerging roles.

Typically offered in Spring only

LAR 555 International Landscape Architecture Design Studio (6 credit hours)
Landscape architectural problems and design solution in international setting. Exercises and projects related to design, culture and physical environment of host country. Focus on landscape architecture, gardens and urbanism through sketching and documentation, discussion, site investigation, historical context, current design examples and design applications.

Prerequisite: Graduate standing the College of Design and approval of the International Study Abroad Office

Typically offered in Fall only

LAR 565 Special Topics In Landscape Architecture (1-6 credit hours)
Topics of current interest to programs in School of Design offered by faculty in the School. Subjects offered under this number are normally used to test and develop new courses.

Prerequisite: Graduate standing

Typically offered in Fall and Spring

LAR 630 Independent Study (1-3 credit hours)
Special problems in various aspects of design developed under direction of a faculty member on a tutorial basis.

Prerequisite: Graduate standing

Typically offered in Fall, Spring, and Summer

LAR 650 Internship in Landscape Architecture (3 credit hours)
Supervised field experience in a professional landscape architecture office, related design office, or governmental agency.

Prerequisite: LAR 501 and LAR 502 and LAR 503 or department head or DGP consent.

Typically offered in Fall, Spring, and Summer

LAR 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student

Typically offered in Fall and Spring
LAR 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.
Prerequisite: Master's student
Typically offered in Fall and Spring

LAR 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.
Prerequisite: Master's student
Typically offered in Fall and Spring

LAR 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

LAR 696 Summer Thesis Res (1 credit hours)

LAR 697 Design Research Project Independent Study (3 credit hours)
Advanced Independent study under taken by 1-4 students leading to the preparation of the Project Proposal, as a prerequisite for undertaking LAR 508-Design Research Project. (Permission to proceed with LAR 697 requires approval by department head or DGP and faculty mentor.)
Prerequisite: LAR 540 or approval from Department Head or DGP.
Typically offered in Fall, Spring, and Summer

LAR 896 Summer Dissert Res (1 credit hours)

Leadership in the Public Sector (LPS)

LPS 200 Introduction to Public Leadership (3 credit hours)
This introductory course is designed for students who are interested in exploring public sector leadership. It starts with acquainting how to conduct adequate academic research for studying leadership. Covering fundamental concepts and assumptions of leadership, it will focus on necessary skills and approaches for good public and non-profit sector leadership. The course will also address contemporary e-government practices and the role of information technology in the public sector.
Typically offered in Fall, Spring, and Summer

LPS 201 The Humanitarian Response to Conflict (3 credit hours)
LPS 201 offers up an introduction to the ideals and paradoxes of humanitarian intervention, with a special emphasis on military responses to humanitarian crises. This course explores the history, animating ideals and contemporary paradoxes of humanitarian action and related military interventions. Throughout history and ever increasingly in the present, there is an intersection between military and humanitarian operations in conflict zones.
Typically offered in Fall only

LPS 202 Essentials of Fundraising for Leaders in Public and Non-Profit Institutions (3 credit hours)
The course covers the basics of fundraising for public and non-profit agencies which include the agencies history, board development, event planning, and the motivation of the giver. In addition, the students will learn the elements of grant proposals related to public sector agencies. The work will include case studies, weekly lectures, discussion assignments, final exam and a special event planning proposal.
Typically offered in Fall only

LPS 205 International Leadership for the Public Sector (3 credit hours)
Typically offered in Fall only

LPS 210 LPS Career Development (1 credit hours)
This course is designed for senior status LPS students who are considering a career change and are interested in exploring job opportunities related to the public sector field. Students will learn about their personal strengths, values, skills, and understand how these self-assessments will affect their career choices. Explorations of these areas include specific emphasis on developing and refining interviewing skills, professional and personal networks, and job application and selection.
Restriction: LPS Senior Status Only
Typically offered in Spring only

LPS 302 Diversity and Leadership in the Public Sector (3 credit hours)
This course provides students with information regarding diversity and leadership in history as well as material and activities that foster an understanding of how diversity and leadership intersect in the public sector and how diversity can improve org

GEP U.S. Diversity
Typically offered in Fall and Spring

LPS 315 Public Leadership (3 credit hours)
Nature and varieties of political leadership by elected and appointed officials in government, officials and volunteers in nonprofit organizations, and leaders of political movements and community groups. The course draws on literature in political science, self-assessment of student's leadership characteristics, and examination of outlets for political leadership activity.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer
LPS 320 Research Methodology for the Public Sector (3 credit hours)
This course will teach students to investigate political and policy related questions in a systematic and scientifically rigorous fashion. Students will become familiar with the basic toolkit of social science methodology, practice basic data analysis, and develop a research project. They will acquire the skills essential for evaluating the claims of others and for advancing sound arguments of their own. This knowledge is applicable in a wide variety of organizational research, needs assessment, program and performance evaluation.

Typically offered in Fall, Spring, and Summer

LPS 398 Special Topics in Leadership in the Public Sector (3 credit hours)
For topics not part of regular course offerings, or offering of new courses on a trial basis. May be taken up to three times provided the topics are different.

Typically offered in Fall, Spring, and Summer

LPS 400 Advanced Military Leadership Theory (3 credit hours)
Advanced Military Leadership Theory (AMLT) is a challenging course that will study, practice, and apply the fundamentals of leadership, values and ethics, personal development, decision-making, influencing and motivating others and team tactics in problem solving and mission accomplishment. Especially military officers enrolled in the LPS program will gain immediate benefit from the leadership self-assessments and new leadership strategies.

Typically offered in Fall and Summer

LPS 425 Leadership in the Public & Nonprofit Sectors Capstone (3 credit hours)
Leadership is a critical topic in public, nonprofit, and business administration. Leadership is what we expect of U.S. presidents, association directors, and CEOs, as well as of mid-level and frontline supervisors. Clearly, leaders are awarded the accolades when the organization succeeds and given the blame for its failures. But organizations succeed not just because of the top leader's actions; a positive leadership climate that pervades the organization helps it to learn, adapt, and perform at a high level. Only LPS major students must complete LPS 200 Introduction to Public Leadership course prior to enrolling in LPS 425.

Prerequisite: LPS Majors need to have passed LPS 200

Typically offered in Spring only

LPS 490 Undergraduate Internship in Leadership in the Public Sector (1-3 credit hours)
Students can earn 1-3 credits for completing internships in the public sector or non-profit agencies. Emphasis is placed on gaining work experience needed to explore and plan careers in the public and non-profit sector. Students must prepare an intern

Prerequisite: LPS 200

Typically offered in Fall, Spring, and Summer

Liberal Studies (MLS)

MLS 501 Seminar In Liberal Studies (3 credit hours)
Intensive study of an interdisciplinary issue or area. Seminars, varying each semester, address such topics as arts studies, history and literature, sociobiology and social sciences, world trade and world conflict, and technology and social change.

Prerequisite: Admission to M.A. in liberal studies

Typically offered in Fall, Spring, and Summer

MLS 630 Independent Study (1-3 credit hours)
Advanced independent study of an interdisciplinary topic under supervision of a faculty member.

Prerequisite: Admission to M.A. in liberal studies

Typically offered in Fall, Spring, and Summer

MLS 676 Independent Project (1-3 credit hours)
Advanced independent research on an interdisciplinary project under supervision of a faculty member.

Prerequisite: Admission to M.A. in liberal studies

Typically offered in Fall, Spring, and Summer

MLS 685 Master’s Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master’s student

Typically offered in Fall, Spring, and Summer

MLS 690 Master’s Examination (1-9 credit hours)
For students in non thesis master’s programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master’s student

Typically offered in Fall, Spring, and Summer

Life Sciences First Year (LSC)

LSC 101 Critical and Creative Thinking in the Life Sciences (2 credit hours)
Through case studies and discussion-based classes, this course guides students through a metacognitive approach to (1) critical and creative thinking, (2) the nature and practice of science, (3) the rhetoric of science, and (4) the process of learning. This course will challenge students to apply the standards of critical and creative thinking in critiquing their own work and the work of others; guide students to an understanding and appreciation of the rhetoric of science; help students gain an understanding of fundamental principles of the nature and conduct of science within the life science disciplines; and encourage students to become active, engaged learners through an understanding of effective approaches to learning with an emphasis on the neurobiology of learning. Incoming freshmen admitted to the Life Sciences First Year Program (will open available seats to other FR in the spring semester section).

GEP Interdisciplinary Perspectives

Typically offered in Fall, Spring, and Summer
LSC 103 Exploring Opportunities in the Life Sciences (1 credit hours)
The overarching goal of this course is to help students create a solid foundation on which they can build to enhance their success in college and especially in their studies within the life sciences. Students will be challenged to think intentionally about how they will approach learning inside and outside the classroom and what factors might influence their college experience. Through this course, students will think about their transition from high school to college; identify campus resources and explore academic policies; research potential majors in the life sciences and potential minors; attend and reflect upon cultural and educational events across campus; and create a "plan for success" for their time at NC State. Cannot get credit for both LSC 103, and BCH 103, or MB 103, or PB 103. Restricted to incoming freshmen admitted to the Life Sciences First Year Program.

R: 11LSFY or 17LSFY
Typically offered in Fall and Spring

LSC 170 First Year Seminar in the Life Sciences (1 credit hours)
Topical problems in the life sciences. LSC 170 provides an opportunity for LSFY students to work in a small group setting with a faculty member to explore a topic within the faculty member’s area of expertise. Emphasis will be placed on active, collaborative learning; effective communication skills; higher order cognitive skills; and applying the intellectual standards of critical thinking. Topics and instructors will vary from section to section and from semester to semester. Students can repeat LSC 170 once as long as the two sections are on different topics.

R: 11LSFY or 17LSFY
Typically offered in Fall and Spring

LSC 205 Class Assistant Experience (1 credit hours)
LSC 205 provides an opportunity for students to gain experience as Class Assistants within the Life Sciences First Year Program and to reflect on that experience as it relates to their own college experiences, personal growth, and professional development. Expectations, to be detailed in the LSC 205 contract, will include attendance at all LSC 205 class meetings, attendance at all class meetings of the section for which you are working as Class Assistant, and completion of written reflection assignments. Instructor consent required.

Typically offered in Fall only

LSC 295 Special Topics in Life Science (1-3 credit hours)
New courses offered on a temporary or trial basis for Life Sciences First Year students.

R: 11LSFY or 17LSFY
Typically offered in Fall, Spring, and Summer

Logic (LOG)

LOG 201 Logic (3 credit hours)

GEP Mathematical Sciences
Typically offered in Fall and Spring

LOG 335/MA 335 Symbolic Logic (3 credit hours)
Intermediate level introduction to modern symbolic logic focusing on standard first-order logic; topics include proofs, interpretations, applications and basic metalogical results.

Prerequisite: LOG 201 or MA 225 or CSC 226
GEP Mathematical Sciences
Typically offered in Fall only

LOG 430 Varieties of Logic (3 credit hours)
Study of various non-classical logics such as modal logic, many-valued logic, paraconsistent logic, second-order logic, and intuitionistic logic. Emphasizes their applications in fields such as philosophy, linguistics, mathematics, computer science, and artificial intelligence. Students cannot receive credit for both LOG 430 and LOG 530.

P: LOG 201 or LOG 335 or MA 335 or MA 225 or CSC 226
Typically offered in Spring only

LOG 435 Advanced Logic & Metamathematics (3 credit hours)
Advanced topics in logic and metamathematics: proof procedures, first-order theories, soundness and completeness theorems, recursive functions, the formalization of arithmetic, the Goedel Incompleteness Theorems. Emphasis on mathematical study of logic and mathematics. Students cannot receive credit for both LOG 435 and LOG 535.

Prerequisite: LOG 335. Credit is not allowed for both LOG 435 and LOG 535.

LOG 498/LOG 598 Special Topics in Logic (1-6 credit hours)
Detailed investigation of selected topics in logic. Topics determined in consultation with head of the department. Course may be used for individualized study. Students cannot receive credit for both LOG 498 and LOG 598 unless the topic is different.

Prerequisite: One of the following: (MA/LOG 335, LOG 435, LOG 437, MA 403, MA 407, MA 408, MA 410, MA/CSC 416, MA 421, MA 425, MA 426, CSC 333, CSC 411, or CSC 417)
Typically offered in Fall and Spring

LOG 530 Varieties of Logic (3 credit hours)
Study of various non-classical logics such as modal logic, many-valued logic, paraconsistent logic, second-order logic, and intuitionistic logic. Emphasizes their applications in fields such as philosophy, linguistics, mathematics, computer science, and artificial intelligence. Students cannot receive credit for both LOG 430 and LOG 530.

Prerequisite: Graduate standing
Typically offered in Spring only

LOG 535 Advanced Logic and Metamathematics (3 credit hours)
Advanced topics in logic and metamathematics: proof procedures, first-order theories, soundness and completeness theorems, recursive functions, the formalization of arithmetic, the Goedel Incompleteness Theorems. Emphasis on mathematical study of logic and mathematics. Students cannot receive credit for both LOG 435 and LOG 535.

Prerequisite: LOG 335. Credit is not allowed for both LOG 435 and LOG 535.
LOG 598/LOG 498  Special Topics in Logic  (1-6 credit hours)
Detailed investigation of selected topics in logic. Topics determined in consultation with head of the department. Course may be used for individualized study. Students cannot receive credit for both LOG 498 and LOG 598 unless the topic is different.

Prerequisite: One of the following: (MA/LOG 335, LOG 435, LOG 437, MA 403, MA 407, MA 408, MA 410, MA/CSC 416, MA 421, MA 425, MA 426, CSC 333, CSC 411, or CSC 417)
Typically offered in Fall and Spring

Management Innovation Entrepreneurship (MIE)

MIE 201  Introduction to Business Processes  (3 credit hours)
Cross-functional treatment of major activities of business, such as product design, distribution, production, and marketing. Description of specific tasks, via lectures and case studies, in support of major business activities. Interactions among various functional areas of business.

GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

MIE 295  Special Topics in MIE  (1-6 credit hours)
Presentation of material at the 200-level not normally available in regular course offerings, or offering of new courses on a trial basis. Course may be taken multiple times only if topic is different.

Typically offered in Fall, Spring, and Summer

MIE 305  Legal and Regulatory Environment  (3 credit hours)
Introduction to fundamental subfields, rules, and concepts of law that are regularly significant to business operations. Emphasis on the law of contracts, torts, property and intellectual property rights, business organizations, and agency. Includes principals of constitutional, administrative and criminal law in a business context, and issues of ethics, fiduciary duty, civil procedure and legal risk management generally. Credit is not allowed for both BUS 305 and MIE 305.

Typically offered in Fall, Spring, and Summer

MIE 306  Managing Ethics in Organizations  (3 credit hours)
Management practices to define, communicate, and implement ethical conduct in business organizations. Normative and applied analysis of current ethical dilemmas of corporations in free markets, techniques for effective management of corporate social responsibility, and formulation and implementation of ethics management programs. College of Management majors only.

Prerequisite: MIE 201
Typically offered in Fall and Spring

MIE 310  Introduction to Entrepreneurship  (3 credit hours)
Introduction to planning, formation, and management of entrepreneurial ventures. Fundamental business concepts and managerial skills applied to entrepreneurial ventures. Course projects support experiential learning of critical skills. Some individual off-campus travel is required.

Typically offered in Fall, Spring, and Summer

MIE 330  Human Resource Management  (3 credit hours)
The systematic principles for managing the human resource component of organizations. Topics include: environmental influences on planning, recruitment, and selection; managing workforce diversity; developing effectiveness and enhancing productivity; compensation, benefits, and security; and strengthening employee-management relations.

Prerequisite: MIE 201, Sophomore standing
Typically offered in Fall, Spring, and Summer

MIE 335  Organizational Behavior  (3 credit hours)
Survey of contemporary managerial applications for managing people in modern organizations. Topics include: motivation, group dynamics, team development, ethics, communications, organizational politics, leadership, power, organizational development, organizational design and structure. Current managerial issues include total quality management and technology management.

Prerequisite: 9 hrs. of social science or 6 hours of social science plus MIE 201
Typically offered in Spring only

MIE 410  Business Opportunity Analysis  (3 credit hours)
Issues and management processes related to the identification of new business opportunities with emphasis on commercializing new technologies. Students will analyze and develop individual plans for commercialization of a new technology or other innovation. New venture formation is the primary focus, but the processes and skills students develop are relevant to new product introductions by existing firms.

Prerequisite: MIE 310
Typically offered in Fall, Spring, and Summer

MIE 411  Managing the Growth Venture  (3 credit hours)
Managing a growth venture with emphasis on entrepreneurial planning in the dynamic context of rapidly growing ventures and the development of managerial skills necessary for successful leadership in high growth ventures. Fundamental concepts, issues and skills are taught through an integrated combination of readings, lectures, discussions, cases analyses, and applied project with a local venture. Students need to provide their own transportation to off-campus sites.

Prerequisite: MIE 310
Typically offered in Spring only

MIE 412  Finance and Accounting for Entrepreneurs  (3 credit hours)
Financial planning for new ventures including financial reporting conventions and projection of critical financial amounts for new ventures. Introduction to fundamental accounting and finance concepts applied in the context of entrepreneurial ventures. Topics include projection of revenues, expenses, capital expenditures, cash flows, and balance sheet amounts; and the creation of pro-forma financial statements. Individual student projects integrate financial projections and pro-forma financial statements with the preparation of a complete business plan. Some individual off-campus travel is required.

Prerequisite: MIE 410
Typically offered in Fall and Spring
MIE 413 New Venture Planning (3 credit hours)
Developing the business plan for a new venture and the entrepreneurial process of executing the first phases of new venture creation. Topics include idea conception, entrepreneurship, business planning, market research, entrepreneurial opportunities and strategies. Emphasis is placed on high growth business opportunities. The final deliverable is a complete business plan for a high growth venture and formal presentation of the plan to mock investors. Some individual off-campus travel is required.

Prerequisite: MIE 410
Typically offered in Fall and Spring

MIE 416 The Legal Dynamics of Entrepreneurship (3 credit hours)
Overview of important legal and regulatory issues facing entrepreneurs and start-up entities including legal structure of the organization, intellectual property protection, human resource requirements, product liability, and risk management.

Prerequisite: MIE 310
Typically offered in Fall only

MIE 418 Social Entrepreneurship Practicum (3 credit hours)
Application of entrepreneurship skills and knowledge to plan a social entrepreneurial venture envisioned by the student. This course is a capstone course for the Minor in Entrepreneurship and the Concentration in Entrepreneurship. The deliverables include:

- Development of leadership and management skills for organizational development.
- Staffing of contemporary organizations including strategic and environmental influences on: HR planning, job analysis, measurement, recruitment, assessment and selection, decision making, employment, and termination. Considerable emphasis on employment and labor legislation.

Prerequisite: MIE 310
Typically offered in Fall and Spring

MIE 419 Entrepreneurship Practicum (3 credit hours)
Application of entrepreneurship skills and knowledge to plan an entrepreneurial venture envisioned by the student. This course is the capstone course for the Minor in Entrepreneurship. The final deliverable includes an evaluation of the project and a formal presentation.

Prerequisite: MIE 410
Typically offered in Fall and Spring

MIE 420 Teamwork in Organizations (3 credit hours)
This course will impart cutting edge thinking on leading in team-based organizations including the organizational changes required to move to a team-based structure and the organizational factors required to create successful work teams.

Prerequisite: MIE 330
Typically offered in Fall and Spring

MIE 421 Labor and Employee Relations (3 credit hours)
Utilizing textbook, readings, lectures, and practitioner presentations, students will become familiar with Employee Relations. Concepts in maintaining positive employer-employee relationships to promote productivity, morale, motivation and engagement will be reviewed. The course will explore the history of labor unions and the regulations that impact present day domestic and international business. The course will review approaches to negotiations.

Prerequisite: MIE 330
Typically offered in Spring only

MIE 434 Compensation Systems (3 credit hours)
Compensation philosophy, strategy, and policy. Earnings, individual and group incentive plans, voluntary and mandated benefits. Legal, regulatory, economic, and strategic issues affecting compensation and benefits. Strategies for developing the structure and level of compensation to enhance organizational performance.

Prerequisite: MIE 330
Typically offered in Fall and Spring

MIE 435 Leadership and Management (3 credit hours)
Development of leadership and management skills for organizational settings. Self-awareness: interpersonal needs, attitudes toward change; cognitive styles, ethics and values; listening; communicating; interviewing; time and stress management; creativity and managing creativity. Team building and group dynamics. Leadership and followership: theory and case studies (Churchill, Antigone; Henry V; Machiavelli); the use of power and authority; women and leadership the use of language in leadership embodiment of leadership traits; effective traits and characteristics of great leaders.

Prerequisite: MIE 330
Typically offered in Spring only

MIE 436 Training and Development (3 credit hours)
Training and development functions in organizations. Needs assessment, legal issues, training program design, learning, training methods, transfer of training, effectiveness and utility of training programs, and executive development.

Prerequisite: MIE 330
Typically offered in Fall and Spring

MIE 437 Human Resources Analytics (3 credit hours)
This course is an introduction to common analytical approaches used in human resource management. Various methods and analyses are helpful for HR professionals to evaluate questions and issues. Students in this course will learn statistical techniques that are often used to interpret organizational situations and information decision making. At the end of the course, students will be able to (a) develop and test research questions relevant for the organizational context; (b) critically evaluate quantitative information and illustrations you encounter; (c) communicate your understanding of statistics to others; and (d) perform common statistical analysis in Microsoft Excel, SAS, and/or R.

Prerequisite: MIE 330
Typically offered in Fall and Spring

MIE 438 Staffing (3 credit hours)
Staffing of contemporary organizations including strategic and environmental influences on: HR planning, job analysis, measurement, recruitment, assessment and selection, decision making, employment, and termination. Considerable emphasis on employment and labor recruitment, assessment and selection, decision making, employment, and termination. Considerable emphasis on employment and labor legislation.

Prerequisite: MIE 330
Typically offered in Fall and Spring
MIE 439 Human Resources Practicum (3 credit hours)
Utilizing textbooks, readings, lectures, and practitioner presentations, and an extended study of an organization's Human Resources practice and identified problem area, students will gain practical experience with diagnosing needs and then planning and recommending interventions to address identified needs. Experience with identifying needs will occur through needs assessment interviews with company representatives and analysis and interpretation of key demographic and relevant operational and HR metric data. Student groups need to provide their own transportation to off-campus sites.

Prerequisite: MIE 330
Typically offered in Spring only

MIE 480 Business Policy and Strategy (3 credit hours)
Comprehensive analysis of administrative policy-making from the point of view of the general manager. Integration of perspectives from marketing, finance, and other functional areas of management. Use of case analyses and written reports to develop decision making skills.

Corequisites: MIE 305, MIE 330, BUS 320, BUS 340, BUS 360, BUS 370, and (BUS/ST 350 or ST 305 or ST 312 or ST 370 or ST 372), and (ENG 331 or ENG 332 or ENG 333)
Typically offered in Fall, Spring, and Summer

MIE 495 Special Topics in MIE (1-6 credit hours)
Presentation of material normally not available in regular course offerings, or offering of new courses on a trial basis.

MIE 498 Independent Study in MIE (1-6 credit hours)
Detailed investigation of topics of particular interest to advanced undergraduates under faculty direction on a tutorial basis. Credits and content determined by faculty member in consultation with Department Head. Individualized/Independent Study and

Typically offered in Fall, Spring, and Summer

Management (M)

M 100 Personal and Professional Identity Development (1 credit hours)
Personal and Professional Identity Development is a one-hour Poole required course which will help you learn about and develop multiple facets of your social and cultural identity, your strengths, and about how these things interrelate with leadership and career choices. By exploring the diverse components of your personal identity, you will have a better understanding of how you relate to and interact with others in a global business market. Through this course, you will learn about yourself, others and how you can use your strengths and your identity to create an action plan for future success at NC State, become engaged in your local community and engage in career path exploration.

R: Poole College of Management Students Only
GEP U.S. Diversity
Typically offered in Fall and Spring

M 120 Professional Development and Career Planning (1 credit hours)
The Professional Development Course is a one-credit hour course designed to give you the tools necessary to start your career. The course involves thoughtful self-assessment, career exploration, planning and follow-through with preliminary employment strategies. Taking advantage of the opportunities in this course will aid you in your transition from college student to intern to professional employee. The course navigates you through a more direct route to your long-term career goals by anticipating and acquiring the essential skill sets and experiences for an internship or entry-level job that will be the best starting point for your career.

R: Poole College of Management Students Only
Typically offered in Fall and Spring

M 298 Special Topics in Management (1-6 credit hours)
Presentation of material normally not available in regular course offering.

Typically offered in Fall, Spring, and Summer

M 299 Professional Internship in Management (1 credit hours)
Poole College of Management students participating in an approved internship with an organization providing no monetary compensation and where academic credit is required will have an opportunity to gain real world insight and experience into the day-to-day management of an organization.

Management Students Only
Typically offered in Fall, Spring, and Summer

M 300 Leadership and Professional Development (1 credit hours)
This course is specifically designed for new Peer Leaders and Ambassadors in the Poole College of Management. The goal of the course is to give students the necessary skills to become effective leaders and representatives both within and outside of the College. As a part of this course, students will attend Poole College of Management events/activities. Some topics we will discuss are: professional networking, communication, leadership, working in groups, and presentation skills.

Typically offered in Fall only

M 380 Doing Business Globally (3 credit hours)
International academic and cultural immersion into how business is conducted in a specific country/region abroad. Interdisciplinary exploration of political, and economic factors as they impact global business practices. Focus on key macro-environmental influences within a specific country/region as contrasted to those in the United States.

Restricted to: Study Abroad Students Only
GEP Interdisciplinary Perspectives
Typically offered in Summer only

M 399 International Business Dual Degree Student Professional Internship in Management (1-6 credit hours)
International Business Dual Degree students participating in an approved internship with an organization will have an opportunity to gain real world insight and experience into the day-to-day functions and responsibilities encountered in the profession.

R: Poole College of Management major enrolled in the International Business Dual Degree Program
Typically offered in Fall, Spring, and Summer
Marine, Earth, and Atmospheric Sciences (MEA)

MEA 100  Earth System Science: Exploring the Connections  (4 credit hours)

Prerequisite: Competence in high school algebra and chemistry
GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Fall and Spring

MEA 101  Geology I: Physical  (3 credit hours)
Systematic consideration of processes operating on and below the earth's surface and the resulting features of landscape, earth structures, and earth materials. Occurrences and utilization of the earth's physical resources.

Corequisite: Recommended that MEA 110 be taken concurrently
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

MEA 110  Geology I Laboratory  (1 credit hours)
Scientific methodology applied to the study of common rock-forming minerals, common rocks, topographic maps, geologic structures and geological maps. Field trips.

Corequisite: MEA 101 or Prerequisite: MEA 100, MEA 101, MEA 120, MEA 140 or MEA 200
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

MEA 130  Introduction to Weather and Climate  (3 credit hours)
Explores the structure, physical causes, and climatology of weather systems including the jet streams, mid-latitude cyclones, hurricanes, thunderstorms, and tornadoes. Clouds and precipitation, air pollution, climate modification, optical effects (rainbows, halos) and weather instruments. Weather systems and forecasting techniques are illustrated through daily weather map discussions.

Prerequisite: For Non-Majors
GEP Natural Sciences
Typically offered in Fall and Spring

MEA 135  Introduction to Weather and Climate Laboratory  (1 credit hours)
Experiments include effects of air pressure change on temperature and density (gas law); measurement of atmospheric moisture; formation of clouds and hail; effects of variable solar heating. Graphical display and interpretation of data; weather instrum

Corequisite: MEA 130
GEP Natural Sciences
Typically offered in Fall and Spring

MEA 150  Environmental Issues in Water Resources  (4 credit hours)
The science of current environmental concerns, particularly those related to water resources. Major topics include weather and climate, natural resource cycles, resource depletion and contamination, societal impacts. Scientific aspects of environmental issues. Required field trips.

GEP Natural Sciences
Typically offered in Fall only

MEA 200  Introduction to Oceanography  (3 credit hours)
The ocean as a part of our environment including interactions between atmosphere and ocean, ocean circulation, physical and chemical properties of sea water, marine geology and marine biology.

Corequisite: Recommended that MEA 210 be taken concurrently
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

MEA 202  Geology II: Historical  (3 credit hours)
The second semester of the basic introductory sequence in geology. Utilization of the principles of geology to reconstruct and understand the earth's history. Geologic events that cause modification of the earth's crust, emphasizing North America. History of life and the environmental significance of changes in animal and plant life through geologic time.

Prerequisite: (MEA 100, MEA 101, MEA 120, MEA 140 or MEA 200 )and MEA 110; Corequisite: Recommended that MEA 211 be taken concurrently
GEP Natural Sciences
Typically offered in Spring only

MEA 210  Oceanography Lab  (1 credit hours)
Complements the lecture course in Oceanography. Numerous demonstrations and resource materials visualize basic oceanographic concepts such as geological processes operating in the marine realm, the chemical properties of seawater, oceanic circulation, tides and waves, as well as processes affecting the biology of the oceans.

Corequisite: MEA 200
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

MEA 211  Geology II Laboratory  (1 credit hours)
Reconstruction and interpretation of events in the history of the earth. Interpretation of sedimentary rocks, construction and interpretation of geological maps, identification of fossil organisms and utilization of fossils in the reconstruction of earth history.

Corequisite: MEA 202
GEP Natural Sciences
Typically offered in Spring only

MEA 215  Introduction to Atmospheric Sciences  (4 credit hours)
Introduction to the Earth's atmosphere. Fundamental concepts and applications of meteorology and how they relate to daily and seasonal weather, major types of storms, and climate.

Corequisite: MA 141
Typically offered in Spring only
MEA 217 Introduction to Computing in the Geosciences (3 credit hours)
This course is for students with little or no programming experience. It provides students with programming and problem solving skills using MATLAB with emphasis on the systematic development of algorithms and programs. Topics include Boolean math, data representation and types (array, vectors, strings, structures), evaluation of expressions, program control (iteration, functions), algorithm development (pseudo code, physical problem solving, numerical algorithms), basic MATLAB graphics, and limits of computing. Problems and projects are selected from the Geosciences. Students are expected to be proficient in solving algebraic equations, solving non-calculus Physics problems, including dimensional analysis, and operating a computer.

Typically offered in Fall only

MEA 220 Marine Biology (3 credit hours)
Introduction to marine plants and animals, their adaptations to life in the sea and ecological interactions in selected marine environments (e.g. coral reefs, deep sea, salt marshes). Interactions of man with the sea: food from the seas, biology of diving. Optional trip.

Prerequisite: MEA 200 or BIO 181
GEP Natural Sciences
Typically offered in Fall only

MEA 240 The Planets of Our Solar System (3 credit hours)
This course will cover the formation mechanisms, physical properties, and processes of the vast array of bodies that compose our Solar System, and how they compare and contrast with our own world. Among the diverse range of topics we will explore are planetary formation, volcanism of Mars, the deep oceans of Jupiter’s icy moons, the atmosphere of Venus, and the fate of our Sun. We will also focus on what other planetary bodies can tell us of the early and future Earth, as well as the conditions required for planetary habitability. Finally, we will consider the exciting field of exoplanet research, including the search for extraterrestrial intelligence, and discuss key milestones in the exploration of the Solar System. Delivered through lectures, in-class discussion, and associated reading, the course will be assessed through a series of quizzes, an essay, a group project, and two mid-term exams and a final exam.

GEP Natural Sciences
Typically offered in Fall only

MEA 250 Introduction to Coastal Environments (3 credit hours)
A global survey of coastal habitats, the processes that shape these dynamic environments, and the physicochemical controls that regulate their indigenous biological communities.

Prerequisite: MEA 200/210 or MEA 101/110
GEP Natural Sciences
Typically offered in Spring only

MEA 251 Introduction to Coastal Environments Laboratory (1 credit hour)
Complements the lecture course Introduction to Coastal Environments (MEA 250). Experiments involving the physical, chemical and biological processes that shape a variety of coastal environments.

Corequisite: MEA 250
Typically offered in Spring only

MEA 252 Biology of Marine Mammals (3 credit hours)
Biology of marine mammals, including cetaceans, pinnipeds, sirenians and sea otters. Topics covered include the evolution, physiology, behavior and ecology of marine mammals. We will focus on current topics in conservation and management of marine mammals. Instructor permission required.

Typically offered in Spring only

MEA 260 Human Dimensions of Climate Change (3 credit hours)
Climate is changing with potentially catastrophic implications for the Earth and for people. In this course we discuss how and why climate is changing and how climate change is affecting and will affect human well-being in society. We draw upon the multiple disciplinary lenses and diverse perspectives needed to evaluate, across multiple dimensions, proposed solutions to climate change and/or to assess fully the consequences of inaction.

GEP Interdisciplinary Perspectives
Typically offered in Fall only

MEA 300 Environmental Geology (4 credit hours)
Geologic aspects of the environment. Effects of humans upon or interactions with geologic processes. Geologic considerations in land use planning, waste disposal, water resources, and natural resources. A field and lab oriented course with combined lecture/laboratory. Inquiry-based learning approach to study the basic processes of environmental geology and develop research skills. Required field trips.

Prerequisite: MEA 101 or MEA 150 or MEA 140 or SSC 200
Typically offered in Spring only

MEA 312 Atmospheric Thermodynamics (4 credit hours)
Introduction to atmospheric thermodynamics for meteorology majors. Topics include the equation of state for mixture of gases; first and second laws of thermodynamics; diabatic and adiabatic processes for dry and moist air; measurement and phase changes.

Prerequisite: MA 141, PY 205; Corequisite: MA 241, PY 208
Typically offered in Spring only

MEA 315/MA 315 Mathematics Methods in Atmospheric Sciences (4 credit hours)
For sophomore meteorology and marine science students. A complement to MA 242 designed to prepare students for quantitative atmospheric applications. Topics include an introduction to vectors and vector calculus, atmospheric waves, phase and group velocity, perturbation analysis, fourier decomposition, matrix operations, chaos and predictability. For MY, MMY, and MRM majors only.

Prerequisite: MEA 217 or MA 116 or CSC 113; Corequisite: MA 242
Typically offered in Spring only

MEA 320/ET 320 Fundamentals of Air Pollution (3 credit hours)
Air pollution sources, and the influence of natural and anthropogenic processes on the atmosphere. Roles of local, state and federal governments in air pollution control and importance of the Clean Air Act and it amendments.

Prerequisite: (MA 121, MA 131, or MA 141) and (PY 131 or PY 201 or PY 205 or PY 211)
Typically offered in Spring only
MEA 321 Fundamentals of Air Quality and Climate Change (3 credit hours)
An intermediate-level introduction, for meteorology majors, to the physical and chemical environment of the atmosphere and to climate change. Topics include the atmosphere's chemical composition; atmospheric chemical reaction processes in gas phase, liquid phase, and on particle surfaces.
Prerequisite: CH 101, CH 201, MA 141, MA 241; Corequisite: PY 205
Typically offered in Fall only

MEA 323 Geochemistry of Natural Waters (3 credit hours)
Biogeochemical processes related to water in the natural environment. Course focuses on chemical equilibria and kinetics of: precipitation and dissolution, acid-base chemistry and the carbonate system, oxidation-reduction chemistry, and organic geochemistry in lakes, rivers, estuaries, and oceans. Topics revolve around water quality and global change. Course includes in class field sampling and lab work as well as a mandatory Saturday field trip.
Restriction: MEA and ENE Majors Only. Other Majors With Permission of Instructor; Prerequisite: CH 201 or CH 203
Typically offered in Fall and Spring

MEA 350 Marine Conservation Biology (3 credit hours)
This course will focus on the field of marine conservation, including the scientific, regulatory, social and economic factors that must be considered when trying to solve complex conservation issues. Important concepts will include: (i) sampling and experimental design, (ii) modern definitions of conservation, scientific areas of expertise in conservation, (iii) priority threats to biodiversity, (iv) laws which govern conservation in the US and internationally, and (v) social and economic considerations. The class will include presentation and critical evaluation of global, regional and local case studies marine conservation actions. Optional Friday field trips. Instructor permission required.
Typically offered in Spring only

MEA 369 Life on Earth: Principles of Paleontology (3 credit hours)
This class offers an interdisciplinary introduction to the history of life on Earth and the principles of paleontology that allow for its study and application. Key topics include: fossil records and description, evolution and extinction, paleoecology, field/lab methods, and a survey of major life forms from the early Earth through the present. This course is a learning-centered program aimed at students interested in past life and using paleontology as a tool for examining the natural world. Required field trips.
P: BIO 181 or MEA 202
Typically offered in Spring only

MEA 409 Watershed Forensics (3 credit hours)
Spatial analysis of watersheds with emphasis on pollution and controversies concerning water quality and regulation issues. GIS exercises will introduce students to the latest spatial analytical techniques. Case studies and lectures will be used to exam
Prerequisite: GIS 280
Typically offered in Fall only

MEA 410 Introduction to Mineralogy and Petrology (4 credit hours)
Introduction to the fundamentals of mineralogy, optical mineralogy, and igneous and metamorphic petrology. Description and identification of minerals, using physical properties and geological associations. Optical properties of non-opaque rock-forming minerals, emphasizing petrographic thin sections. Introduction to igneous and metamorphic environments and rocks. Description and classification of common crystalline rocks. Required overnight field trips; additional expenses required.
Prerequisite: (MEA 100, MEA 101, MEA 120, MEA 140 or MEA 200), and MEA 110 and CH 101/102
Typically offered in Fall only

MEA 411 Marine Sediment Transport (3 credit hours)
Quantitative study of sediment transport in the marine environment including an introduction to fluid mechanics and sediment transport theory. Discussion of the processes and products of sediment transport in specific marine environments from estuaries
Prerequisite: MEA 101 or MEA 200, MA 241, PY 201 or PY 205
Typically offered in Fall only

MEA 412 Atmospheric Physics (3 credit hours)
Physical and analytical descriptions of atmospheric aerosols, clouds/ fogs, and precipitation processes; size distribution and sources of atmospheric aerosols; impact of aerosols on visibility and climate; microstructure of warm and cold clouds and their interaction with solar and terrestrial radiation; collision-coalescence and ice phase mechanisms of precipitation formation; atmospheric electricity; planned and inadvertent weather modification; weather radar; atmospheric optics.
Prerequisite: MA 242, PY 208
Typically offered in Spring only

MEA 415/MEA 515 Climate Dynamics (3 credit hours)
A comprehensive look at climate integrated across terrestrial, marine, and atmospheric perspectives. Topics include an in-depth look at climate proxies, drivers of future, current and past climate change, climate monitoring approaches, and climate model projections. Students will be exposed to the quantitative aspects (chemistry, physics, theory, observations, models) scientists use to place constraints on climate conditions over broad spatial and temporal scales. MEA 415 is open to upper-level undergraduate science majors interested in learning more about Earth’s climate systems and the dynamics within. MEA 515 is open to all graduate students with the expectation of an additional climate assessment course project relevant to the student's own research discipline. Students cannot receive credit for both MEA 415 and MEA 515.
Prerequisite: MA 121 or MA 131 or MA 141 and CH 101 or CH 103 and PY 201 or PY 205 or PY 211
Typically offered in Fall only

MEA 421 Atmospheric Dynamics I (3 credit hours)
Meteorological applications of fluid kinematics: divergence, vorticity, deformation, advection, mass continuity and vertical motion. Atmospheric dynamics: the equation of motion on a rotating earth; component equations in Cartesian, polar-sphericaland pressure coordinates. Scale analysis and simplifications. Cases of horizontal flow: geostrophic and gradient wind, ageostrophy and acceleration; thermal wind and vorticity.
Prerequisite: MA 242 and PY 208 and MEA 312
Typically offered in Fall only
MEA 422 Atmospheric Dynamics II (3 credit hours)
Vorticity and potential vorticity equations; dynamics of synoptic-scale motions; quasi-geostrophic theory; atmospheric waves including shallow water, internal gravity, inertia-gravity, and Rossby waves; finite difference methods; numerical weather prediction; atmospheric instabilities including static, Kelvin-Helmholtz, inertial, symmetric, barotropic, and baroclinic instabilities.
Prerequisite: MEA 421
Typically offered in Spring only

MEA 425/MEA 525 Introduction to Atmospheric Chemistry (3 credit hours)
The course covers history, regulations, sources, physics, and chemistry of major air pollutants and factors affecting their transport and fate. Emphasis is placed on atmospheric chemistry and physics underlying five major air pollutant problems including urban outdoor air pollution, indoor air pollution, acid deposition, stratospheric ozone reduction, and global climate change. Credit will not be allowed for MEA 425 and MEA 525.
Prerequisite: MA 141, CH 201, (PY 205, PY 211 or MEA 320)
Typically offered in Fall, Spring, and Summer

MEA 440 Igneous and Metamorphic Petrology (4 credit hours)
The study of rocks formed by the crystallization of magmas (igneous) and by the recrystallization of existing rocks (metamorphic), with emphasis on whole-rock and mineral compositions, classification, petrography, hand-sample and thin-section identification, and the rock origins in terms of magma genesis and emplacement and tectonics. Field trips are required.
Prerequisite: MEA 410
Typically offered in Spring only

MEA 443 Synoptic Weather Analysis and Forecasting (4 credit hours)
Analysis and forecasting of mid-latitude weather systems with emphasis on simplified models and methods. Barotropic model, Rossby waves; baroclinic structure, upper-level wave evolution, forecasting; surface cyclone evolution, Sutcliffe-Petterssen model. Numerical computation methods; numerical weather prediction and operational models, subjective and objective analysis of meteorological fields.
Prerequisite: MEA 421
Typically offered in Fall only

MEA 444 Mesoscale Analysis and Forecasting (4 credit hours)
Analysis and forecasting of mid-latitude weather systems with emphasis on mesoscale phenomena. Definition of the mesoscale, approximations to the governing equations, basic measurements and techniques; observations, basic governing dynamics, and forecasting of mesoscale phenomena, including drylines, low-level jets, conditional symmetric instability, c trochographically-induced circulations, thunderstorms, mesoscale convective, and severe convective weather.
Prerequisite: MEA 443
Typically offered in Spring only

MEA 449/MEA 549 Principles of Biological Oceanography (3 credit hours)
Environmental dependencies, biological productivity, and trophic relationships in plankton, nekton and benthos; Sampling methods and experimental design; Human impacts on marine systems. Credit is not allowed for both MEA 449 and MEA(ZO)549.
Typically offered in Fall only

MEA 450 Introductory Sedimentology and Stratigraphy (4 credit hours)
Properties and classification of sediments and sedimentary rocks, geologic occurrences and origin of minerals and rocks formed by physical, chemical, and biologic processes at and near the Earth's surface. Principles of the division of stratified terrains into natural units, the correlation of strata and associated data, the interpretation of depositional environments, facies, and sequences, description of burial histories, and sedimentary basin analysis. Required field trips.
Prerequisite: MEA 410
Typically offered in Spring only

MEA 451 Structural Geology (4 credit hours)
Basic principles of geometric, kinematic and dynamic analysis as applied to fractures, shear zones, folds, and fabrics of deformed rock bodies. Considers both brittle and ductile realms of the crust from microscale to regional tectonics. Required overnight field trips.
Prerequisite: MEA 410
Typically offered in Fall only

MEA 454/MEA 554 Marine Physical-Biological Interactions (3 credit hours)
Space-time relationships between physics and biology; influence of Reynolds Number on aquatic life style; aspects of physical and biological mathematical modeling; influence of biology on physical phenomena; influence of static physical/chemical properties on biology; influence of dynamic physical phenomena (turbulence, waves and advection) on biology within the water column and its boundaries. Credit is not allowed for both MEA454 and 554
Prerequisite: MEA 460 and MEA(ZO) 449
Typically offered in Spring only

MEA 455 Micrometeorology (3 credit hours)
Energy budget near the earth's surface; soil temperatures and heat transfer; air temperature, humidity, and wind distribution in the planetary boundary layer; fundamentals of viscous flows and turbulence; semiempirical theories of turbulence; exchanges of momentum, heat and moisture in the atmospheric surface layer; air modification due to changes in surface properties; agricultural and forest micrometeorology.
Prerequisite: MEA 422 or MAE 308
Typically offered in Fall only

MEA 458 Introduction to Tropical Meteorology (3 credit hours)
Prerequisite: MEA 422
Typically offered in Fall only
ME 459 Field Investigation of Coastal Processes (5 credit hours)
Coastal zone processes and dynamics with emphasis on the forcing factors that regulate changing coastal landforms, the ecology and physicochemical character of coastal ocean water-masses, seabed morphologies, landscape academies, etc. Field observations and field techniques will be emphasized in tidal-freshwater coastal wetlands, estuaries, barrier island, tidal inlets, continental shelves and shelf-margin habitats. Additional fees required.
Prerequisite: MEA 250
Typically offered in Summer only

ME 460 Principles of Physical Oceanography (3 credit hours)
Introduction to principles and practices of physical oceanography. Equation of state of seawater; energy transfer to the ocean by thermal, radiative and mechanical processes; the heat budget; oceanic density distribution; oceanic boundary conditions; conservation equations; air-sea interaction; global fluxes and general description of major ocean currents. Credit is not allowed for both MEA 460 and MEA 540
Prerequisite: MA 241 or MA 231; Corequisite: PY 203, PY 208 or PY 212.
Typically offered in Fall only

ME 461 Preparatory Course for Field Camp (1 credit hours)
Introduction to theory, instruments, and techniques used in MEA 465 geologic field camp. Geologic context of the area where field camp will be held. Students will supply their own graph paper for a map cross-section exercise. Credit for this course cannot be used to fulfill elective credits in any Geology curricula.
Typically offered in Spring only

ME 462 Observational Methods and Data Analysis in Marine Physics (3 credit hours)
Practical experience in the observational techniques used by physical oceanographers. Basic instrumentation described, emphasizing principles rather than detailed descriptions. Both direct and indirect techniques used to define the three-dimensional circulation of the ocean as a function of time.
Prerequisite: MEA 460
Typically offered in Spring only

ME 463 Fluid Physics (3 credit hours)
A derivation of the basic equations governing fluid motion in a rotating coordinate system. Equations include conservation of mass or the continuity equation, momentum equations, thermodynamic energy equation and the vorticity equation. Application of equations to simplified oceanic flows which include surface gravity waves, inertial motion, geostrophic motion, Ekman dynamics and vorticity dynamics.
Prerequisite: MA 341 and PY 208
Typically offered in Fall only

ME 464 Ocean Circulation Systems (3 credit hours)
Dynamical processes governing ocean circulation. Driving of ocean currents by the atmosphere, currents on a rotating spherical earth. Mid-ocean gyre, western boundary currents, equatorial current systems, and polar circulation. Currents in coastal regions and shallow-water processes.
Prerequisite: MEA 460
Typically offered in Spring only

ME 465 Geologic Field Camp (4 credit hours)
Introduction to field instruments and techniques used in geological sciences. Geologic field mapping in areas ranging from undeformed sedimentary rocks to complexly deformed crystalline rocks. May include field techniques specific to engineering geology, geophysics, hydrogeology, and paleontology. Preparation of maps and reports. Four-week course taught off-campus, typically out-of-state. Additional fees required.
Prerequisite: MEA 450 and MEA 451
Typically offered in Summer only

ME 466 Preparatory Course for Field Camp (1 credit hours)
Introduction to theory, instruments, and techniques used in MEA 465 geologic field camp. Geologic context of the area where field camp will be held. Students will supply their own graph paper for a map cross-section exercise. Credit for this course cannot be used to fulfill elective credits in any Geology curricula.
Typically offered in Spring only

ME 467 Marine Meteorology (3 credit hours)
Basic equation and concepts. Review of ocean and atmospheric circulations. Ocean mixed layer, air-sea interaction and coastal ocean and meteorological processes, marine boundary layer and cloud processes.
Prerequisite: MA 241 and PY 205
Typically offered in Spring only

ME 468/MEA 568 Aquatic Microbiology (3 credit hours)
Aquatic microbes are key drivers of biogeochemistry on Earth. They also influence the 'health' of valuable ecosystems, e.g. estuaries, coasts, lakes, as well as, larger organisms (e.g. shellfish, humans). In this course, multiple facets of aquatic microbiology will be covered, including (not limited to): population diversity, spatial and temporal dynamics, sampling methodologies, metabolisms, and their environmental and societal importance. A primary goal for this course is for students to be exposed to key paradigms and current challenges within the field of aquatic microbiology, but also a general perspective on how aquatic microbes thrive in nature. Although largely a classroom-based course, select class periods will be devoted to hands-on activities and/or measurements providing students with methodological experience or in-depth exposure to key topics.
Prerequisite: BIO 183
Typically offered in Spring only

ME 469 Ecology of coastal Resources (3 credit hours)
Anthropogenic impacts on estuarine and coastal marine ecosystems. Survey of basic biological, physical, chemical and geological mechanisms underlying habitat-specific functioning, followed by discussion, in-class presentation, and critique of real and hypothetical case studies involving anthropogenic impacts.
Prerequisite: MEA 250 and MEA 220 or MEA 449
Typically offered in Spring only

ME 470 Introduction to Geophysics (3 credit hours)
Structure of the earth, a dynamic and evolving entity, as inferred from seismology, gravity, magnetism and heat flow. Geodynamic processes responsible for continental drift; plate tectonic theory; regional geophysics of selected areas.
Prerequisite: PY 208 or 212

ME 471 Exploration and Engineering Geophysics (3 credit hours)
Geophysical methods applied to exploring the earth's shallow subsurface. Principles of gravity, magnetic, electrical, and seismic exploration surveys. Planning, conducting, and interpreting geophysical surveys.
Prerequisite: PY 208 or PY 211
MEA 473/MEA 573  Principles of Chemical Oceanography  (3 credit hours)
Chemical processes controlling the composition of oceans, including
discussions of chemical equilibria, biological cycling of nutrients and use
of chemical tracers in marine environment; consideration of origin and
chemical history of oceans. Credit is not allowed for both MEA 473 and
MEA 573.
Prerequisite: CH 201 or CH 203
Typically offered in Fall only

MEA 476  Worldwide River and Delta Systems: Their Evolution and
Human Impacts  (3 credit hours)
Survey of major world rivers and deltas, such as the Amazon, Mississippi,
Yellow, Indus, Nile, etc.
Definitions of their initiation, development, and evolution processes.
Descriptions of the impacts caused by climate changes and human
activities. Examination of the river-ocean interactions and sedimentary
and geochemical processes in terms of sea-level change, monsoon, and
sediment dispersal and deposition.
Prerequisite: Senior undergraduate or Graduate standing
Typically offered in Fall only

MEA 479/CE 479  Air Quality  (3 credit hours)
Introduction to: risk assessment, health effects, and regulation of air
pollutants; air pollution statistics; estimation of emissions; air quality
meteorology; dispersion modeling for non-reactive pollutants; chemistry
and models for tropospheric ozone formation; aqueous-phase chemistry,
including the "acid rain" problem; integrated assessment of air quality
problems; and the fundamentals and practical aspects of commonly used
air quality models. Credit is allowed only for one of CE/MEA 479 or CE/
MEA 579.
CE 282 and CE 373; or CHE 311 (CHE Majors); or MEA 421 (MEA
Majors); Corequisite: ST 370; or ST 380 (MEA Majors)
Typically offered in Spring only

MEA 481  Geomorphology: Earth’s Dynamic Surface  (3 credit hours)
Landforms and the processes responsible for their origin. Emphasis on
the geologic principles involved in interpreting the origin and evolution
of various landforms, and discussion of North American geomorphic
process.
Prerequisite: (MEA 100 or MEA 101 or MEA 200) and MEA 110
Typically offered in Spring only

MEA 485  Introduction to Hydrogeology  (3 credit hours)
Basic science of groundwater flow in geological media. Saturated
and unsaturated flow, Darcy’s equation, heterogeneity and anisotrophy,
flownets, storage properties of geological materials, effective stress,
equations for steady and unsteady flow, recharge, groundwater exchange
with surface water, groundwater flow to pumping wells, estimation of
hydraulic properties of aquifers, contaminant plumes and chemical
transport in groundwater.
Prerequisite: (MEA 101 or MEA 202), (MA 131 or MA 141), (CH 201 or
CH 203), and (PY 201, PY 205, or PY 211)
Typically offered in Fall only

MEA 488  Meteorology for Media  (3 credit hours)
Communication of weather and climate information with the public,
including examination of communication theory, public communication
of science, and geoscience communication research. Production techniques
for television and digital graphics, presentation to camera, and audio
recordings.
Prerequisite: One of the following ENG 331, ENG 332, ENG 333, or
COM 110
Typically offered in Fall only

MEA 493  Special Topics in MEAS  (1-6 credit hours)
Directed individual study or experimental course offering.
Typically offered in Fall, Spring, and Summer

MEA 495  Junior Seminar in the Marine, Earth, and Atmospheric
Sciences  (1 credit hours)
Emphasis on student professional development. Discussions of
professional opportunities, resources, and ethics. Professionals from the
public and private sectors introduce students to career options in marine,
earth and atmospheric sciences. Strategies for finding jobs and graduate
programs. Students reflect on future career goals and plans. For MEAS
majors only.
R: MEAS Majors Only
Typically offered in Spring only

MEA 498  Internship in MEAS  (1-6 credit hours)
Awards academic credit for learning that occurs during internships.
Requires daily journal and written summary report. Successful
completion of the course based on review of summary report by
an MEAS faculty, who shall be identified by the student prior to the
internship. Transportation expenses may be incurred. MEAS majors
only. Individualized/Independent Study and Research courses require a
Course Agreement for Students Enrolled in Non-Standard Courses be
completed by the student and faculty member prior to registration by the
department.
Typically offered in Fall, Spring, and Summer

MEA 507  Discipline-based Education Research in the
Geosciences  (3 credit hours)
This course will prepare students to explain the conditions necessary
for learning to occur in college geoscience classes; plan lessons that
address geoscience literacy standards and incorporate activities that
feature multiple levels of Bloom’s taxonomy
Typically offered in Spring only

MEA 510  Air Pollution Meteorology  (3 credit hours)
Wind structure in atmospheric surface layer and planetary boundary
layer; temperature structure and stability; mixed layer and inversions;
turbulence intensity and scale; meteorological factors affecting dispersion
of pollutants; diffusion theories and models; diffusion and transport
experiments; plume rise, fumigation and trapping; removal processes;
effects of buildings and hills; effects of local winds.
Prerequisite: MAE 308 or MEA 455 or MEA 700
Typically offered in Spring only
ME 511 Introduction to Meteorological Remote Sensing (3 credit hours)
Meteorological remote sensing data sets used in operational forecast and research applications. Sensor physical principles. Emphasis is on understanding the strengths and weaknesses of the different types of observational data so that the student can justly encounter data of this type.

Typically offered in Fall only

ME 514 Advanced Physical Meteorology (3 credit hours)
Fundamental laws and concepts of thermodynamics and electromagnetic radiative transfer considered in an atmospheric context. Application of these principles to a number of meteorological problems, including radiative climate models, the global energy balance, atmospheric aerosols, lidar/radar backscatter and remotely sensed temperature fields.

Prerequisite: MEA 412, MEA 421

Typically offered in Fall only

ME 515/MEA 415 Climate Dynamics (3 credit hours)
A comprehensive look at climate integrated across terrestrial, marine, and atmospheric perspectives. Topics include an in-depth look at climate proxies, drivers of future, current and past climate change, climate monitoring approaches, and climate model projections. Students will be exposed to the quantitative aspects (chemistry, physics, theory, observations, models) scientists use to place constraints on climate conditions over broad spatial and temporal scales. MEA 415 is open to upper-level undergraduate science majors interested in learning more about Earth’s climate systems and the dynamics within. MEA 515 is open to all graduate students with the expectation of an additional formative course feedback through course assignments and exams. Minimum of 50% seats reserved for Climate Change and Society Certificate program students.

Prerequisite: Graduate standing

Typically offered in Spring only

ME 518 Climate Risk Analysis (3 credit hours)
Applying methods of risk analysis to evaluate options for dealing with climate change, this course will introduce appropriate statistical methods and develop applications to climate-change related issues. This course provides practical hands-on experience for professionals in analyzing climate risks and developing adaptation strategies in climate sensitive sectors. The specific content will rely heavily on case studies in hydrology, health, energy, and transportation sectors.

Prerequisite: ME 517 and ST 511 (or equivalent) and Graduate student status

Typically offered in Spring only

ME 519 Barriers to Climate Change Literacy (3 credit hours)
Investigates the discipline-based geoscience education lenses of the cognitive, affective, and behavioral barriers to climate literacy and the practical interventions for addressing them. Critically analyzes key aspects of climate science, common misconceptions, mental models, cultural influences, and risk perceptions about climate change. Students engage with the public and design projects for overcoming barriers to climate change literacy. The course features relevant readings, classroom discussions, student peer-review, and summative and formative course feedback through course assignments and exams.

Prerequisite: Graduate standing

Typically offered in Spring only

ME 525/MEA 425 Introduction to Atmospheric Chemistry (3 credit hours)
The course covers history, regulations, sources, physics, and chemistry of major air pollutants and factors affecting their transport and fate. Emphasis is placed on atmospheric chemistry and physics underlying five major air pollutant problems including urban outdoor air pollution, indoor air pollution, acid deposition, stratospheric ozone reduction, and global climate change. Credit will not be allowed for both MEA 425 and MEA 525.

Prerequisite: MA 141, CH 201, (PY 205, PY 211 or MEA 320)

Typically offered in Spring only

ME 540 Principles of Physical Oceanography (3 credit hours)
Introduction to principles and practice of physical oceanography. The equation of state of seawater; energy transfer to the ocean by thermal, radiative and mechanical processes; the heat budget; oceanic boundary conditions; geographical distribution of oceanic properties; observational methods; conservation equations; simple waves and tides; physical oceanography of North Carolina coastal zone. Application of Fourier analysis techniques to interpretation of low-frequency motions in ocean and atmosphere. Review of Fourier method. Filtering of tidal signals. Spectral estimates and calculation of current ellipses. Identification of coherent motions and their empirical orthogonal modes. Data from field experiments used in lectures and homework assignments. Credit is not allowed for both MEA 460 and MEA 540.

Prerequisite: MA 231 and PY 212

Typically offered in Spring only
MEA 549/MEA 449 Principles of Biological Oceanography (3 credit hours)
Environmental dependencies, biological productivity, and trophic relationships in plankton, nekton and benthos; Sampling methods and experimental design; Human impacts on marine systems. Credit is not allowed for both MEA 449 and MEA(ZO)549.

Typically offered in Fall only

MEA 553 Estuarine Biogeochemistry (3 credit hours)
Biogeochemical cycles of carbon, nitrogen, and phosphorus in coastal rivers and estuaries with selected topics on the origin, physics, and chemistry of estuarine waters and sediments. Emphasis is placed on organic matter and nutrient cycling in estuaries within the context of anthropogenic effects and climate change.

Typically offered in Spring only

MEA 554/MEA 454 Marine Physical-Biological Interactions (3 credit hours)
Space-time relationships between physics and biology; influence of Reynolds Number on aquatic life style; aspects of physical and biological mathematical modeling; influence of biology on physical phenomena; influence of static physical/chemical properties on biology; influence of dynamic physical phenomena (turbulence, waves and advection) on biology within the water column and its boundaries. Credit is not allowed for both MEA454 and 554

Prerequisite: MEA 460 and MEA/ZO 449
Typically offered in Spring only

MEA 562 Marine Sediment Transport (3 credit hours)
Quantitative study of sediment transportation in the marine environment including introduction to fluid mechanics and sediment transportation theory. Processes and products of sediment transportation in specific marine environments from estuaries to deep-sea.

Prerequisite: MEA 101 or MEA 200, MA 241, PY 201 or PY 205
Typically offered in Fall only

MEA 568/MEA 468 Aquatic Microbiology (3 credit hours)
Aquatic microbes are key drivers of biogeochemistry on Earth. They also influence the ‘health’ of valuable ecosystems, e.g. estuaries, coasts, lakes, as well as, larger organisms (e.g. shellfish, humans). In this course, multiple facets of aquatic microbiology will be covered, including (not limited to): population diversity, spatial and temporal dynamics, sampling methodologies, metabolisms, and their environmental and societal importance. A primary goal for this course is for students to be exposed to key paradigms and current challenges within the field of aquatic microbiology, but also a general perspective on how aquatic microbes thrive in nature. Although largely a classroom-based course, select class periods will be devoted to hands-on activities and/or measurements providing students with methodological experience or in-depth exposure to key topics.

Prerequisite: BIO 183
Typically offered in Fall only

MEA 570 Geological Oceanography (3 credit hours)
A comprehensive overview of the geological aspects of oceanography. Topics include: a) marine geophysics and the evolution of ocean basins, b) sedimento logical processes and the formation of marine deposits, c) marine geochemistry and authigenic sedimentation, d) paleoceanography and the interpretation of marine stratigraphy.

Typically offered in Spring only

MEA 573/MEA 473 Principles of Chemical Oceanography (3 credit hours)
Chemical processes controlling the composition of oceans, including discussions of chemical equilibria, biological cycling of nutrients and use of chemical tracers in marine environment; consideration of origin and chemical history of oceans. Credit is not allowed for both MEA 473 and MEA 573

Prerequisite: MEA 440
Typically offered in Fall only

MEA 574 Advanced Igneous Petrology (3 credit hours)
Physicochemical principles related to igneous petrogenesis. General principles and specific problems including origin, differentiation and emplacement of magmas and the possible relationships of igneous processes to global tectonics.

Prerequisite: MEA 440
Typically offered in Fall only

MEA 577 Electron Microprobe Analysis of Geologic Material (2 credit hours)
Theory of quantitative analysis of geologic material by electron beam application; laboratory operation of electron microprobe to acquire chemical composition and x-ray images of geologic material.

Prerequisite: MEA 410
Typically offered in Fall only

MEA 579 Principles of Air Quality Engineering (3 credit hours)
Introduction to: risk assessment, health effects, and regulation of air pollutants; air pollution statistics; estimation of emissions; air quality meteorology; dispersion modeling for non-reactive pollutants; chemistry and models for tropospheric ozone formation; aqueous-phase chemistry, including the ‘acid rain’ problem; integrated assessment of air quality problems; and the fundamentals and practical aspects of commonly used air quality models. Credit is allowed only for one of CE/MEA 479 or CE/MEA 579

Prerequisite: CE 373,CE 282; or CHE 311(CHE Majors); or MEA 421(MEA Majors), Corequisite: ST 370; ST 380(MEA Majors)
Typically offered in Spring only

MEA 580 Air Quality Modeling and Forecasting (4 credit hours)
Topics include numerical solutions to ODEs/PDEs, atmospheric chemistry, cloud and aerosol microphysics, emission modeling, meteorological modeling, and model design, applications, and evaluation. It is targeted for students who would like to learn about air quality modeling and who are prospective air quality model users.

Prerequisite: CSC 112, MEA 425/525, CE 479/579
Typically offered in Fall and Spring

MEA 581/CE 581 Fluid Mechanics in Natural Environments (3 credit hours)
Free surface flows of water and air occurring in natural fluid systems and influencing environmental transport and mixing. Review of fundamental principles of fluids, covering the scales relevant to both engineering and geo-physical applications. Topics and examples include waves, instability, stratification, turbulent boundary layers, jets and plumes, and open channel flows. Cannot receive credit for both CE 581 and MEA 581.

Prerequisite: CE 282 or MEA 463 or permission of instructor
Typically offered in Fall only
ME 582/GIS 582 Geospatial Modeling (3 credit hours)
The course provides foundations in methods for GIS-based surface
analysis and modeling. The topics include proximity analysis with
cost surfaces and least cost paths, multivariate spatial interpolation
and 3D surface visualization. Special focus is on terrain modeling,
geomorphometry, solar irradiation, visibility, and watershed analysis.
Students are also introduced to the basic concepts of landscape process
modeling with GIS and to the principles of open source GIS. Introductory
level knowledge of GIS or surveying/ geomatics principles is required.

Typically offered in Fall and Spring

ME 584/GIS 584 Mapping and Analysis Using UAS (3 credit hours)
The course provides an overview of UAS mapping technology and
its rules and regulations. The principles of UAS data collection are
explained along with optional hands-on practice with in flight planning
and execution. The main focus is on processing imagery collected from
UAS using structure from motion techniques and deriving orthophoto
mosaics and ultra-high resolution digital elevation models of land surface,
vegetation and structures. More advanced topics include multi-temporal
3D data analysis, fusion with lidar data and 3D visualization.

Prerequisite: GIS 510 or GIS/MEA 582 or Permission of Instructor

Typically offered in Summer only

ME 585 Physical Hydrogeology (3 credit hours)
Physical aspects of groundwater flow in geological media. Saturated
and unsaturated flow, Darcy’s equation, heterogeneity and anisotropy,
storage properties of geological materials, effective stress, governing
equations for steady and unsteady flow, recharge, groundwater exchange
with surface water, groundwater flow to wells estimation of hydraulic
properties of aquifers.

Prerequisite: MEA 101, MEA 110, MA 241, and PY 201 or PY 205

Typically offered in Spring only

ME 591 Special Topics in Marine Science (1-6 credit hours)
Opportunity for advanced undergraduate and graduate students to study
timely special problem areas in Marine Science and Engineering

Typically offered in Fall, Spring, and Summer

ME 592 Special Topics in Earth Sciences (1-6 credit hours)
Special topics in earth sciences, provided to groups or to individuals.

Typically offered in Fall, Spring, and Summer

ME 593 Special Topics in Atmospheric Science (1-6 credit hours)
Special topics in atmospheric science, provided to groups or to individuals.

Typically offered in Fall, Spring, and Summer

ME 599 Regional Geology of North America (1-6 credit hours)
Field study of classic geologic localities and geomorphic processes
not indigenous to North Carolina. Typical areas: New England and
adjacent Canada, northern Mexico and southwestern United States and
Pacific Northwest. Representative subjects include Canadian Shield,
Precambrian mineral deposits, San Andreas fault, desert geomorphology,
Grand Canyon stratigraphy, modern and ancient reefs and glaciated

Prerequisite: MEA 101 or MEA 120, Senior standing

Typically offered in Fall only

ME 601 Seminar (1 credit hours)
Presentation by each student of one seminar on his/her current research.
Prerequisite: Graduate standing

Typically offered in Fall and Spring

ME 611 Special Topics in Marine Sciences (1-6 credit hours)
Special topics in earth sciences, provided to groups or to individuals.

Typically offered in Fall, Spring, and Summer

ME 612 Special Topics in Earth Sciences (1-6 credit hours)
Special topics in atmospheric science, provided to groups or to individuals.

Typically offered in Fall, Spring, and Summer

ME 613 Special Topics Atmospheric Sciences (1-6 credit hours)

Typically offered in Fall and Spring

ME 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the
student in planning for the teaching assignment, observe and provide
feedback to the student during the teaching assignment, and evaluate the
student upon completion of the assignment.

Prerequisite: Master’s student

Typically offered in Fall, Spring, and Summer

ME 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all
other requirements of the degree except preparing for and taking the final
master's exam.

Prerequisite: Master’s student

Typically offered in Fall, Spring, and Summer

ME 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member
of the Graduate Faculty.

Prerequisite: Master’s student

Typically offered in Fall and Spring

ME 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master’s Student

Typically offered in Fall and Spring

ME 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course
work during a summer session and who will be devoting full time to thesis
research.

Prerequisite: Master’s student

Typically offered in Summer only

ME 699 Master’s Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-
time enrollment for the master’s degree and are writing and defending
their thesis. Credits Arranged

Prerequisite: Master’s student

Typically offered in Fall, Spring, and Summer
MEA 700 Environmental Fluid Mechanics  (3 credit hours)
Basic concepts and laws governing motion of atmosphere and oceans developed from first principles, including approximations valid for environmental flows, kinematics, dynamics and thermodynamics of fluid flows as well as introduction to environmental turbulence. Credit is not allowed for both MEA 463 and MEA 700
Prerequisite: MA 241, PY 208
Typically offered in Fall only

MEA 703 Atmospheric Aerosols  (3 credit hours)
An understanding of aerosols as primary air pollutants, indoor versus outdoor pollution, transformation processes, prediction of atmospheric concentrations, scavenging of aerosols, transport of air pollutants on a regional scale, discussion of national experiments to characterize and study impact of urban-industrial pollution, tropospheric aerosol and weather, stratospheric aerosol, effect of aerosols on atmospheric warming and cooling and air-quality models.
Prerequisite: (CH 201 or CH 203) and (PY 205 or PY 211), Corequisite: MEA 412
Typically offered in Spring only

MEA 705 Dynamic Meteorology  (3 credit hours)
Brief review of classical and physical hydrodynamics; scale analysis of dynamic equations; atmospheric instabilities; dynamics of tropical convections; perturbation theory and approximations for atmospheric wave motions.
Prerequisite: MEA 422
Typically offered in Spring only

MEA 707 Planetary Boundary Layer  (3 credit hours)
Review of basic equations and concepts of planetary boundary layers. The closure problem and semi-empirical theories of turbulence, buoyancy effects on mean flow and turbulence, instrumentation and observational platforms for PBL experiments, observed characteristics of atmospheric boundary layers, numerical and physical modeling of PBL and its parameterization in large-scale atmospheric circulation models.
Prerequisite: MEA 455 or MEA 721
Typically offered in Fall and Spring

MEA 708 Atmospheric Turbulence  (3 credit hours)
Prerequisite: MAE 550 or MEA 700 or MEA 707
Typically offered in Fall and Spring

MEA 710 Atmospheric Dispersion  (3 credit hours)
Prerequisite: MAE 550 or MEA 700 or MEA 510
Typically offered in Fall only

MEA 712 Mesoscale Modeling  (3 credit hours)
Modeling mesoscale weather phenomena including midlatitude cyclones, mesoscale convective complexes and squall lines. Application of finite difference, spectral and implicit methods and coordinate transforms to these problems. Utilization of explicit representations of moist processes. Development of parameterizations of convective clouds, planetary boundary layer and moist processes.
Prerequisite: MEA 705
Typically offered in Fall only

MEA 713 Mesoscale Dynamics  (3 credit hours)
Prerequisite: MEA 700 and MEA 705
Typically offered in Fall only

MEA 714 Atmospheric Convection  (3 credit hours)
Structure, physics and dynamics of convective clouds and cloud systems; fundamental equations for modeling convection; microphysical parameterization schemes; influence of instabilities on convective cloud systems; severe thunderstorms dynamics; tornadogenesis theories; mesoscale convective systems; upscale feedback effects of convection; cumulus parameterization schemes.
Prerequisite: MEA 412, MEA 700, MEA 705
Typically offered in Fall only

MEA 715 Dynamics of Mesoscale Precipitation System  (3 credit hours)
Frontogenesis theory; inertial and conditional symmetric instability; mesoscale gravity waves and wave-CISK; conveyor belts; seeder-feeder processes and precipitation generating cells; classification and dynamics of precipitation band types.
Prerequisite: MEA 444
Typically offered in Fall only

MEA 716 Numerical Weather Prediction  (3 credit hours)
Parameterization of physical processes in atmospheric modeling, including numerous hands-on experiments to allow evaluation and analysis of process representation in models. Emphasis on experimental design: Using numerical models as a tool with which to test scientific hypotheses. Investigation of data assimilation and ensemble prediction techniques. Journal discussion and student presentations are featured prominently. A semester project allows students to apply knowledge to thesis projects, and synthesize class concepts. Some comfort level with Linux computing environment, shell scripting, and programming languages such as FORTRAN required.
Typically offered in Fall only

MEA 717 Advanced Weather Analysis  (3 credit hours)
Evolution of physical and dynamic structure of synoptic and mesoscale storm systems occurring in middle and high latitudes. Recent advances in understanding these storm systems through intensive field experiments and computer modeling. Introduction to contemporary analysis techniques through laboratory exercises shedding light on storm structure, dynamics and scale interaction.
Prerequisite: MEA 444, MEA 705
Typically offered in Fall only
MEA 719 Climate Modeling  (3 credit hours)

Prerequisite: MEA 705
Typically offered in Fall only

MEA 721 Air-Sea Interaction  (3 credit hours)
Review of basic equations and concepts of turbulent transfer in geophysical flows, air-sea interaction processes and their importance to man's activities, theory and observation of wind-generated ocean surface waves, turbulent transfers in planetaryboundary layer of marine atmosphere, oceanic mixed layer, development of thermocline and inversion.

Prerequisite: MEA 422 or MEA 560
Typically offered in Spring only

MEA 735 Fourier Analysis of Geophysical Data  (3 credit hours)
Application of Fourier analysis to interpretation of low-frequency motions in ocean and atmosphere. Review of Fourier method. Filtering of tidal signals. Spectral estimates and calculation of current ellipses. Identification of coherent motions and

Prerequisite: MA 341 and ST 511
Typically offered in Spring only

MEA 741 Synpotic Physical Oceanography  (3 credit hours)
Basic discussion of the techniques and terminology of synoptic physical oceanography; focus on water characteristics and their relationship to currents in the individual oceans; a systematic quantitative description of the character of ocean waters and

Prerequisite: MEA 560
Typically offered in Spring only

MEA 743 Ocean Circulation  (3 credit hours)
Basic study of mechanics of ocean circulation with emphasis on various simple models of circulation systems.

Prerequisite: MEA 700 or PY 411
Typically offered in Fall only

MEA 744 Dynamics of Shelf Circulation  (3 credit hours)
Description and models of dynamic processes on the shelf, including seiches and tides in gulfs, propagation of tides and storm surges, wind-induced coastal upwelling, continental shelf waves and coastally trapped waves. Steady circulation driven by winds, river plumes and density forcing, formation of shelf-break fronts; and influence from deep-ocean currents.

Prerequisite: MEA 700
Typically offered in Fall only

MEA 752 Marine Plankton Ecology  (3 credit hours)
Examination of worldwide relationships between physical-chemical environment and planktonic organisms. Organism descriptions; effects of light, temperature, salinity, density, water motion and chemical constituents on organisms; interactions among different organisms emphasizing competition and predation; community structure, distribution and succession; and mathematics models of distribution, production and interaction.

Prerequisite: BCH 451 and MA 121 and ZO 419
Typically offered in Fall only

MEA 759 Organic Geochemistry  (3 credit hours)

Typically offered in Fall only

MEA 760 Biogeochemistry  (3 credit hours)
Processes involved in the biogeochemical cycling of C, N, S and related biogenic elements. Stable isotopic and other geochemical signatures of biological processes. Introduction to modeling chemical distributions in sediments. The impact of biogeochemical processes on atmospheric chemistry.

Typically offered in Fall only

MEA 762 Marine Geochemistry  (3 credit hours)
Detailed examination of chemical processes occurring in marine environment. Chemical evolution of the oceans, continental and submarine weathering, particle scavenging of reactive elements from water, column, formation of biogenic and metaliferous deposits, sediment diagenesis and marine geochronology.

Prerequisite: CH 331, MEA 560
Typically offered in Spring only

MEA 763 Isotope Geochemistry  (3 credit hours)
This class offers an interdisciplinary introduction to the principles of isotope chemistry and its application to geological, atmospheric, and biological systems. Key topics include: isotope systematics; isotope measurements and analyses; common radiogenic (U, Ar, Pb, Sr, C, Be) and stable (H, O, C, N, S) isotope systems; applications to geochronology, paleobiology, paleoclimatology, environmental tracking, archeology, and more. This course is aimed at graduate students interested in using isotopes as a tool for examining the natural world.

Restriction: Graduate Standing or Permission of the Instructor
Typically offered in Spring only

MEA 779 Advanced Air Quality  (3 credit hours)
Local, regional and global scale chemical interactions, transport and behavior of trace gases (sulfur carbon, nitrogen, hydrocarbon, and photochemical oxidants) in the atmosphere. covers three primary elements of air quality: anthropogenic and natural emissions of trace gases; interactions of the pollutants in the atmosphere; and monitoring and sampling of gaseous and particulate pollutants.

Prerequisite: (CH 201 or CH 203) and MEA(CE) 479
Typically offered in Spring only
ME 785 Chemical Hydrogeology (3 credit hours)
Prerequisite: (CH 201 or CH 203) and (MEA 585 or CE 584)
Typically offered in Spring only

ME 788 Advanced Structural Geology (3 credit hours)
Principles of rock mechanics and their application in solving geologic problems; finite strain analysis of deformed rocks; advanced techniques of structural analysis; petrofabrics; development of various geologic structures. Emphasis upon application of
Prerequisite: MEA 451
Typically offered in Fall only

ME 789 Topics In Appalachian Geology (3 credit hours)
Examination of geology of areas within Appalachian orogenic belt. Lectures, discussions, reading and review of current literature and consideration of ideas concerning geological evolution of region. Required field trips.
Prerequisite: MEA 440, 450 and 451
Typically offered in Fall only

ME 790 Geotectonics (3 credit hours)
In-depth examination of current ideas in plate tectonic theory. Plate tectonic controls on orogeny, orogenic belts, magmatism and metallogeny.
Prerequisite: MEA 440, 450, 451
Typically offered in Fall only

ME 791 Advanced Special Topics in Marine Science (1-6 credit hours)
Opportunity for advanced undergraduate and graduate students to study timely special problem areas in Marine Science and Engineering
Typically offered in Fall, Spring, and Summer

ME 792 Advanced Special Topics in Earth Sciences (1-6 credit hours)
Special topics in earth sciences, provided to groups or to individuals.
Typically offered in Fall, Spring, and Summer

ME 793 Advanced Special Topics in Atmospheric Science (1-6 credit hours)
Special topics in atmospheric science, provided to groups or to individuals.
Typically offered in Fall, Spring, and Summer

ME 796 Exploration And Engineering Geophysics (3 credit hours)
Geophysical methods as applies to exploring the earth’s mineral and energy resources and to investigating subsurface geological structure and physical properties. Principles, measurements, analyses, and interpretations of gravity, magnetic, electric, electromagnetic, seismic methods. Required research paper.
Prerequisite: MEA 470 or PY 208
Typically offered in Spring only

ME 801 Seminar (1 credit hours)
Presentation by each student of one seminar on his/her current research.
Prerequisite: Graduate standing
Typically offered in Fall and Spring

ME 810 Special Topics (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

ME 811 Special Topics in Marine Sciences (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

ME 812 Special Topics in Earth Sciences (1-6 credit hours)
Typically offered in Fall and Spring

ME 813 Special Topics in Atmospheric Sciences (1-6 credit hours)
Typically offered in Fall and Spring

ME 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

ME 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

ME 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research
Typically offered in Fall, Spring, and Summer

ME 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Summer only

ME 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer
Materials Science and Engineering (MSE)

MSE 200 Mechanical Properties of Structural Materials (3 credit hours)
An introduction to the atomic and grain structure of structural materials emphasizing the mechanical properties. Effects of mechanical and heat treatments on structure and properties. Fatigue and creep of materials, fracture toughness, mechanical and non-destructive evaluation, effects of environment. Design considerations, characteristics of metals, ceramics, polymers and composites. Not for Materials majors
Prerequisite: Grade of C or better in CH 101
Typically offered in Fall, Spring, and Summer

MSE 201 Structure and Properties of Engineering Materials (3 credit hours)
Introduction to the fundamental physical principles governing the structure and constitution of metallic and nonmetallic materials and the relationships among these principles and the mechanical, physical and chemical properties of engineering materials.
Prerequisite: Grade of C or better in CH 101
Typically offered in Fall, Spring, and Summer

MSE 203/BME 203 Introduction to the Materials Science of Biomaterials (3 credit hours)
This course introduces fundamental physical principles governing the structure, processing, properties and performance of metallic, ceramic and polymeric materials. Relationships are developed defining how mechanical, physical and chemical properties are controlled by microstructure and chemistry. Material failure modes are developed with an emphasis on biocompatibility and the applications/performance of materials in the human body. Basic aspects of material biocompatibility are presented, leading into studies of the current and future applications of biomaterials.
Prerequisite: C- or better in CH 101, CH 102 and PY 205
Typically offered in Fall only

MSE 255 Experimental Methods for Structural Analysis of Materials (2 credit hours)
Principles and application of basic techniques for characterizing the structure of materials at different length scales. Optical microscopy, electron microscopy, scanning probe microscopy, X-ray diffraction and spectroscopic methods applied to metals, ceramics, polymers and semiconducting materials.
Corequisite: MSE 201 or MSE 203 or BME 203
Typically offered in Spring only

MSE 260 Mathematical Methods for Materials Engineers (3 credit hours)
Use of MATLAB programming environment to illustrate and discuss principles and applications of analytical and numerical mathematical methods that are central to materials science and engineering. Data plotting, curve fitting, complex numbers and series, Fourier series and transforms, numerical integration and differentiation, linear algebra and matrix manipulation, initial and boundary value problems, numerical solution to ordinary differential equations and transport simulation through the use of partial differential equations.
Corequisite: MA 242
Typically offered in Spring only

MSE 270 Materials Science and Engineering Seminar (1 credit hours)
This course surveys the field of materials science and engineering and introduces students to contemporary issues. Job and career opportunities at the BS and graduate degree levels are presented. Students are introduced to opportunities for laboratory assistant jobs in the MSE department, summer internships, co-ops and summer research experiences at NCSU and other institutions. Students will learn to prepare effective resumes, technical reports and oral presentations.
Corequisite: MSE 201 or MSE 203 or BME 203
Typically offered in Spring only

MSE 300 Structure of Materials at the Nanoscale (3 credit hours)
This course covers the structure of materials at the nanometer scale. Structure includes the periodic arrangements of atoms and ions in crystalline solids, the amorphous networks of atoms, ions, and molecules in glassy materials, and the molecular structure of polymeric and biological materials. The typical means of characterizing nanostructure are also reviewed. Finally, the course will introduce the structure of novel nanomaterials like nanotubes, buckyballs and self assembled monolayers.
Prerequisites: C or better in (MSE 201 or MSE 203 or BME 203)
Typically offered in Fall only

MSE 301 Introduction to Thermodynamics of Materials (3 credit hours)
Review of classical thermodynamics and thermodynamic relationships. Use of statistical methods to describe entropy and other thermodynamic properties. Description of vapor-, liquid-, and solid-phase equilibrium in unary and other multicomponent material systems. Treatment of ideal and nonideal solution behavior in inorganic alloys and organic polymers. Application of gas-phase reaction kinetics and identification of the criteria required for reaction equilibria.
Prerequisite: C or better in (MSE 201 or MSE 203 or BME 203) and MA 242
Typically offered in Fall only

MSE 320 Introduction to Defects in Solids (3 credit hours)
Classification of defects as point, line, surface or volume types. Geometrical and crystallographic aspects of defects. Defects in metallic, ionic and covalently bonded crystal structures. Physical, chemical, electronic and magnetic aspects of defects. Field quantities and forces associated with defects. Novel defects in nanostructured materials and semicrystalline materials.
Prerequisite: C or better in MSE 201 or MSE 203 or BME 203
Typically offered in Fall only

MSE 335 Experimental Methods for Analysis of Material Properties (2 credit hours)
Principles and application of basic techniques for characterizing the properties of materials. Mechanical, thermal, electrical, optical and magnetic property measurements applied to metals, ceramics, polymers and semiconducting materials.
Prerequisite: C- or better in MSE 201
Typically offered in Fall only
MSE 355  Electrical, Magnetic and Optical Properties of Materials  (3 credit hours)
Fundamental treatment of the electronic properties of materials, including the electrical, magnetic and optical characteristics. The role of electrons, band structure, and Brillouin zones on the various classes of materials is discussed from the semiclassical and quantum mechanical viewpoints. Applications of these principles to specific technological devices is also covered.
Prerequisite: PY 208 and MA 341
Typically offered in Spring only

MSE 360  Kinetic Processes in Materials  (3 credit hours)
Types, mechanisms, and kinetics of solid state phase transformations are covered with selected applications to all classes of materials. Mechanisms of diffusion and techniques for diffusion calculations are presented. The role of surface energy and strain in the evolution of structure during transformation is presented. Phenomena at different size scales (atomic, nano, micro) are described relative to the evolution of structure during transformation.
Prerequisite: MA 341 and MSE 301
Typically offered in Spring only

MSE 370  Microstructure of Inorganic Materials  (3 credit hours)
Structure-property relationships in metallic and ceramic materials. Crystal structures of important metallic and ceramic elements, alloys, and compounds. Binary and ternary phase diagrams for notable systems will be presented. Microstructural features to be covered include grain size and distribution, multiphase microstructures, and defects. Examples of important metallic and ceramic systems for structural, electrical, optical and magnetic applications will be given.
Prerequisites: MSE 300, MSE 301, and MSE 320
Typically offered in Spring only

MSE 380  Microstructure of Organic Materials  (3 credit hours)
Covers microstructure and properties of soft materials including polymer molecular weight distributions, amorphous polymers, semicrystalline polymers, copolymers, elastomers, biopolymers, soft tissue, bone and cellular structure. The design and function of implantable biomaterials are also covered.
Prerequisite: CH 220 and MSE 300
Typically offered in Spring only

MSE 409/NE 509/MSE 509/NE 409  Nuclear Materials  (3 credit hours)
Introduces students to properties and selection of materials for nuclear steam supply systems and to radiation effects on materials. Implications of radiation damage to reactor materials and materials problems in nuclear engineering are discussed. Topics include an overview of nuclear steam supply systems, crystal structure and defects, dislocation theory, mechanical properties, radiation damage, hardening and embrittlement due to radiation exposure and problems concerned with fission and fusion materials. Students cannot receive credit for both 409 and 509.
Prerequisite: MSE 201
Typically offered in Fall only

MSE 420  Mechanical Properties of Materials  (3 credit hours)
Basic concepts for mechanical properties of materials, elasticity, plasticity, viscoelasticity, rubber elasticity, strengthening mechanisms, creep, fracture and fatigue. Includes metals, ceramics, polymers and composites. Describes mechanical properties for nanostructured materials and biomaterials.
Prerequisite: MSE 370 and MSE 380
Typically offered in Fall only

MSE 423  Introduction to Materials Engineering Design  (1 credit hours)
Materials selection in engineering design involving lecture, cooperative and problem-based learning techniques. Course stresses creative thinking, problem solving methodology, interdependence of design with analysis and evaluation, teamwork and sharpening of communication skills. Real industrial problems are introduced which are analyzed by student teams. This a half-semester course. The classroom lectures end at mid-semester. In the second half of the semester, student teams develop a proposal which is submitted to the industrial sponsors at the end of the semester. The proposal defines future work to be conducted under MSE 470. Senior standing in MSE.
Prerequisite: Senior standing in MSE
Typically offered in Fall only

MSE 440/MSE 540  Processing of Metallic Materials  (3 credit hours)
Fundamental concepts of solidification and their application to foundry and welding practices; metal forming concepts applied to forging, rolling, extrusion, drawing, and sheet forming operations; machining mechanisms and methods; powder metallurgy; advanced processing methods including rapid solidification and mechanical alloying. Credit for both MSE 440 and MSE 540 is not allowed.
Prerequisite: MSE 360 and MSE 370. Corequisite: MSE 420
Typically offered in Fall only

MSE 445/MSE 545  Ceramic Processing  (3 credit hours)
Ceramic processing of powders includes powder synthesis, characterization, mixing, and size reduction. Theoretical aspects include particle packing, particles in suspension, and some aspects of surface chemistry. Forming methods include compaction, casting, and extrusion. Firing and sintering are examined. Credit for both MSE 445 and MSE 545 is not allowed.
Prerequisite: MSE 370
Typically offered in Fall only

MSE 455  Polymer Technology and Engineering  (3 credit hours)
This course will cover commercial polymers, polymer blends and miscibility, dynamic mechanical behavior, Boltzmann superposition principle, ultimate properties of polymers, polymer rheology and processing, recycling and design and selection of polymeric materials. Guest instructors from industry will give presentations on contemporary topics in polymer technology and engineering. Field trips are required.
Prerequisite: MSE 380
Typically offered in Spring only
MSE 456/MSE 556 Composite Materials (3 credit hours)
The course covers the basic principles underlying properties of composite materials as related to the properties of individual constituents and their interactions. Polymer, metal and ceramic matrix composites are included. Property averaging and micromechanics of composites are covered at an introductory level. Emphasis is placed on design and processing of composite systems to yield desired combinations of properties. Credit for both MSE 456 and MSE 556 is not allowed.
Prerequisite: MSE 420
Typically offered in Spring only

MSE 460 Microelectronic Materials (3 credit hours)
Processes and characterization techniques relevant to microelectronic materials science and technology. Boule growth, wafer preparation, oxidation, epitaxial growth, doping techniques, metallization, and device applications of elemental and compound semiconductors. Electrical, structural and chemical characterization of semiconductors is included as well as materials considerations relevant to device fabrication. Credit for both MSE 460 and MSE 560 is not allowed.
Prerequisite: MSE 355
Typically offered in Fall only

MSE 465/MSE 565 Introduction to Nanomaterials (3 credit hours)
Introduction to nanoparticles, nanotubes, nanowires, and nanostructured films, emphasizing their synthesis, structural and property characterization, novel physical and chemical properties, applications and contemporary literature.
Prerequisite: MSE 201
Typically offered in Spring only

MSE 470 Materials Science and Engineering Senior Design Project (3 credit hours)
Design project in materials science and engineering requiring problem definition and analysis, synthesis, and presentation of a designed solution. Students work in groups with a faculty adviser on problems submitted by local industrial sponsors or emerging research issues that represent the major specialty areas including ceramics, metals, polymers, or electronic materials.
Prerequisite: MSE 423
Typically offered in Spring only

MSE 480/MSE 580 Materials Forensics and Degradation (3 credit hours)
Covers principles and prevention of the degradation of materials. The topics will include dissolution of polymer and ceramic materials, electrochemical corrosion, oxidation of metals and polymers, degradation of polymers, friction and wear, degradation of electrical device components, bio-deterioration of materials, and failure analysis. The general practice in failure analysis will be applied to a variety of case studies to illustrate important failure mechanisms. Credit will not be given for both MSE 480 and MSE 580.
Prerequisite: MSE 370 and MSE 380
Typically offered in Spring only

MSE 485 Biomaterials (3 credit hours)
Introduction to materials of natural and synthetic origin and brief survey of historic, current, and future applications of materials in medicine. Examination of the classes and properties of degradable and non-degradable materials, interactions of materials with cells and tissues, and fundamentals of biocompatibility including inflammation, encapsulation, and infection. Discussion of biomaterial failure mechanisms, regulation, and related ethical concerns.
Prerequisite: BME 203 and BIO 183
Typically offered in Spring only

MSE 489/MSE 589/PY 489/PY 589/ECE 489/ECE 589 Solid State Solar and Thermal Energy Harvesting (3 credit hours)
This course studies the fundamental and recent advances of energy harvesting from two of the most abundant sources, namely solar and thermal energies. The first part of the course focuses on photovoltaic science and technology. The characteristics and design of common types of solar cells is discussed, and the known approaches to increasing solar cell efficiency will be introduced. After the review of the physics of solar cells, we will discuss advanced topics and recent progresses in solar cell technology. The second part of the course is focused on thermoelectric effect. The basic physical properties, Seebeck coefficient, electrical and thermal conductivities, are discussed and analyzed through the Boltzmann transport formalism. Advanced subject such as carrier scattering time approximations in relation to dimensionality and the density of states are studied. Different approaches for further increasing efficiencies are discussed including energy filtering, quantum confinement, size effects, band structure engineering, and phonon confinement.
P: ECE 302 or E 304 or MSE 355 or PY 407
Typically offered in Fall only

MSE 490 Special Topics in Materials Engineering (1-4 credit hours)
Offered as needed for the development of new courses in materials engineering, including areas such as metals, ceramics, polymers, or microelectronic materials.

MSE 495 Materials Engineering Projects (1-6 credit hours)
Application of engineering principles to a specific materials engineering project by a student or small group of students under supervision of a faculty member. A written report required.
Prerequisite: Junior standing or Senior standing
Typically offered in Fall, Spring, and Summer

MSE 500 Modern Concepts in Materials Science (3 credit hours)
Fundamentals of structure, structure modification and properties of materials with emphasis on structure-property relationships and modern theory of solids.
Prerequisite: Graduate standing
Typically offered in Fall and Spring
MSE 509/NE 409/MSE 409/NE 509  Nuclear Materials  (3 credit hours)
Introduces students to properties and selection of materials for nuclear steam supply systems and to radiation effects on materials. Implications of radiation damage to reactor materials and materials problems in nuclear engineering are discussed. Topics include an overview of nuclear steam supply systems, crystal structure defects, dislocation theory, mechanical properties, radiation damage, hardening and embrittlement due to radiation exposure and problems concerned with fission and fusion materials. Students cannot receive credit for both 409 and 509.
Prerequisite: MSE 201
Typically offered in Fall only

MSE 531 Physical Metallurgy  (3 credit hours)
Application and design of selected metals and alloys in a theoretical and practical context. Relationships between mechanical behavior, and alloy chemistry, microstructure, and processing. Corrosion resistance; fatigue failure; creep; brittle fracture. Design of specific microstructures. Credit for both MAT 431 and MSE 531 is not allowed.
Prerequisite: MAT 321, MAT 450, Corequisite: MAT 430
Typically offered in Fall only

MSE 539/MAE 539 Advanced Materials  (3 credit hours)
Introduces production/structure/property/function relation and application of a number of materials mainly for biomedical, mechanical and aerospace applications. Topics include ultra light materials (production, processing and applications of cellular solids), biomaterials (classes and application of materials in medicine and dentistry), composites (classes and application), refractory materials and coatings for high temperature applications, thin film shape memory alloys for micro-electro mechanical systems (MEMS).
Prerequisite: MSE 201 and MAE 314
Typically offered in Fall only

MSE 540/MSE 440 Processing of Metallic Materials  (3 credit hours)
Fundamental concepts of solidification and their application to foundry and welding practices; metal forming concepts applied to forging, rolling, extrusion, drawing, and sheet forming operations; machining mechanisms and methods; powder metallurgy; advanced processing methods including rapid solidification and mechanical alloying. Credit for both MSE 440 and MSE 540 is not allowed.
Prerequisite: MSE 360 and MSE 370. Corequisite: MSE 420
Typically offered in Fall only

MSE 545/MSE 445 Ceramic Processing  (3 credit hours)
Ceramic processing of powders includes powder synthesis, characterization, mixing, and size reduction. Theoretical aspects include particle packing, particles in suspension, and some aspects of surface chemistry. Forming methods include compaction, casting, and extrusion. Firing and sintering are examined. Credit for both MSE 445 and MSE 545 is not allowed.
Prerequisite: MSE 370
Typically offered in Fall only

MSE 555 Polymer Technology and Engineering  (3 credit hours)
Classes of commercially important polymers, advanced topics in phase behavior, viscoelasticity, fracture and ultimate properties of polymers; polymer rheology, and processing; design of polymeric materials. Credit for both MSE 455 and MSE 555 is not allowed.
Prerequisite: MSE 424 or equivalent
Typically offered in Spring and Summer

MSE 556/MSE 456 Composite Materials  (3 credit hours)
The course covers the basic principles underlying properties of composite materials as related to the properties of individual constituents and their interactions. Polymer, metal and ceramic matrix composites are included. Property averaging and micromechanics of composites are covered at an introductory level. Emphasis is placed on design and processing of composite systems to yield desired combinations of properties. Credit for both MSE 456 and MSE 556 is not allowed.
Prerequisite: MSE 420
Typically offered in Spring and Summer

MSE 560 Microelectronic Materials Science and Technology  (3 credit hours)
Processes and characterization techniques relevant to microelectronic materials science and technology. Boule growth, water preparation, oxidation, epitaxial growth, doping techniques, metallization, and device applications of elemental and compound semiconductors. Electrical, structural and chemical characterization of semiconductors as well as materials considerations relevant to device fabrication. Credit for both MAT 460 and MSE 560 is not allowed.
Prerequisite: MAT 331, Corequisite: MAT 431
Typically offered in Fall only

MSE 561/TC 561 Organic Chemistry Of Polymers  (3 credit hours)
Principles of step reaction and addition polymerizations; copolymerization; emulsion polymerization; ionic polymerization; characterization of polymers; molecular structure and properties.
Prerequisite: TC 461 and CH 231 or CH 431

MSE 565/MSE 465 Introduction to Nanomaterials  (3 credit hours)
Introduction to nanoparticles, nanotubes, nanowires, and nanostructured films, emphasizing their synthesis, structural and property characterization, novel physical and chemical properties, applications and contemporary literature.
Prerequisite: MSE 201
Typically offered in Spring only

MSE 566 Mechanical Properties of Nanostructured Materials  (3 credit hours)
The course covers mechanical behavior that is unique to nanostructured materials- typically nanocrystalline metals and alloys. The various methods for processing nanostructured materials will be presented, emphasizing those that are suitable for mechanical property studies. The thermal stability of nanocrystalline microstructures will be covered and strategies for inhibiting grain growth described. Mechanical testing methods for uniaxial loading, creep, fracture and fatigue will be covered. Testing methods will also be discussed in context with structure-property relations, deformation mechanisms and failure modes.
Prerequisite: MSE 500 or an instructor approved equivalent.
Typically offered in Spring only

MSE 575 Polymer Technology and engineering  (3 credit hours)
Classes of commercially important polymers, advanced topics in phase behavior, viscoelasticity, fracture and ultimate properties of polymers; polymer rheology, processing and permeability; design of polymeric materials. Credit for both MAT 475 and MSE 575 is not allowed.
Prerequisite: MAT 424
MSE 576/MBA 576  Technology Entrepreneurship and Commercialization I  (3 credit hours)
First course in a two-course entrepreneurship sequence focusing on opportunities for technology commercialization. Evaluation of commercialization of technologies in the context of new business startups. Emphasis is placed on creating value through technology portfolio evaluation and fundamentals of technology-based new business startups. This includes development of value propositions and strong technology-product-market linkages. The process based approach is appropriate for new business startup as well as entrepreneurship in existing organizations through spinoffs, licensing, or new product development. Credit not allowed for MBA 576 if the student has already taken MBA 570 or MBA 571.

Credit not allowed in MBA 576 if the student has already taken MBA 570 or MBA 571
Typically offered in Fall and Spring

MSE 577/MBA 577  Technology Entrepreneurship and Commercialization II  (3 credit hours)
Continuation of evaluation of technologies for commercialization through new business startups. Emphasis is placed on creating value through strong technology-products-markets linkages using the TEC algorithm. Topics include industry and market testing of assumptions, legal forms of new business startups, funding sources and creating a quality, integrative new business startup plan. Credit not allowed in 577 for students who have already taken 570 or 571.

Prerequisite: MBA/MSE 576. Credit not allowed in 577 for students who have already taken 570 or 571.
Typically offered in Spring only

MSE 580/MSE 480  Materials Forensics and Degradation  (3 credit hours)
Covers principles and prevention of the degradation of materials. The topics will include dissolution of polymer and ceramic materials, electrochemical corrosion, oxidation of metals and polymers, degradation of polymers, friction and wear, degradation of electrical device components, bio-deterioration of materials, and failure analysis. The general practice in failure analysis will be applied to a variety of case studies to illustrate important failure mechanisms. Credit will not be given for both MSE 480 and MSE 580.

Prerequisite: MSE 370 and MSE 380
Typically offered in Spring and Summer

MSE 589/PY 489/PY 589/ECE 489/ECE 589/MSE 489  Solid State Solar and Thermal Energy Harvesting  (3 credit hours)
This course studies the fundamental and recent advances of energy harvesting from two of the most abundant sources, namely solar and thermal energies. The first part of the course focuses on photovoltaic science and technology. The characteristics and design of common types of solar cells is discussed, and the known approaches to increasing solar cell efficiency will be introduced. After the review of the physics of solar cells, we will discuss advanced topics and recent progresses in solar cell technology. The second part of the course is focused on thermoelectric effect. The basic physical properties, Seebeck coefficient, electrical and thermal conductivities, are discussed and analyzed through the Boltzmann transport formalism. Advanced subject such as carrier scattering time approximations in relation to dimensionality and the density of states are studied. Different approaches for further increasing efficiencies are discussed including energy filtering, quantum confinement, size effects, band structure engineering, and phonon confinement.

P: ECE 302 or E 304 or MSE 355 or PY 407
Typically offered in Fall only

MSE 601  Seminar  (1 credit hours)
Reports and discussion of special topics in materials science and engineering and allied fields.

Typically offered in Fall and Spring

MSE 685  Master's Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MSE 690  Master's Examination  (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Summer only

MSE 693  Master's Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Summer only

MSE 695  Master's Thesis Research  (1-9 credit hours)
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MSE 696  Summer Thesis Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only
MSE 699 Master’s Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.
Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

MSE 702 Defects In Solids (3 credit hours)
Prerequisite: MSE 500
Typically offered in Spring only

MSE 703 Interaction of Electrons with Materials (3 credit hours)
This course reviews basic interaction of electrons with solids through the free electron theory, quantum mechanics and quantum phenomena, and band theory. The course provides a practical foundation for understanding of electrical behavior of metals, semiconductors, dielectrics and non-crystalline materials and how this behavior relates to structure and materials processing. Graduate standing in MSE, CBME, ECE, PY, CH, or consent of the instructor required.
Prerequisite: MSE 500
Typically offered in Fall only

MSE 704 Interaction of Photons with Materials (3 credit hours)
This course will answer basic questions on photon-matter interaction: Why do materials appear the way we see them? How can we change and control that? How can we apply their optical properties in various optical elements and optoelectronic devices? The course provides a practical foundation for working with and developing of materials for modern optoelectronic and photonic technologies. Graduate standing in MSE, CBME, ECE, PY, CH, or consent of the instructor required.
Prerequisite: MSE 703
Typically offered in Spring only

MSE 705 Mechanical Behavior Of Engineering Materials (3 credit hours)
Coverage of both fundamental and engineering aspects of mechanical behavior of materials. Elasticity, plasticity and dislocation theory concepts used to describe phenomenological behavior and micro-mechanical mechanisms. Strengthening mechanisms in crystals, high-temperature deformation, fracture mechanics, fracture toughening mechanisms and cyclic deformation.
Prerequisite: MAT 450, MAT 702
Typically offered in Spring and Summer

MSE 706 Phase Transformations and Kinetics (3 credit hours)
Homogeneous and heterogeneous nucleation, spinodal decomposition, interface and diffusion-controlled growth, formal theory of transformation kinetics, precipitation, coarsening, order-disorder, and martensitic transformations.
Prerequisite: MAT 700, MAT 710, and MSE 500
Typically offered in Spring only

MSE 708 Thermodynamics Of Materials (3 credit hours)
Review of first and second laws of thermodynamics, equilibrium and irreversible processes, open and closed systems, partition functions and particle distribution functions. Applications include extension of thermodynamic potentials to situations where electrical, magnetic and stress fields present, heat capacity of crystals, electron gas in metals, solution models, binary phase diagrams and rubber elasticity in polymers.
Prerequisite: MAT 301 and MSE 500
Typically offered in Fall only

MSE 709 Metastable Materials: Processing, Structure, and Properties (3 credit hours)
The thermodynamics and kinetics of the synthesis and stability of a variety of important metastable materials - those materials that are not in the lowest free energy state for the composition and structure - will be described. The common methods for non-equilibrium processing will be covered. A significant part of the course will be devoted to amorphous materials, including their synthesis, structure, and properties. Other topics will include quasi-crystalline materials, metastable crystalline materials, and shape memory alloys. As background for shape memory alloys, diffusionless phase transformations with emphasis on martensitic transformations will be reviewed.
Prerequisite: MSE 500 or Instructor Consent
Typically offered in Fall only

MSE 710 Elements Of Crystallography and Diffraction (3 credit hours)
Crystal symmetry, lattices and space groups; elementary diffraction by crystalline matter; experimental methods of x-ray diffraction.
Typically offered in Fall only

MSE 712 Scanning Electron Microscopy (3 credit hours)
Electron optics, sources and detectors. Beam specimen interactions, secondary and backscattered electrons, and EDS. Resolution limits, experimental conditions, related techniques, beam-induced damage and materials modifications.
Typically offered in Fall only

MSE 715 Fundamentals Of Transmission Electron Microscopy (4 credit hours)
Electron optics, electron-solid interactions, electron diffraction, image contrast, defect characterization, analytical and high resolution microscopy. Parallel laboratory demonstrations and exercises. Laboratory enrollment limited to twelve, but laboratory may be waived with consent of instructor.
Prerequisite: MAT 710
Typically offered in Spring only

MSE 718 Advanced Transmission Electron Microscopy (3 credit hours)
This course provides the advanced graduate student with a detailed knowledge of transmission electron microscopy covering: advanced topics in electron sources, details of electron optics and aberrations, aberration corrected electron microscopy, modeling and simulating interactions of electrons with the specimen, image processing and analysis, and analytical techniques (EELS and EDX). Graduate standing in MSE, CHE, ECE, PHY, CH required or consent of the instructor.
Prerequisite: MSE 715
Typically offered in Fall only

MSE 721 Nanoscale Simulations and Modeling (3 credit hours)
The course is designed to assist engineering students in learning the fundamentals and cutting-edge nature of various simulations methods. The modeling tools range from accurate first principles quantum-based approaches to multi-scale approaches that combine atomic and continuum modeling. Previous knowledge of simulations is not required. The course is appropriate for graduate students in materials science, engineering, chemistry, physics and biomedical fields.
Typically offered in Fall only
MSE 723 Materials Informatics (3 credit hours)
The course aims to introduce the emergent field of materials informatics and current approaches that employ informatics and experimental and computational data to accelerate the process of materials optimization, discovery and development. An emphasis will be placed on practical implementation of machine learning techniques to various materials science problems.

Typically offered in Fall only

MSE 731/MAE 731 Materials Processing by Deformation (3 credit hours)
Presentation of mechanical and metallurgical fundamentals of materials processing by deformation. Principles of metal working, friction, forging, rolling, extrusion, drawing, high energy rate forming, chipless forming techniques, manufacturing system concept in production.

Prerequisite: Six hrs. of solid mechanics and/or materials
Typically offered in Fall only

MSE 741 Principles of Corrosion (3 credit hours)
Fundamentals of metallic corrosion and passivity. Electro-chemical nature of corrosive attack, basic forms of corrosion, corrosion rate factors, methods of corrosion protection. Laboratory work included.

Prerequisite: MAT 201 and CH 431 or MAT 301

MSE 751 Thin Film and Coating Science and Technology I (3 credit hours)
Vacuum science and technology including gas kinetics, gas flow calculations, system design and use of various pumps, materials and components. Atomistics of solid surfaces. Nucleation and growth of films and coatings.

Prerequisite: MAT 700
Typically offered in Spring only

MSE 752 Thin Film and Coating Science and Technology II (3 credit hours)

Prerequisite: MSE 751
Typically offered in Spring only

MSE 757 Radiation Effects on Materials (3 credit hours)
Interaction of radiation with matter with emphasis on microstructural modification, physical and mechanical effects. Defects generation and annealing, void swelling, irradiation growth and creep, and irradiation induced effects in reactor materials are discussed. Current theories and experimental techniques are discussed.

Typically offered in Spring only

MSE 760 Materials Science in Processing of Semiconductor Devices (3 credit hours)
Ion implantation and doping for advanced semiconductor devices, thin films and epitaxy, silicides, ohmic contacts and interconnection metallurgy, oxidation and nitration, gettering of impurities and dopant segregation phenomena, electromigration, electronic packaging materials science and advanced device concepts.

Prerequisite: MAT 460 and MSE 500
Typically offered in Fall only

MSE 761/CHE 761 Polymer Blends and Alloys (3 credit hours)
Thermodynamics, morphological characteristics and properties of multiphase polymer systems composed of homopolymers or copolymers. Interfacial characteristics and modification of multicomponent polymer blends through emulsification and reactive blending. Microphase ordering in block copolymers, and emerging technologies employing these nanostructured materials. Conformational properties and dynamics of macromolecules constrained near an interface.

Prerequisite: CHE 316 or MAT 301
Typically offered in Fall only

MSE 763/TMS 763 Characterization Of Structure Of Fiber Forming Polymers (3 credit hours)
Theories, experimental evidence and characterization methods of the molecular fine structure of fiber forming polymers in the solid state. Characterization methods include X-ray diffraction, microscopy, infrared, thermal and magnetic resonance.

Prerequisite: Graduate standing
Typically offered in Fall only

MSE 770 Defects, Diffusion and Ion Implantation In Semiconductors (3 credit hours)
Thermodynamics of vacancies and interstitials, defect complexes, electronic defects, defect annealing processes, self diffusion, dopant and impurity diffusion, substitutional/interstitial diffusion, diffusion in amorphous solids, electro transport, fundamentals of ion-solid interactions, semiconductor doping atomic structure of defects, damage annealing processes, supersaturated alloys, laser annealing, ion beam mixing phenomena, ion implantation and rapid thermal annealing processes, shallow junctions and devices.

Prerequisite: MAT 701
Typically offered in Spring only

MSE 771 Materials Science of Nanoelectronics (3 credit hours)
Effects of scale less than 100 nm on the electrical properties & processing of all materials (metals, semiconductors, ceramics, polymers and biomaterials). Current status and future prospects for the semiconductor industry summarized by invited scientists and by review and discussion of selected current literature. Student presentations and research proposals are required.

Prerequisite: MSE 500
Typically offered in Fall only

MSE 775 Structure of Semicrystalline Polymers (3 credit hours)
Structure and organization of semicrystalline polymers, from molecular scale to bulk state, including chain configuration, unit cell geometries, polymer crystallography, single crystals, spherulites, epitaxial crystallization, morphology, crystal defects, annealing and deformation mechanisms. Emphasis on analysis of x-ray diffraction, electron diffraction and electron microscopy data for structural characterization.

Prerequisite: MAT 425
Typically offered in Fall only

MSE 791 Advanced Topics in Materials Science and Engineering (1-3 credit hours)
Special studies of advanced topics in materials science and engineering.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer
MSE 795 **Advanced Materials Experiments** (1-3 credit hours)
Advanced engineering principles applied to a specific experimental project dealing with materials. A seminar period provided; required written report.
Prerequisite: Senior standing or Graduate standing
Typically offered in Fall, Spring, and Summer

MSE 801 **Seminar** (1 credit hours)
Reports and discussion of special topics in materials science and engineering and allied fields.
Typically offered in Fall and Spring

MSE 885 **Doctoral Supervised Teaching** (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MSE 890 **Doctoral Preliminary Exam** (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Summer only

MSE 893 **Doctoral Supervised Research** (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MSE 895 **Doctoral Dissertation Research** (1-9 credit hours)
Dissertation Research
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MSE 896 **Summer Dissertation Research** (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Summer only

MSE 899 **Doctoral Dissertation Preparation** (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

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**Math & Science Education (EMS)**

EMS 204 **Introduction to Mathematics Education** (2 credit hours)
This course introduces students to the teaching of Mathematics in middle and high schools. Students will become familiar with state mathematics standards and national recommendations for teaching mathematics. The course has a required fieldwork component in local K-12 schools, and students are responsible for their own transportation to and from the schools. Students are required to purchase internshio liability insurance to participate in this course. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge. This course is restricted to Teacher Education majors.
Prerequisite: ED 100; Corequisite: ED 204
Typically offered in Fall and Spring

EMS 205 **Introduction to Teaching Science** (2 credit hours)
Introduces perspective teachers to the teaching of science in the middle school and high school. Topics include nature of the science learner, common alternative conceptions in science, introduction to science teaching strategies, and the science curriculum in middle and high school. Sophomore status or higher is required. Sophomore status or higher is required.
Prerequisite: Sophomore standing; Corequisite: ED 204
Typically offered in Spring only

EMS 296 **Special Topics in Education** (1-3 credit hours)
Individual or group study of particular areas of education at the freshman and sophomore levels. Specific topics will vary from semester to semester.

EMS 350 **Teaching Environmental Education** (3 credit hours)
This course is designed to provide disciplinary and interdisciplinary overviews of environmental education. Students will learn a range of research-supported practices in environmental education that are effective for youth and adults. Topics include a GEP Interdisciplinary Perspectives
Typically offered in Fall only

EMS 373 **Instructional Materials in Science** (3 credit hours)
Development and selection of teaching materials that reflect concepts of content and emphasis in middle and secondary school science. Experimental and laboratory approaches, including use of microcomputer and video technologies. 2 lecture hours and 6 lab hours per week for 7 weeks.

EMS 375 **Methods of Teaching Science I** (3 credit hours)
Classroom, laboratory, and internship experiences for pre-service teachers to effectively prepare, plan and assess learning environments in the middle and secondary science classroom and instructional laboratory. Emphasis placed on knowledge, skills, and dispositions for inquire-based learning environments.
Prerequisite: EMS 205, ED 204
Typically offered in Spring only
EMS 470/EMS 570 Methods and Materials for Teaching Mathematics (3 credit hours)
Purpose, methods, curricula, and evaluation practices for teaching mathematics in middle and high school levels.
Prerequisite: C or better in EMS 480 and admittance to Teacher Candidacy; Corequisite: EMS 472 OR EMS 474
Typically offered in Fall only

EMS 471 Student Teaching in Mathematics (1-12 credit hours)
Supervised experience in a selected middle or secondary school for the semester, to develop and practice the skills and techniques for teaching mathematics. Students are required to provide their own transportation. MED, MSM and MSD majors only.
Prerequisite: Admission to professional semester, Completion of EMS 470 with a C or better; Corequisite: EMS 495
Typically offered in Spring only

EMS 472/EMS 572 Teaching Mathematics Topics in Senior High School (3 credit hours)
Preparation for teaching mathematics in grades 9-12. This course includes a school-based field experience. Students are required to provide their own transportation. MED Majors only.
Prerequisite: EMS 480 passed with a C or better; Corequisite EMS 470
Typically offered in Fall and Spring

EMS 474 Teaching Mathematics Topics in the Middle Grades (3 credit hours)
Methods of teaching arithmetic, geometry, algebra, and pre-algebra topics in grades 6-9. Emphasizes approaches that actively involve learners and relate operations on concrete and pictorial representations to mathematical symbols. This course includes a school-based field experience. Students are required to provide their own transportation. MSM Majors only.
Prerequisite: EMS 480 passed with a C or better; Co-requisite: EMS 470
Typically offered in Fall and Spring

EMS 475 Methods of Teaching Science II (3 credit hours)
Goals, methods, curricula, and evaluation practices in teaching the physical and biological sciences at the middle and secondary school levels. Taught during the fall.
Prerequisite: EMS 375
Typically offered in Fall only

EMS 476 Student Teaching in Science (1-12 credit hours)
Supervised experience in a selected middle or secondary school for the semester, to develop and practice the skills and techniques for teaching Science. Students are required to provide their own transportation. SED and MSS majors only. Students are required to purchase internships liability insurance to participate in student teaching. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge.
Prerequisite: EMS 475; and Corequisite: EMS 495
Typically offered in Spring only

EMS 480/EMS 580 Teaching Mathematics with Technology (3 credit hours)
Prepares prospective mathematics teachers to use technology in their classrooms to assist students in formulating and solving math problems in the middle and high school mathematics curricula.
Prerequisite: EMS 204 with a B- or better; MA 131 or 141
Typically offered in Fall and Spring

EMS 490 School Mathematics from an Advanced Perspective (3 credit hours)
This course will serve as a culminating experience for all students majoring in mathematics education and intending to become secondary mathematics teachers. Course content includes functions in both secondary and collegiate mathematics, development of euclidean geometry from euclid's elements, and historical overview of algebra, and other mathematics subject matter, a trigonometry review from both triangle basis and function basis, connections between linear algebra and the high school presentation of matrices, and other topics. For Math Education majors only.
Prerequisite: MA 403 or MA 407, MA 308 or MA 408, MA 205 or MA 305 or MA 405
Typically offered in Fall and Spring

EMS 495 Senior Seminar in Mathematics and Science Education (1-3 credit hours)
In-depth investigation of one or more teaching areas in mathematics or science education.
Prerequisite: Advanced Undergraduate standing
Typically offered in Spring only

EMS 496 Special Topics in Education (1-3 credit hours)
Individual or group study of special topics in professional education. The topic and mode of study are determined by the faculty member after discussion with the student.
Prerequisite: Junior or senior standing

EMS 505 Methods of Teaching Science I (3 credit hours)
Graduate students new to science teaching will read current research literature that defines best practices and incorporate these practices to lesson planning that enhances student learning. Classroom, laboratory, and school-based experiences in middle and secondary science classrooms and instructional laboratories will help students to effectively prepare, plan, and assess learning environments. Emphasis placed on the development of knowledge, skills, and dispositions for inquiry-based learning environments. Underlying theoretical framework is constructivism, and experiences will be discussed using current learning theory. PBS or Graduate Standing.
Typically offered in Spring only

EMS 506 Methods of Teaching Science II (3 credit hours)
Second course in the MAT science series. Students will plan units of instruction for student teaching, and an emphasis is placed on planning for classroom management and student diversity. Current theoretical frameworks are emphasized in the context of practical field experiences. PBS or Graduate Standing.
Typically offered in Fall only
EMS 510 Interactions In the Mathematics Classroom (3 credit hours)
This course focuses on interactions between students and teachers in the mathematics classroom. Topics studied will include: whole class instruction, small group activity, questioning and facilitating classroom discussion. This course will include a field experience in the schools for which students will be required to provide their own transportation. Course restricted to mathematics education students in the MED, MS or MAT programs.

Typically offered in Spring only

EMS 512 Teaching and Learning Elementary and Middle Grades Mathematics (3 credit hours)
Focus on theory, research, and methodology of teaching and learning mathematics in elementary and middle grades. Emphasizes the development of a foundation for understanding and assessing mathematical growth and learning through historical and psychological sources, research, and reflective practice. Emphasis is placed upon understanding how children come to learn elementary mathematics meaningfully and what this necessarily implies about the way mathematics is taught and how elementary and middle grades education can be improved.

Prerequisite: EMS 471
Typically offered in Fall only

EMS 513 Teaching and Learning of Algebraic Thinking (3 credit hours)
Teaching and learning of algebra from a developmental perspective; research-based methods for developing students’ algebraic thinking; structure and processes used in algebra. Focus on how students develop algebraic ideas from upper elementary grades through middle grades.

Prerequisite: EMS 471 or equivalent teaching experience.
Typically offered in Fall only

EMS 514 Teaching and Learning of Geometric Thinking (3 credit hours)
Focus will be on the development of geometric thinking in grades K-12 using multiple instructional approaches, including technology, and considered using different theories of learning and frameworks (e.g., Van Hiele, SOLO taxonomy). Topics may include: measurement, similarity, congruence, properties of 2 and 3 dimensional figures, circles, non-Euclidean geometries. Synthetic, analytic and transformational, formal and informal approaches will be highlighted.

Prerequisite: EMS 471 and either MA 308 or MA 408
Typically offered in Fall only

EMS 519/ST 519 Teaching and Learning of Statistical Thinking (3 credit hours)
This course is designed to bridge theory and practice on how students develop understandings of key concepts in data analysis, statistics, and probability. Discussion of students’ understandings, teaching strategies and the use of manipulatives and technology tools. Topics include distribution, measures of center and spread, sampling, sampling distribution, randomness, and law of large numbers. Must complete a first level graduate statistics course (ST 507, ST 511, or equivalent) before enrolling.

Prerequisite: ST 507 or ST 511
Typically offered in Spring only

EMS 521 Advanced Methods in Science Education I (3 credit hours)
Current research literature will guide the development of plans to improve classroom teaching practices. Action research used to evaluate instructional impact of modifications to classroom strategies. What it means to teach science, what it means to teach a diverse population of students and how to develop, interpret, and implement alternative assessment.

Prerequisite: Graduate standing in Science Education
Typically offered in Spring only

EMS 522 Advanced Methods in Science Education II (3 credit hours)
Examines science instruction through analysis of curricula, instructional practices, current research on science learning and teaching. Five areas of interest: curriculum, instruction, assessment, diversity, learning environments and technology in science education.

Prerequisite: EMS 521 and graduate standing in Science Education
Typically offered in Spring only

EMS 531 Introduction to Research in Science Education (3 credit hours)
Introduction to techniques and designs specific to and/or in the context of science education research. Analyze and critique findings of other science education researchers in current science education research literature. Perform and interpret quantitative and qualitative analyses commonly used in science education research. Carry out research project focusing on an aspect of science education, communicate research findings in both oral and written form.

Prerequisite: Graduate standing in Science Education
Typically offered in Spring only

EMS 570/EMS 470 Methods and Materials for Teaching Mathematics (3 credit hours)
Purposes, methods, curricula, and evaluation practices for teaching mathematics in middle and high school levels.

Prerequisite: C or better in EMS 480 and admittance to Teacher Candidacy; Corequisite: EMS 472 OR EMS 474
Typically offered in Fall only

EMS 572/EMS 472 Teaching Mathematics Topics in Senior High School (3 credit hours)
Preparation for teaching mathematics in grades 9-12. This course includes a school-based field experience. Students are required to provide their own transportation. MED Majors only.

Prerequisite: EMS 480 passed with a C or better; Corequisite EMS 470
Typically offered in Fall and Spring

EMS 573 Design of Tools and Learning Environments in STEM Education (3 credit hours)
The course aims to develop: familiarity with research related to the teaching and learning of STEM content within technological learning environments, advanced knowledge of the ways technology can support teaching and learning in STEM, and ability to design technology-enabled learning experiences. Course activities are designed to enhance understandings and applications of technological tools within and across STEM disciplines.

Restriction: Graduate standing in STEM Education
Typically offered in Fall and Spring
EMS 575 Foundations Of Science Education (3 credit hours)
Study and analysis of philosophical, historical, sociological, political and economic factors affecting science education in schools of the U.S. Implications for science education of various learning theories along with models for curriculum development and program planning. Critical analysis of current trends, issues and problems in science education in terms of multiple perspectives.
Prerequisite: EMS 475
Typically offered in Spring only

EMS 577 Improving Classroom Instruction In Science (3 credit hours)
Application of major principles of education and psychology to improvement of science teaching in elementary, middle and secondary schools. Emphasis on critical analysis of research and the development of research-based classroom applications. Goals and objectives of science teaching, instructional strategies, development or selection of science materials, evaluation of achievement and elements of a desirable classroom climate.
Prerequisite: EMS 475
Typically offered in Spring only

EMS 580/EMS 480 Teaching Mathematics with Technology (3 credit hours)
Prepares prospective mathematics teachers to use technology in their classrooms to assist students in formulating and solving math problems in the middle and high school mathematics curricula.
Prerequisite: EMS 204 with a B- or better; MA 131 or 141
Typically offered in Fall only

EMS 581 Advanced Applications of Technology in Mathematics Education (3 credit hours)
Research-based applications of technology tools in secondary and middle school mathematics. Advanced use of various technology tools for learning and teaching mathematics, including design of technology environments, appropriate investigation tasks, and professional development.
Typically offered in Spring only

EMS 592 Special Problems In Mathematics Teaching (1-6 credit hours)
In-depth investigation of topical problems in mathematics teaching chosen from areas of curriculum, methodology, technology, supervision and research.
Prerequisite: EMS 471
Typically offered in Fall, Spring, and Summer

EMS 594 Special Problems In Science Teaching (1-3 credit hours)
In-depth investigation of topics in science education not covered in existing courses. Includes critical analysis of research and may include field work. May be offered on individual basis or as a class.
Prerequisite: EMS 476
Typically offered in Fall, Spring, and Summer

EMS 621 Special Problems In Mathematics Teaching (1-6 credit hours)
In-depth investigation of topical problems in mathematics teaching chosen from areas of curriculum, methodology, technology, supervision and research.
Prerequisite: EMS 471
Typically offered in Summer only

EMS 622 Special Problems In Science Teaching (1-6 credit hours)
In-depth investigation of topics in science education not covered in existing courses. Includes critical analysis of research and may include field work. May be offered on individual basis or as a class.
Prerequisite: EMS 476
Typically offered in Fall, Spring, and Summer

EMS 630 Independent Study in EMS (1-3 credit hours)
Detailed investigation of topics of particular interest to graduate students under faculty direction on a tutorial basis. Determination of credits and content by faculty member in consultation with department head.
Typically offered in Fall, Spring, and Summer

EMS 641 Practicum In Science and Mathematics Education (1-6 credit hours)
Supervised practicum in appropriate settings both on- and off-campus. Provision for opportunity for development, implementation and evaluation in science and mathematics in clinical environment under faculty supervision.
Prerequisite: EMS 770 or EMS 775
Typically offered in Fall and Spring

EMS 651 Internship In Mathematics And Science Education (1-9 credit hours)
Utilizing the participant-observed role, required participation in selected educational situations with emphasis upon development of observational skills, ability to record relevant observations by means of written journals, skills in analyzing experiences identifying critical incidents and projection of events and consequences. Student required to develop possible alternative courses of action in various situations, select one of the alternatives and evaluate consequences of selected course of action.
Prerequisite: Nine hrs. in grad. level courses
Typically offered in Summer only

EMS 675 Portfolio Development (1 credit hours)
Techniques of portfolio construction for documenting attainment of advanced competencies in science training. For students in the last or next to last semester of coursework in the Science Education Masters Program.
Typically offered in Fall only

EMS 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall and Spring
EMS 686 Teaching In College (3 credit hours)
Focus on development of competencies to perform fundamental tasks of a college teacher as well as consideration of more long-range tasks such as course development and university responsibilities of a professor. In addition to attending lectures and other types of presentations, students make video tapes of their teaching, develop tests, design introductory courses in their teaching fields and consider current issues related to university and college teaching.

Typically offered in Summer only

EMS 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master’s programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master’s exam, etc.

Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

EMS 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master’s programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master’s exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master’s student
Typically offered in Spring and Summer

EMS 690 Master’s Examination (1-9 credit hours)
For students in non-thesis master’s programs who have completed all other requirements of the degree except preparing for and taking the final master’s exam.

Prerequisite: Master’s student
Typically offered in Spring only

EMS 692 Research Projects In Mathematics and Science Education (1-3 credit hours)
A project or problem in research in education for graduate students, supervised by members of the graduate faculty. The research chosen on basis of individual students’ interests and not to be part of thesis or dissertation research.

Prerequisite: ELP 532
Typically offered in Fall, Spring, and Summer

EMS 693 Master’s Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master’s student
Typically offered in Fall and Summer

EMS 695 Master’s Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

EMS 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master’s student
Typically offered in Summer only

EMS 699/EOE 699/EAC 699/ECI 699/ELP 699 Master’s Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master’s degree and are writing and defending their theses.

Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

EMS 703 Teaching Mathematics and Science In Higher Education (3 credit hours)
Examination of collegiate mathematics and science instruction with respect to goals and objectives, design of courses and curricula, innovative programs and facilities, and methods and materials for instruction.

Prerequisite: EMS 770, 621 or 622, Graduate standing
Typically offered in Spring only

EMS 704 Curriculum Development and Evaluation In Science and Mathematics (3 credit hours)
Critical study of elements of curriculum design and theory in mathematics education and science education and examination of evaluation procedures for assessing educational innovations.

Prerequisite: 500-level statistics, PSY 535
Typically offered in Spring only

EMS 705 Education and Supervision Of Teachers Of Mathematics and Science (3 credit hours)
Critical analysis of theories, programs and techniques designed to promote interpersonal interactions leading to more effective teaching of science and mathematics.

Prerequisite: EMS 770 or 621 or 622
Typically offered in Spring only

EMS 711 Research on the Teaching and Learning of Math at Secondary and Early College Levels (3 credit hours)
This course familiarizes students with theories and research related to mathematical thinking, learning and teaching at the secondary and early college levels with a focus on the following topics: function, expressions and equations, geometry, proof, limit, calculus, differential equations, and linear algebra. Students will apply theories to analyze secondary and freshmen/sophomore standing mathematical thinking, synthesize research findings, explain difficulties students experience, and design and conduct research. Restriction: at least 18 hrs of 400-500 level mathematics and a PhD student in Mathematics Education.

Typically offered in Spring only
EMS 712 Teaching Mathematics in Elementary and Junior High School (3 credit hours)
Comprehensive study of teaching mathematics in elementary and junior high schools. Major emphasis on building skills in teaching arithmetic, elementary algebra and intuitive geometry. Thorough search of literature relative to mathematics curricula conducted, designing and sequencing of learning activities, teaching mathematical concepts and relationships, building skill in computation, reading mathematics, problem solving and measurement.
Prerequisite: EMS 471
Typically offered in Spring and Summer

EMS 730 Trends and Issues in Science Education (3 credit hours)
Provides an in-depth examination and analysis of literature and research in science education as well as current trends in science education reform. Emphasis is placed on the analysis of theoretical models of inquiry. Course includes the development of
Prerequisite: Graduate standing
Typically offered in Fall only

EMS 731 Fundamentals of Research in Science Education: Qualitative and Quantitative Inquiry (3 credit hours)
Analyzes the range of research designs currently utilized by science education researchers. Develop an understanding of the assumptions and frameworks of different types of inquiry in science education. A brief history of research in science education is examined as a means to orient students to the trends that have taken place. Read, comprehend, and critically analyze qualitative and quantitative designs in science education.
Prerequisite: Graduate standing and ST 507 or 511, Corequisite: ST 508 or 512
Typically offered in Spring only

EMS 732 Theoretical and Critical Perspectives of Science Education (3 credit hours)
Examines current theoretical and critical perspectives of science education. Examines a variety of approaches which re-assess cultural notions of meaning, identity, power, and representation in the sciences and science education. Applies research theory to reform in science education.
Prerequisite: Graduate standing
Typically offered in Fall only

EMS 770 Foundations of Mathematics Education (3 credit hours)
The current status of mathematics education with special emphasis on study and critical analysis of current practices in mathematics instruction from elementary school through college.
Prerequisite: EMS 471
Typically offered in Spring only

EMS 775 Foundations of Science Education (3 credit hours)
Study and analysis of philosophical, historical, sociological, political and economic factors affecting science education in schools of the U.S. Implications for science education of various learning theories along with models for curriculum development and program planning. Critical analysis of current trends, issues and problems in science education in terms of multiple perspectives.
Prerequisite: EMS 475
Typically offered in Spring only

EMS 777 Improving Classroom Instruction in Science (3 credit hours)
Application of major principles of education and psychology to improvement of science teaching in elementary, middle and secondary schools. Emphasis on critical analysis of research and the development of research-based classroom applications. Goals and objectives of science teaching, instructional strategies, development or selection of science materials, evaluation of achievement and elements of a desirable classroom climate.
Prerequisite: EMS 475
Typically offered in Spring only

EMS 786/EAC 786 Teaching in College (3 credit hours)
Focus on development of competencies to perform fundamental tasks of a college teacher as well as consideration of more long-range tasks such as course development and university responsibilities of a professor. In addition to attending lectures and another types of presentations, students make video tapes of their teaching, develop tests, design introductory courses in their teaching fields and consider current issues related to university and college teaching.
Typically offered in Fall and Summer

EMS 791 Contemporary Research and Critical Issues in STEM Education (3 credit hours)
This course is designed to provide disciplinary and interdisciplinary overviews of STEM issues and trends that will help graduate students construct their own theoretical foundations and practical understanding of STEM education. In the course, students will discuss a wide range of current issues, movements, and research-supported practices in STEM education not only in K-16 classrooms but also informal education settings. Students will also have opportunities to conceptualize their own framework for quality STEM education connecting research and practice in the field. A main course activity will be reading, analysis, and discussion of selected readings in each topic area. Students will share the responsibility of guiding class discussions, write up reflection and conceptualization, and conduct individual project that relates directly to the main topics explored in the course.
Typically offered in Spring only

EMS 792 Special Problems in Math Teaching (3-6 credit hours)
In-depth investigation of topical problems in mathematics teaching chosen from areas of curriculum, methodology, technology, supervision and research.
Typically offered in Fall, Spring, and Summer

EMS 794 Special Problems in Science Teaching (3-6 credit hours)
In-depth investigation of topics in science education not covered in existing courses. Includes critical analysis of research and may include field work. May be offered on individual basis or as a class.
Prerequisite: EMS 476
Typically offered in Fall, Spring, and Summer

EMS 802 Seminar in Mathematics Education (1-12 credit hours)
In-depth examination and analysis of literature and research in a particular topic(s) in mathematics education.
Prerequisite: Departmental Majors
Typically offered in Fall and Spring
EMS 803 Seminar in Science Education (2 credit hours)
In-depth examination and analysis of literature and research in a particular topic(s) in science education.
Prerequisite: Department Majors
Typically offered in Fall and Spring

EMS 821 Special Problems in Mathematics Teaching (1-6 credit hours)
In-depth investigation of topical problems in mathematics teaching chosen from areas of curriculum, methodology, technology, supervision and research.
Prerequisite: EMS 471
Typically offered in Summer only

EMS 822 Special Problems in Science Teaching (1-6 credit hours)
In-depth investigation of topics in science education not covered in existing courses. Includes critical analysis of research and may include field work. May be offered on individual basis or as a class.
Prerequisite: EMS 476
Typically offered in Fall, Spring, and Summer

EMS 832 Research Applications in Science Education (3 credit hours)
Provides students with the opportunity to design science education research including formulating research questions, designing the methodologies to be used in the study, selecting assessments and protocols, and identifying appropriate analyses. Theoretical frameworks and associated assumptions are identified and critiqued. Develop advanced skills in reviewing different types of science education research and identifying issues of validity and reliability.
Prerequisite: EMS 730, EMS 731, ST 508
Typically offered in Spring only

EMS 841 Practicum in Science and Mathematics Education (1-6 credit hours)
Supervised practicum in appropriate settings both on- and off-campus. Provision for opportunity for development, implementation and evaluation in science and mathematics in clinical environment under faculty supervision.
Prerequisite: EMS 770 or EMS 775
Typically offered in Fall, Spring, and Summer

EMS 851 Internship in Mathematics and Science Education (1-9 credit hours)
Utilizing the participant-observer role, required participation in selected educational situations with emphasis upon development of observational skills, ability to record relevant observations by means of written journals, skills in analyzing experiences identifying critical incidents and projection of events and consequences. Student required to develop possible alternative courses of action in various situations, select one of the alternatives and evaluate consequences of selected course of action.
Prerequisite: Nine hrs. in grad. level courses
Typically offered in Fall, Spring, and Summer

EMS 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

EMS 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

EMS 892 Research Projects in Mathematics and Science Education (1-3 credit hours)
A project or problem in research in education for graduate students, supervised by members of the graduate faculty. The research chosen on basis of individual students’ interests and not to be part of thesis or dissertation research.
Prerequisite: ELP 532
Typically offered in Fall, Spring, and Summer

EMS 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

EMS 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

EMS 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Summer only

EMS 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer
Math in Agriculture and Related Sciences (MAA)

MAA 102 Mathematics in Agriculture and Related Sciences (3 credit hours)
Develops the ability to utilize skills and technology to solve problems at a level found in non-mathematics-intensive programs. Topics include applications to percent, ratio and proportions, formulas, algebra and solutions to linear equations and the elements of plane geometry. Applications include, but are not limited to, business, finance and agriculture. Restricted to Agricultural Institute Students only. C-Wall course; Prerequisite for MA 103, Topics in Contemporary Math.

Requisite: Agricultural Institute Only
Typically offered in Fall and Spring

Mathematical Sciences (MSGE)

MSGE 295 Mathematical Sciences Special Topics (3 credit hours)
Special topics course offering for the general education Mathematical Sciences category.

GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

Mathematics (MA)

MA 101 Intermediate Algebra (4 credit hours)
Preparation for MA 103, MA 105, MA 107, MA 111, and MA 114. Reviews main topics from high school Algebra I and Algebra II emphasizing functions and problem solving. Other concepts and skills covered include algebraic operations, factoring, linear equations, graphs, exponents, radicals, complex numbers, quadratic equations, radical equations, inequalities, systems of equations, compound inequalities, absolute value in equations and inequalities. MA 101 may not be counted as credit toward meeting graduation. Credit for MA 101 is not allowed if student has prior credit in any other mathematical course.

Typically offered in Summer only

MA 103/MA 103A Topics in Contemporary Mathematics (3 credit hours)
Primarily for students in Humanities and Social Sciences. Illustrations of contemporary uses of mathematics, varying from semester to semester, frequently including sets and logic, counting procedures, probability, modular arithmetic, and game theory.

Prerequisite: MA 101 or equivalent completed in high school
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 103A/MA 103 Topics in Contemporary Mathematics (3 credit hours)
Primarily for students in Humanities and Social Sciences. Illustrations of contemporary uses of mathematics, varying from semester to semester, frequently including sets and logic, counting procedures, probability, modular arithmetic, and game theory.

Prerequisite: MA 101 or equivalent completed in high school
GEP Mathematical Sciences
Typically offered in Fall and Spring

MA 105 Mathematics of Finance (3 credit hours)
Simple and compound interest, annuities and their application to amortization and sinking fund problems, installment buying, calculation of premiums of life annuities and life insurance.

Prerequisite: MA 101 or equivalent completed in high school
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 107 Precalculus I (3 credit hours)
Algebra and basic trigonometry; polynomial, rational, exponential, logarithmic and trigonometric functions and their graphs. Credit for MA 107 does not count toward graduation for students in Engineering, College of Sciences, Bio and Ag Engineering (Science Program), Bio Sci (all options), Math Edu, Sci Edu, Textiles, and B.S. degrees in CHASS. Credit is not allowed for both MA 107 and MA 111

Prerequisite: C- or better in MA 101, or a 450 or better on the SAT Subject Test in Mathematics Level 2 or the NCSU Math Skills Test.
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 108 Precalculus II (3 credit hours)
Algebra, analytic geometry and trigonometry; inequalities, conic sections, complex numbers, sequences and series, solving triangles, polar coordinates, and applications. Credit for MA 108 does not count toward graduation for students in Engineering, College of Sciences, Design, Bio and Ag Engineering (Science Program), Bio Sci (all options), Math Edu, Sci Edu, Textiles, and B.S. degrees in CHASS. Credit is not allowed for both MA 108 and MA 111. Also, MA 108 should not be counted toward the GER mathematical sciences.

Prerequisite: C- or better in MA 107
Typically offered in Spring only

MA 111 Precalculus Algebra and Trigonometry (3 credit hours)
Real numbers, functions and their graphs (special attention to polynomial, rational, exponential, logarithmic, and trigonometric functions), analytic trigonometry. Credit in MA 111 does not count toward graduation for students in Engr., College of Sciences., Design, Biological & Ag. Engr. (Science Program), Biological Sci.(all options),Math. Edu., Forestry, & Textiles. Credit is not allowed for both MA 111 and either MA 107 or MA 108.

Prerequisite: C- or better in MA 101, or 480 or better on the SAT Subject Test in Mathematics Level 2 or the NCSU Math Skills Test.
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 114 Introduction to Finite Mathematics with Applications (3 credit hours)
Elementary matrix algebra including arithmetic operations, inverses, and systems of equations; introduction to linear programming including simplex method; sets and counting techniques, elementary probability including conditional probability; Markov chains; applications in the behavioral, managerial and biological sciences. Computer use for completion of assignments.

Prerequisite: MA 101 or equivalent completed in high school.
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer
MA 116 Introduction to Scientific Programming (Math) (3 credit hours)
Computer-based mathematical problem solving and simulation techniques using MATLAB. Emphasizes scientific programming constructs that utilize good practices in code development, including documentation and style. Covers user-defined functions, data abstractions, data visualization and appropriate use of pre-defined functions. Applications are from science and engineering.

Prerequisite: MA 141, and either COS 100 or E 115; Corequisite: MA 241
Typically offered in Fall and Spring

MA 121 Elements of Calculus (3 credit hours)
For students who require only a single semester of calculus. Emphasis on concepts and applications of calculus, along with basic skills. Algebra review, functions, graphs, limits, derivatives, integrals, logarithmic and exponential functions, functions of several variables, applications in management, applications in biological and social sciences. Credit is not allowed in more than one of MA 121, 131, 141. MA 121 may not be substituted for MA 131 or MA 141 as a curricular requirement

Prerequisite: MA 107 or 111 with a C- or better, or 480 on the SAT Subject Test in Mathematics Level 2 or the NCSU Math Skills Test, or 2 or better on an AP Calculus exam. Credit is not allowed for both MA 121 and MA 131 or MA 141.
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 131 Calculus for Life and Management Sciences A (3 credit hours)
First order finite difference models; derivatives - limits, power rule, graphing, and optimization; exponential and logarithmic functions - growth and decay models; integrals - computation, area, total change; applications in life, management, and social sciences. Credit not allowed for more than one of MA 121, 131, and 141

Prerequisite: C- or better in MA 107 or MA 111, or 520 or better on the SAT Subject Test in Mathematics Level 2 or the NCSU Math Skills Test, or 2 or better on an AP Calculus exam. Credit is not allowed for both MA 131 and MA 121 or MA 141.
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 132 Computational Mathematics for Life and Management Sciences (1 credit hours)
Computational aspects of calculus for the life and management sciences; use of spreadsheets and a computer algebra system; applications to data models, differential equation models, and optimization.

Prerequisite: C- or better in MA 121 or MA 131
Typically offered in Fall, Spring, and Summer

MA 141 Calculus I (4 credit hours)
First of three semesters in a calculus sequence for science and engineering majors. Functions, graphs, limits, derivatives, rules of differentiation, definite integrals, fundamental theorem of calculus, applications of derivatives and integrals. Use of computation tools. Credit is not allowed for more than one of MA 141, 131, 121

Prerequisite: MA 111 or MA 108 with grade of C- or better, or 550 or better on the SAT Subject Test in Mathematics Level 2 or the NCSU Math Skills Test, or 2 or better on an AP Calculus exam. Credit is not allowed for both MA 141 and MA 121 or MA 131.
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 151 Calculus for Elementary Education I (3 credit hours)
Calculus for Elementary Education I is the first semester of a two semester sequence of courses designed for the Elementary Education Program. Topics will include sequences, limit, and derivative. Also, topics related to teaching elementary mathematics will be discussed. Students cannot receive credit for more than one of MA 151, MA 121, MA 131, or MA 141. MA 151 is not an accepted prerequisite for MA 231 and MA 241. This course is restricted to Elementary Education majors only.

Prerequisite: C- or better in MA 107 or MA 111, or 520 or better on the SAT Subject Test in Mathematics Level 2 or the NCSU Math Skills Test, or 2 or better on an AP Calculus exam. Credit is not allowed for both MA 131 and MA 121 or MA 141.
GEP Mathematical Sciences
Typically offered in Spring only

MA 152 Calculus for Elementary Education II (3 credit hours)
Calculus for Elementary Education II is the second semester of a two semester sequence of courses designed for the Elementary Education Program. Topics will include derivative, integrals, difference equations, and differential equations. Also, topics related to teaching elementary mathematics will be discussed. This course is restricted to Elementary Education majors only. Students cannot receive credit for both MA 152 and MA 121, MA 131, or MA 141. MA 152 is not an accepted prerequisite for MA 241.

Prerequisite: MA 151
GEP Mathematical Sciences
Typically offered in Fall only

MA 205 Elements of Matrix Computations (3 credit hours)
Complex numbers and Euler's formula. Vectors in 2-D and 3-D, lines, planes, vector products and determinants. Vectors in n-D, matrices and matrix products. Algebraic systems, row operations, inverse matrices and LU factors. Least squares, undetermined systems and null and column spaces. Applications to linear systems of differential equations and/or to visualization and image filters. Emphasis is on by-hand computations, but it is to include applications and computing tools. Students cannot receive credit for more than one of MA 205, MA 305, or MA 405.

Prerequisite: C- in MA 121, 131, or 141
GEP Mathematical Sciences
Typically offered in Fall and Spring

MA 225 Foundations of Advanced Mathematics (3 credit hours)
Introduction to mathematical proof with focus on properties of the real number system. Elementary symbolic logic, mathematical induction, algebra of sets, relations, functions, countability. Algebraic and completeness properties of the reals.

Prerequisite: MA 241
Typically offered in Fall, Spring, and Summer

MA 231 Calculus for Life and Management Sciences B (3 credit hours)
Functions of several variables - partial derivatives, optimization, least squares, Lagrange multiplier method; differential equations - population growth, finance and investment models, systems, numerical methods; MA 121 is not an accepted prerequisite for MA 231.

Prerequisite: MA 131 or MA 141; Credit is not allowed for both MA 231 and MA 241.
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer
MA 241 Calculus II (4 credit hours)
Second of three semesters in a calculus sequence for science and engineering majors. Techniques and applications of integration, elementary differential equations, sequences, series, power series, and Taylor's Theorem. Use of computational tools.

Prerequisite: MA 141 with grade of C- or better or AP Calculus credit. Credit is not allowed for both MA 241 and MA 231.

GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 242 Calculus III (4 credit hours)

Prerequisite: MA 241 with grade of C- or better or AP Calculus credit, or Higher Level IB credit.

Typically offered in Fall, Spring, and Summer

MA 302 Numerical Applications to Differential Equations (1 credit hour)
Numerical methods for approximating solutions for differential equations, with an emphasis on Runge-Kutta-Fehlberg methods with stepsize control. Applications to population, economic, orbital and mechanical models.

Prerequisite: MA 241
Typically offered in Fall and Spring

MA 303 Linear Analysis (3 credit hours)
Linear difference equations of first and second order, compound interest and amortization. Matrices and systems of linear equations, eigenvalues, diagonalization, systems of difference and differential equations, transform methods, population problems. Credit not allowed if credit has been obtained for MA 341 or MA 405

Prerequisite: MA 241
 Typically offered in Fall and Spring

MA 305 Introductory Linear Algebra and Matrices (3 credit hours)
The course is an elementary introduction to matrix theory and linear algebra. Emphasis is given to topics that will be useful in other disciplines, including systems of equations, Euclidean vector spaces, determinants, eigenvalues and eigenvectors, linear transformations, similarity, and applications such as numerical solutions of equations and computer graphics. Compares with MA 405 Introductory Linear Algebra, more emphasis is placed on methods and calculations. Credit is not allowed for both MA 305 and MA 405.

Prerequisite: MA 241 or MA 231 with MA 132
Typically offered in Fall, Spring, and Summer

MA 315/MEA 315 Mathematics Methods in Atmospheric Sciences (4 credit hours)
For sophomore meteorology and marine science students. A complement to MA 242 designed to prepare students for quantitative atmospheric applications. Topics include an introduction to vectors and vector calculus, atmospheric waves, phase and group velocity, perturbation analysis, fourier decomposition, matrix operations, chaos and predictability. For MY, MMY, and MRM majors only.

Prerequisite: MEA 217 or MA 116 or CSC 113; Corequisite: MA 242
Typically offered in Spring only

MA 325 Introduction to Applied Mathematics (3 credit hours)
Introduces students with multivariable calculus to five different areas of applied mathematics. These areas will be five three-week modules, which lead to higher level courses in the application areas. Topics will vary, and examples of modules are heat and mass transfer, biology and population, probability and finance, acoustic models, cryptography as well as others.

Prerequisite: (MA 231 or MA 242) and (MA 116 or CSC 112 or CSC 114 or CSC 116)
Typically offered in Spring only

MA 331 Differential Equations for the Life Sciences (3 credit hours)
This course provides students with an understanding of how mathematics and life sciences can stimulate and enrich each other. The course topics include first order differential equations, separable equations, second order systems, vector and matrix systems, eigenvectors/eigenvalues, graphical and qualitative methods. The methods are motivated with examples from the biological sciences (growth models, kinetics and compartmental models, epidemic models, predator-prey, etc). Computational modeling will be carried out using SimBiology, a MATLAB toolbox based graphical user interface, which automates and simplifies the process of modeling biological systems. Credit cannot be given for both MA 341 and MA 331.

P: MA 231 or MA 241; X: Credit cannot be given for both MA 341 and MA 331
Typically offered in Fall only

MA 335/LOG 335 Symbolic Logic (3 credit hours)
Intermediate level introduction to modern symbolic logic focusing on standard first-order logic; topics include proofs, interpretations, applications and basic metalogical results.

Prerequisite: LOG 201 or MA 225 or CSC 226

GEP Mathematical Sciences
Typically offered in Fall only

MA 341 Applied Differential Equations I (3 credit hours)

Prerequisite: MA 242 or (MA 132 and MA 231)
Typically offered in Fall, Spring, and Summer
MA 351 Introduction to Discrete Mathematical Models (3 credit hours)
Basic concepts of discrete mathematics, including graph theory, Markov chains, game theory, with emphasis on applications; problems and models from areas such as traffic flow, genetics, population growth, economics, and ecosystem analysis.
Prerequisite: MA 224, 225, 231 or 241
Typically offered in Fall only

MA 401 Applied Differential Equations II (3 credit hours)
Wave, heat and Laplace equations. Solutions by separation of variables and expansion in Fourier Series or other appropriate orthogonal sets. Sturm-Liouville problems. Introduction to methods for solving some classical partial differential equations. Use of power series as a tool in solving ordinary differential equations. Credit for both MA 401 and MA 501 will not be given.
Prerequisite: MA 341; Credit not allowed for both MA 401 and MA 501
Typically offered in Fall, Spring, and Summer

MA 402 Mathematics of Scientific Computing (3 credit hours)
This course will provide an overview of methods to solve quantitative problems and analyze data. The tools to be introduced are mathematical in nature and have links to Algebra, Analysis, Geometry, Graph Theory, Probability and Topology. Students will acquire an appreciation of (I) the fundamental role played by mathematics in countless applications and (II) the exciting challenges in mathematical research that lie ahead in the analysis of large data and uncertainties. Students will work on a project for each unit. While this is not a programming class, the students will do some programming through their projects.
P: (MA 341 or MA 405) and programming proficiency (MATLAB, C++, Java, Fortran, or other language)
Typically offered in Fall and Spring

MA 403 Introduction to Modern Algebra (3 credit hours)
Sets and mappings, equivalence relations, rings, integral domains, ordered integral domains, ring of integers. Other topics selected from fields, polynomial rings, real and complex numbers, groups, permutation groups, ideals, and quotient rings. Credit is not allowed for both MA 403 and MA 407
Prerequisite: MA 225
Typically offered in Fall and Spring

MA 405 Introduction to Linear Algebra (3 credit hours)
This course offers a rigorous treatment of linear algebra, including systems of linear equations, matrices, determinants, abstract vector spaces, bases, linear independence, spanning sets, linear transformations, eigenvalues and eigenvectors, similarity, inner product spaces, orthogonality and orthogonal bases, factorization of matrices. Compared with MA 305 Introductory Linear Algebra, more emphasis is placed on theory and proofs. MA 225 is recommended as a prerequisite. Credit is not allowed for both MA 305 and MA 405
Prerequisite: MA 241 (MA 225 recommended); Corequisite: MA 341 is recommended
Typically offered in Fall, Spring, and Summer

MA 407 Introduction to Modern Algebra for Mathematics Majors (3 credit hours)
Elementary number theory, equivalence relations, groups, homomorphisms, cosets, Cayley's Theorem, symmetric groups, rings, polynomial rings, quotient fields, principal ideal domains, Euclidean domains. Credit is not allowed for both MA 403 and MA 407
Prerequisite: MA 225 and MA 405
Typically offered in Fall and Spring

MA 408 Foundations of Euclidean Geometry (3 credit hours)
An examination of Euclidean geometry from a modern perspective. The axiomatic approach with alternative possibilities explored using models.
Prerequisite: MA 225
Typically offered in Fall and Spring

MA 410 Theory of Numbers (3 credit hours)
Arithmetic properties of integers. Congruences, arithmetic functions, diophantine equations. Other topics chosen from quadratic residues, the quadratic reciprocity Law of Gauss, primitive roots, and algebraic number fields.
Prerequisite: One year of calculus
Typically offered in Spring only

MA 412/ST 412 Long-Term Actuarial Models (3 credit hours)
Long-term probability models for risk management systems. Theory and applications of compound interest, probability distributions of failure time random variables, present value models of future contingent cash flows, applications to insurance, health care, credit risk, environmental risk, consumer behavior and warranties.
Prerequisite: MA 241 or MA 231, Corequisite: MA 421, BUS(ST) 350, ST 301, ST 305, ST 311, ST 361, ST 370, ST 371, ST 380 or equivalent
Typically offered in Fall only

MA 413/ST 413 Short-Term Actuarial Models (3 credit hours)
Short-term probability models for risk management systems. Frequency distributions, loss distributions, the individual risk model, the collective risk model, stochastic process models of solvency requirements, applications to insurance and business decisions.
Prerequisite: MA 241 or MA 231, and one of MA 421, ST 301, ST 305, ST 370, ST 371, ST 380, ST 421.
Typically offered in Summer only

MA 414/MA 514/CSC 414/CSC 514 Foundations of Cryptography (3 credit hours)
Cryptography is the study of mathematical techniques for securing digital information, systems and distributed computation against adversarial attacks. In this class you will learn the concepts and the algorithms behind the most used cryptographic protocols: you will learn how to formally define security properties and how to formally prove/disprove that a cryptographic protocol achieves a certain security property. You will also discover that cryptography has a much broader range of applications. It solves absolutely paradoxical problems such as proving knowledge of a secret without ever revealing the secret (zero-knowledge proof), or computing the output of a function without ever knowing the input of the function (secure computation). Finally, we will look closely at one of the recent popular application of cryptography: the blockchain technology. Additionally, graduate students will study some of the topics in greater depth.
Prerequisite: (CSC 226 AND CSC 333) OR MA 225
Typically offered in Fall only
MA 416/CSC 416 Introduction to Combinatorics (3 credit hours)
Basic principles of counting; addition and multiplication principles, generating functions, recursive methods, inclusion-exclusion, pigeonhole principle; basic concepts of graph theory; graphs, digraphs, connectedness, trees; additional topics from: Polya theory of counting, Ramsey theory; combinatorial optimization - matching and covering, minimum spanning trees, minimum distance, maximum flow; sieves; mobius inversion; partitions; Gaussian numbers and q-analogues; bijections and involutions; partially ordered sets.
Prerequisite: Grade of C or better in either MA 225 or CSC 226
Typically offered in Spring only

MA 421 Introduction to Probability (3 credit hours)
Axioms of probability, conditional probability and independence, basic combinatorics, discrete and continuous random variables, joint densities and mass functions, expectation, central, limit theorem, simple stochastic processes.
Prerequisite: MA 242
Typically offered in Fall, Spring, and Summer

MA 425 Mathematical Analysis I (3 credit hours)
Real number system, functions and limits, topology on the real line, continuity, differential and integral calculus for functions of one variable. Infinite series, uniform convergence. Credit is not allowed for both MA 425 and MA 511.
Prerequisite: MA 225 (MA 407 desirable)
Typically offered in Fall and Spring

MA 426 Mathematical Analysis II (3 credit hours)
Calculus of several variables, topology in n-dimensions, limits, continuity, differentiability, implicit functions, integration. Credit is not allowed for both MA 426 and MA 512.
Prerequisite: MA 425 and 405
Typically offered in Fall and Spring

MA 427/CSC 427 Introduction to Numerical Analysis I (3 credit hours)
Theory and practice of computational procedures including approximation of functions by interpolating polynomials, numerical differentiation and integration, and solution of ordinary differential equations including both initial value and boundary value problems. Computer applications and techniques.
Prerequisite: (MA 341 or MA 301) and (CSC 111 or CSC 112 or CSC 113 or CSC 114 or CSC 116 or MA 116 or PY 251 or ST 114 or ECE 209)
Typically offered in Fall only

MA 428/CSC 428 Introduction to Numerical Analysis II (3 credit hours)
Computational procedures including direct and iterative solution of linear and nonlinear equations, matrices and eigenvalue calculations, function approximation by least squares, smoothing functions, and minimax approximations.
Prerequisite: (MA 305 or MA 405) and (CSC 111 or CSC 112 or CSC 113 or CSC 114 or CSC 116 or MA 116 or PY 251 or ST 114 or ECE 209)
Typically offered in Spring only

MA 430 Mathematical Models in the Physical Sciences (3 credit hours)
Application of mathematical techniques to topics in the physical sciences. Problems from such areas as conservative and dissipative dynamics, calculus of variations, control theory, and crystallography.
Prerequisite: MA 341 and MA 405
Typically offered in Fall only

MA 432 Mathematical Models in Life and Social Sciences (3 credit hours)
Topics from differential and difference equations, probability, and matrix algebra applied to formulation and analysis of mathematical models in biological and social science (e.g., population growth).
Prerequisite: MA 341, (MA 305 or MA 405), and programming proficiency;
Corequisite: (MA 421 or ST 371)
Typically offered in Spring only

MA 437 Applications of Algebra (3 credit hours)
Error correcting codes, cryptography, crystallography, enumeration techniques, exact solutions of linear equations, and block designs.
Prerequisite: MA 403 or 407, MA 405
Typically offered in Fall and Spring

MA 440 Game Theory (3 credit hours)
Game Theory as a language for modeling situations involving conflict and cooperation in the social, behavioral, economic, and biological sciences. Backward induction; dominated strategies; Nash equilibria; games with incomplete information; repeated games; evolutionary dynamics.
Prerequisite: MA 231 or MA 242
Typically offered in Fall only

MA 444 Problem Solving Strategies for Competitions (1 credit hours)
Analyze the most common problem-solving techniques and illustrate their use by interesting examples from past Putnam and Virginia Tech math competitions. Problem solving methods are divided into groups and taught by professors of the math department. After the lecture, students practice writing the solutions for the assignment and have informal discussions in the next class.
Typically offered in Fall only

MA 450 Methods of Applied Mathematics I (3 credit hours)
Mathematical methods covered include dimensional analysis, asymptotics, continuum modeling and traffic flow analysis. These topics are discussed in the context of applications and real data. This course is independent of MA 451 Methods of Applied Mathematics II.
Prerequisite: MA 341
Typically offered in Fall only

MA 451 Methods of Applied Mathematics II (3 credit hours)
The mathematical methods of this course give insight into physical continuum processes such as fluid flow and the deformation of solid elastic materials. Techniques include the modeling and formulation of equations of motion, the use of Lagrangian and Eulerian variables; further topics are: examples of incompressible fluid flow, calculus of variations and applications to optimal control problems. This course is independent of MA 450 Methods of Applied Mathematics I.
Prerequisite: MA 341
Typically offered in Spring only
MA 491 Reading in Honors Mathematics (1-6 credit hours)
A reading (independent study) course available as an elective for students participating in the mathematics honors program.
Prerequisite: Membership in honors program
Typically offered in Fall and Spring

MA 493 Special Topics in Mathematics (1-6 credit hours)
Directed individual study or experimental course offerings.
Typically offered in Fall and Spring

MA 494 Major Paper in Math (1 credit hours)
Introduces students to one or more forms of writing used in scientific and research environments. Students are required to take a companion math course at the 400-level or above, and adapt writing assignment(s) to the topics in the companion course. Instruction covers all phases of the writing process (planning, drafting, revising, and critiquing other people's work). Emphasis is placed on organizing for needs of a variety of readers; concise, clear expression.
Corequisite: MA class at the 400-level or above
Typically offered in Fall and Spring

MA 499 Independent Research in Mathematics (1-6 credit hours)
Study and research in mathematics. Topics for theoretical, modeling or computational investigation. Consent of Department Head. Honors Program should enroll in MA 491H. At most 6 hours total of MA 499 and 491H credit can be applied towards an undergraduate degree. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.
Typically offered in Fall, Spring, and Summer

MA 501 Advanced Mathematics for Engineers and Scientists I (3 credit hours)
Survey of mathematical methods for engineers and scientists. Ordinary differential equations and Green's functions; partial differential equations and separation of variables; special functions, Fourier series. Applications to engineering and science. Not for credit by mathematics majors. Credit for this course and MA 401 is not allowed
Prerequisite: MA 341; credit not allowed for both MA 501 and MA 401
Typically offered in Fall, Spring, and Summer

MA 502 Advanced Mathematics for Engineers and Scientists II (3 credit hours)
Determinants and matrices; line and surface integrals, integral theorems; complex integrals and residues; distribution functions of probability. Not for credit by mathematics majors. Any student receiving credit for MA 502 may receive credit for, at most, one of the following: MA 405, MA 512, MA 513
Prerequisite: MA 341.
Typically offered in Fall, Spring, and Summer

MA 504/OR 504 Introduction to Mathematical Programming (3 credit hours)
Basic concepts of linear, nonlinear and dynamic programming theory. Not for majors in OR at Ph.D. level.
Prerequisite: MA 242, MA 405
Typically offered in Fall only

MA 505/OR 505/ISE 505 Linear Programming (3 credit hours)
Introduction including: applications to economics and engineering; the simplex and interior-point methods; parametric programming and post-optimality analysis; duality matrix games, linear systems solvability theory and linear systems duality theory; polyhedral sets and cones, including their convexity and separation properties and dual representations; equilibrium prices, Lagrange multipliers, subgradients and sensitivity analysis.
Prerequisite: MA 405
Typically offered in Fall only

MA 507 Survey of Real Analysis (3 credit hours)
A broad overview of topics in analysis. Historical development, logical refinement and applications of concepts such as limits, continuity, differentiation and integration. May not be taken for graduate credit by Master's or Ph.D. students in Mathematics or Applied Mathematics.
Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

MA 508 Geometry For Secondary Teachers (3 credit hours)
Topics in geometry of concern to secondary teachers in their work and provision for background and enrichment. Various approaches to study of geometry, including vector geometry, transformational geometry and axiomatics. Course may be taken for graduate credit and for certificate renewal by secondary school teachers. Credit towards a graduate degree may be allowed only for students in mathematics education.
Prerequisite: Graduate standing
Typically offered in Spring and Summer

MA 509 Survey of Abstract Algebra (3 credit hours)
A broad overview of topics in abstract algebra. Theory of equations, polynomial rings, rational functions and elementary number theory. May not be taken for graduate credit by Master's or Ph.D. students in Mathematics or Applied Mathematics.
Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

MA 510 Selected Topics In Mathematics For Secondary Teachers (1-6 credit hours)
Coverage of various topics in mathematics of concern to secondary teachers. Topics selected from areas such as mathematics of finance, probability, statistics, linear programming and theory of games, intuitive topology, recreational math, computers and applications of mathematics. Course may be taken for graduate credit for certification renewal by secondary school teachers. Credit towards a graduate degree may be allowed only for students in mathematics education.
Prerequisite: Graduate standing
Typically offered in Spring and Summer

MA 511 Advanced Calculus I (3 credit hours)
Fundamental theorems on continuous functions; convergence theory of sequences, series and integrals; the Riemann integral. Credit for both MA 425 and MA 511 is not allowed
Prerequisite: MA 341
Typically offered in Fall, Spring, and Summer
MA 512 Advanced Calculus II (3 credit hours)
General theorems of partial differentiation; implicit function theorems; vector calculus in 3-space; line and surface integrals; classical integral theorems. Credit will not be given for both MA 426 and MA 512.
Prerequisite: MA 341
Typically offered in Fall, Spring, and Summer

MA 513 Introduction To Complex Variables (3 credit hours)
Operations with complex numbers, derivatives, analytic functions, integrals, definitions and properties of elementary functions, multivalued functions, power series, residue theory and applications, conformal mapping.
Prerequisite: MA 242
Typically offered in Fall and Spring

MA 514/CSC 414/CSC 514/MA 414 Foundations of Cryptography (3 credit hours)
Cryptography is the study of mathematical techniques for securing digital information, systems and distributed computation against adversarial attacks. In this class you will learn the concepts and the algorithms behind the most used cryptographic protocols: you will learn how to formally define security properties and how to formally prove/disprove that a cryptographic protocol achieves a certain security property. You will also discover that cryptography has a much broader range of applications. It solves absolutely paradoxical problems such as proving knowledge of a secret without ever revealing the secret (zero-knowledge proof), or computing the output of a function without ever knowing the input of the function (secure computation). Finally, we will look closely at one of the recent popular application of cryptography: the blockchain technology. Additionally, graduate students will study some of the topics in greater depth.
Prerequisite: (CSC 226 AND CSC 333) OR MA 225
Typically offered in Fall only

MA 515 Analysis I (3 credit hours)
Prerequisite: MA 426
Typically offered in Fall and Spring

MA 518 Geometry of Curves and Surfaces (3 credit hours)
Geometry of curves and surfaces in space; Arclength, torsion, and curvature of curves; Tangent spaces, shape operators, and curvatures of surfaces; metrics, covariant derivatives, geodesics, and holonomy. Applications in the physical sciences and/or projects using computer algebra.
Prerequisite: MA 242 and MA 405
Typically offered in Spring only

MA 520 Linear Algebra (3 credit hours)
Prerequisite: MA 405
Typically offered in Fall and Spring

MA 521 Abstract Algebra I (3 credit hours)
Groups, quotient groups, group actions, Sylow's Theorems. Rings, ideals and quotient rings, factorization, principal ideal domains. Fields, field extensions, Galois theory.
Prerequisite: MA 405 and MA 407
Typically offered in Fall only

MA 522 Computer Algebra (3 credit hours)
Basic techniques and algorithms of computer algebra. Integer arithmetic, primality tests and factorization of integers, polynomial arithmetic, polynomial factorization, Groebner bases, integration in finite terms.
Prerequisite: MA 407 or MA 521 and MA 405 or MA 520
Typically offered in Fall only

MA 523 Linear Transformations and Matrix Theory (3 credit hours)
Vector spaces, linear transformations and matrices, orthogonality, orthogonal transformations with emphasis on rotations and reflections, matrix norms, projectors, least squares, generalized inverses, definite matrices, singular values.
Prerequisite: MA 405
Typically offered in Fall and Spring

MA 524 Combinatorics I (3 credit hours)
Enumerative combinatorics, including placements of balls in bins, the twelveloaf way, inclusion/exclusion, sign-reversing involutions and lattice path enumeration. Partially ordered sets, lattices, distributive lattices, Moebius functions, and rational generating functions.
Prerequisite: MA 405
Typically offered in Fall and Spring

MA 526 Algebraic Geometry (3 credit hours)
Abstract theory of solutions of systems of polynomial equations. Topics covered: ideals and affine varieties, the Nullstellensatz, irreducible varieties and primary decomposition, morphisms and rational maps, computational aspects including Groebner bases and elimination theory, projective varieties and homogeneous ideals, Grassmannians, graded modules, the Hilbert function, Bezout's theorem.
Prerequisite: MA 521
Typically offered in Fall only

MA 528/ECG 528/MBA 528/FIM 528 Options and Derivatives Pricing (3 credit hours)
The course covers (i) structure and operation of derivative markets, (ii) valuation of derivatives, (iii) hedging of derivatives, and (iv) applications of derivatives in areas of risk management and financial engineering. Models and pricing techniques include Black-Scholes model, binomial trees, Monte-Carlo simulation. Specific topics include simple no-arbitrage pricing relations for futures/forward contracts; put-call parity relationship; delta, gamma, and vega hedging; implied volatility and statistical properties; dynamic hedging strategies; interest-rate risk, pricing of fixed-income product; credit risk, pricing of defaultable securities.
Prerequisites: MA 341 and MA 405 and MA 421
Typically offered in Fall only
MA 531/E 531/OR 531 Dynamic Systems and Multivariable Control
I (3 credit hours)
Introduction to modeling, analysis and control of linear discrete-time and
continuous-time dynamical systems. State space representations
and transfer methods. Controllability and observability. Realization.
Applications to biological, chemical, economic, electrical, mechanical and
sociological systems.
Prerequisite: MA 341, MA 405
Typically offered in Fall only

MA 532 Ordinary Differential Equations I (3 credit hours)
Existence and uniqueness theorems, systems of linear equations,
fundamental matrices, matrix exponential, nonlinear systems, plane
autonomous systems, stability theory.
Prerequisite: MA 341, 405, 425 or 511, Corequisite: MA 426 or 512
Typically offered in Fall only

MA 534 Introduction To Partial Differential Equations (3 credit
hours)
Linear first order equations, method of characteristics. Classification of
second order equations. Solution techniques for the heat equation, wave
equation and Laplace's equation. Maximum principles. Green's functions
and fundamental solutions.
Prerequisite: MA 425 or MA 511, MA 341, Corequisite: MA 426 or 512
Typically offered in Fall only

MA 537 Nonlinear Dynamics and Chaos (3 credit hours)
Usage of computer experiments for demonstration of nonlinear dynamics
and chaos and motivation of mathematical definitions and concepts.
Examples from finance and ecology as well as traditional science
and engineering. Difference equations and iteration of functions as
nonlinear dynamical systems. Fixed points, periodic points and general
orbits. Bifurcations and transition to chaos. Symbolic dynamics, chaos,
Sarkovskii's Theorem, Schwarzian derivative, Newton's method and
fractals.
Prerequisite: MA 341 and MA 405
Typically offered in Spring only

MA 540 Uncertainty Quantification for Physical and Biological
Models (3 credit hours)
Introduction to uncertainty quantification for physical and biological
models. Parameter selection techniques, Bayesian model calibration,
propagation of uncertainties, surrogate model construction, local and
global sensitivity analysis.
Prerequisite: MA 341 and basic knowledge of probability, linear algebra,
and scientific computation
Typically offered in Spring only

MA 544 Computer Experiments in Mathematical Probability (3 credit
hours)
Exposure of student to practice of performing mathematical experiments
on computer, with emphasis on probability. Programming in an interactive
language such as APL, MATLAB or Mathematica. Mathematical
treatment of random number generation and application of these tools
to mathematical topics in Monte Carlo method, limit theorems and
stochastic processes for purpose of gaining mathematical insight.
Prerequisite: MA 421
Typically offered in Spring only

MA 546/ST 546 Probability and Stochastic Processes I (3 credit
hours)
Modern introduction to Probability Theory and Stochastic Processes.
The choice of material is motivated by applications to problems such as
queueing networks, filtering and financial mathematics. Topics include:
review of discrete probability and continuous random variables, random
walks, markov chains, martingales, stopping times, ergodicity, conditional
expectations, continuous-time Markov chains, laws of large numbers,
central limit theorem and large deviations.
Prerequisite: MA 421 and MA 425 or MA 511
Typically offered in Fall only

MA 547 Financial Mathematics (3 credit hours)
Stochastic models of financial markets. No-arbitrage derivative pricing.
From discrete to continuous time models. Brownian motion, stochastic
calculus, Feynman-Kac formula and tools for European options and
equivalent martingale measures. Black-Scholes formula. Hedging
strategies and management of risk. Optimal stopping and American
options. Term structure models and interest rate derivatives. Stochastic
volatility models.
Prerequisite: MA(ST) 546
Typically offered in Spring only

MA 548/FIM 548 Monte Carlo Methods for Financial Math (3 credit
hours)
Monte Carlo (MC) methods for accurate option pricing, hedging and risk
management. Modeling using stochastic asset models (e.g. geometric
Brownian motion) and parameter estimation. Stochastic models, including
use of random number generators, random paths and discretization
methods (e.g. Euler-Maruyama method), and variance reduction.
Implementation using Matlab. Incorporation of the latest developments
regarding MC methods and their uses in Finance.
Prerequisites: (MA 421 or ST 421), MA 341, and MA 405
Typically offered in Spring only

MA 549/FIM 549 Financial Risk Analysis (3 credit hours)
This course focuses on mathematical methods to analyze and manage
risks associated with financial derivatives. Topics covered include
aggregate loss distributions, extreme value theory, default probabilities,
Value-at-Risk and expected shortfall, coherent risk measures, correlation
and copula, applications of principle component analysis and Monte
Carlo simulations in financial risk management, how to use stochastic
differential equations to price financial risk derivatives, and how to back-
test and stress-test models.
Prerequisites: MA 405 and (MA 421 or ST 421) and (MA/ST 412 or MA/
ST 413)
Typically offered in Spring only

MA 551 Introduction to Topology (3 credit hours)
Set theory, topological spaces, metric spaces, continuous functions,
separation, cardinality properties, product and quotient topologies,
compactness, connectedness.
Prerequisite: MA 426
Typically offered in Fall only
MA 555 Introduction to Manifold Theory (3 credit hours)
An introduction to smooth manifolds. Topics include: topological and smooth manifolds, smooth maps and differentials, vector fields and flows, Lie derivatives, vector bundles, tensors, differential forms, exterior calculus, and integration on manifolds.
Prerequisite: MA 405 and MA 426
Typically offered in Fall only

MA 561 Set Theory and Foundations Of Mathematics (3 credit hours)
Logic and axiomatic approach, the Zermelo-Fraenkel axioms and other systems, algebra of sets and order relations, equivalents of the Axiom of Choice, one-to-one correspondences, cardinal and ordinal numbers, the Continuum Hypothesis.
Prerequisite: MA 407
Typically offered in Spring only

MA 565/OR 565/CSC 565 Graph Theory (3 credit hours)
Prerequisite: CSC 226 or MA 351.
Typically offered in Spring only

MA 573/BMA 573 Mathematical Modeling of Physical and Biological Processes I (3 credit hours)
Introduction to model development for physical and biological applications. Mathematical and statistical aspects of parameter estimation. Compartamental analysis and conservation laws, heat transfer, and population and disease models. Analytic and numerical solution techniques and experimental validation of models. Knowledge of high-level programming languages required.
Prerequisite: MA 341 and knowledge of high-level programming language.
Typically offered in Fall only

MA 574/BMA 574 Mathematical Modeling of Physical and Biological Processes II (3 credit hours)
Model development, using Newtonian and Hamiltonian principles, for acoustic and fluid applications, and structural systems including membranes, rods, beams, and shells. Fundamental aspects of electromagnetic theory. Analytic and numerical solution techniques and experimental validation of models.
Prerequisite: MA/BMA 573
Typically offered in Spring only

MA 580/CSC 580 Numerical Analysis I (3 credit hours)
Algorithm behavior and applicability. Effect of roundoff errors, systems of linear equations and direct methods, least squares via Givens and Householder transformations, stationary and Krylov iterative methods, the conjugate gradient and GMRES methods, convergence of method.
Prerequisite: MA 405; MA 425 or MA 511; high-level computer language
Typically offered in Fall and Spring

MA 583/CSC 583 Introduction to Parallel Computing (3 credit hours)
Introduction to basic parallel architectures, algorithms and programming paradigms; message passing collectives and communicators; parallel matrix products, domain decomposition with direct and iterative methods for linear systems; analysis of efficiency, complexity and errors; applications such as 2D heat and mass transfer.
Prerequisite: CSC 302 or MA 402 or MA/CSC 428 or MA/CSC 580
Typically offered in Spring only

MA 584 Numerical Solution of Partial Differential Equations--Finite Difference Methods (3 credit hours)
Survey of finite difference methods for partial differential equations including elliptic, parabolic and hyperbolic PDE's. Consideration of both linear and nonlinear problems. Theoretical foundations described; however, emphasis on algorithm design and implementation.
Prerequisite: MA 501; knowledge of a high level programming language
Typically offered in Fall only

MA 587 Numerical Solution of Partial Differential Equations--Finite Element Method (3 credit hours)
Introduction to finite element method. Applications to both linear and nonlinear elliptic and parabolic partial differential equations. Theoretical foundations described; however, emphasis on algorithm design and implementation.
Prerequisite: MA 501; knowledge of a high level programming language
Typically offered in Spring only

MA 591 Special Topics (1-6 credit hours)
Typically offered in Fall and Spring

MA 676 Master's Project (3 credit hours)
Investigation of some topic in mathematics to a deeper and broader extent than typically done in a classroom situation. For the applied mathematics student the topic usually consists of a realistic application of mathematics to student's minor area. A wr
Typically offered in Fall, Spring, and Summer

MA 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall and Spring

MA 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer
典型仅在春季提供

先修课程：MA 515

Fredholm-Fiesz Schauder theory and spectral theorem.

MA 715

典型仅在春季提供

有限空间，弱收敛，共轭算子，有界线性算子，计算机（例如CSC 112）

先修课程：MA 405，OR（ME, IE）505，辅修课程：熟悉一些计算经验

MA 708/ISE 708

整数规划 （3学分）

整数规划问题和主要解法。侧重于算法思想的直观介绍，而不详细介绍计算机代码。学生需要掌握一些“实际的”计算经验

先修课程：MA 405，OR（ME, IA）505，辅修课程：熟悉计算机（例如CSC 112）

MA 719/OR 719

向量空间方法在系统优化（3学分）

介绍代数和功能分析概念在系统建模和优化中：空间、映射、 Riccati方程和优化问题。主要算法分析。主题包括最少平方优化、线性系统、最小化问题在Banach空间中的线性化，Hilbert空间中的迭代求解系统方程和优化问题。广泛的在研究和系统工程中的应用，包括控制论，数学规划，经济计量，统计估计，电路理论和数值分析。

先修课程：MA 405, 511

典型仅在秋季提供

MA 720 Lie Algebras （3学分）

利代数和例子。幂零，可解和semisimple利代数。Engel定理，Lie的定理，Killing表形和Cartan的判断。Weyl的定理关于完全可约性。进行数分解的semisimple利代数。根系统和Weyl群。

先修课程：MA 520

典型仅在春季提供

MA 721 Abstract Algebra II （3学分）

体的延拓，Galois理论，模块，张量产品，外积。

先修课程：MA 521

典型仅在春季提供

MA 722 Computer Algebra II （3学分）

有效算法的代数矩阵，交换代数，实和复代数几何，和微分方程。重点是算法方面。

先修课程：MA 522

典型仅在春季提供

MA 723 Theory of Matrices and Applications （3学分）

实数，函数，矩阵，变分方法，扰动理论，数值方法，非负矩阵，应用到微分方程，马尔可夫链。

先修课程：MA 520或523

典型仅在春季提供

MA 724 Combinatorics II （3学分）

Polytopes（V-polytopes和H-polytopes），Fourier-Motzkin消元法，Farkas引理，图生成的多项式，polytopes的图形，线性规划的几何，Baliniski的定理，Steinitz的定理，Schlegel图形，polyhedral complexes，shellability和face rings。

先修课程：MA 524

典型仅在春季提供

MA 690 Master's Examination （1-9学分）

为没有论文的硕士课程已经完成全部要求的学位，并且准备和参加最终考试。

先修课程：硕士学位

秋季和春季

MA 693 Master's Supervised Research （1-9学分）

研究和研究在导师的指导下。

先修课程：硕士学位

秋季，春季，和夏季

MA 695 Master's Thesis Research （1-9学分）

论文研究

先修课程：硕士学位

秋季和春季

MA 696 Summer Thesis Research （1学分）

为在夏季课程的研究生准备了正式课程。和谁将在夏季学期全职工作。

先修课程：硕士学位

秋季和春季

MA 699 Master's Thesis Preparation （1-9学分）

为完成全学时要求和全学时的研究为硕士的学位，并且写作和提交他们的论文。学分安排

先修课程：硕士学位

秋季，夏季

MA 706/OR 706/ST 706 Nonlinear Programming （3学分）

非线性规划

先修课程：OR（ME, IA）505和MA 425

典型仅在春季提供

MA 708/708/ISE 708 Integer Programming （3学分）

整数规划

先修课程：MA 405, OR（ME, IA）505，辅修课程：熟悉计算机（例如CSC 112）

典型仅在春季提供

MA 800 Analytic II （3学分）

分析II

集成：Lebesgue测度和测量，Lebesgue支配的收敛性和单调收敛定理，Fubini的定理，扩展的傅里叶变换理论。Banach空间：Lp空间，弱收敛性，共轭算子，有限线性算子，Fredholm-Fiesz Schauder理论和谱理论。

先修课程：MA 515

典型仅在春季提供

MA 716 Advanced Functional Analysis （3学分）

高级功能分析

先修课程：MA 715

典型仅在秋季提供

MA 719/OR 719 Vector Space Methods in System Optimization （3学分）

向量空间方法在系统优化

典型仅在春季提供
MA 725 Lie Algebra Representation Theory (3 credit hours)
Prerequisite: MA 720
Typically offered in Fall only

MA 731/ST 731 Dynamic Systems and Multivariable Control II (3 credit hours)
Prerequisite: OR(E,MA) 531
Typically offered in Spring only

MA 732 Ordinary Differential Equations II (3 credit hours)
Existence-uniqueness theory, periodic solutions, invariant manifolds, bifurcations, Fredholm’s alternative.
Prerequisite: MA 532, Corequisite: MA 515
Typically offered in Spring only

MA 734 Partial Differential Equations (3 credit hours)
Prerequisite: MA 534, Corequisite: MA 515
Typically offered in Spring only

MA 746/ST 746 Introduction To Stochastic Processes (3 credit hours)
Markov chains and Markov processes, Poisson process, birth and death processes, queuing theory, renewal theory, stationary processes, Brownian motion.
Prerequisite: MA 405 and MA(ST) 546 or ST 521
Typically offered in Spring only

MA 747/ST 747 Probability and Stochastic Processes II (3 credit hours)
Fundamental mathematical results of probabilistic measure theory needed for advanced applications in stochastic processes. Probability measures, sigma-algebras, random variables, Lebesgue integration, expectation and conditional expectations w.r.t. sigma algebras, characteristic functions, notions of convergence of sequences of random variables, weak convergence of measures, Gaussian systems, Poisson processes, mixing properties, discrete-time martingales, continuous-time Markov chains.
Prerequisite: MA(ST) 546
Typically offered in Spring only

MA 748/ST 748 Stochastic Differential Equations (3 credit hours)
Prerequisite: MA(ST) 747
Typically offered in Fall only

MA 753 Algebraic Topology (3 credit hours)
Homotopy, fundamental group, covering spaces, classification of surfaces, homology and cohomology.
Prerequisite: MA 551 or MA 555
Typically offered in Spring only

MA 755 Introduction to Riemannian Geometry (3 credit hours)
An introduction to smooth manifolds with metric. Topics include: Riemannian metric and generalizations, connections, covariant derivatives, parallel translation, Riemannian (or Levi-Civita) connection, geodesics and distance, curvature tensor, Bianchi identities, Ricci and scalar curvatures, isometric embeddings, Riemannian submanifolds, hypersurfaces, Gauss-Bonnet Theorem; applications and connections to other fields.
Prerequisite: MA 555
Typically offered in Spring only

MA 766/OR 766/ISE 766 Network Flows (3 credit hours)
Study of problems of flows in networks. These problems include the determination of shortest chain, maximal flow and minimal cost flow in networks. Relationship between network flows and linear programming developed as well as problems with nonlinear cost functions, multi-commodity flows and problem of network synthesis.
Prerequisite: OR(E,MA) 505
Typically offered in Spring only

MA 771/ST 771/BMA 771 Biomathematics I (3 credit hours)
Role of theory construction and model building in development of experimental science. Historical development of mathematical theories and models for growth of one-species populations (logistic and offshoots), including considerations of age distributions (matrix models, Leslie and Lopez; continuous theory, renewal equation). Some of the more elementary theories on the growth of organisms (von Bertalanffy and others; allometric theories; cultures grown in a chemostat). Mathematical theories of two and more species systems (predator-prey, competition, symbiosis; leading up to present-day research) and discussion of some similar models for chemical kinetics. Much emphasis on scrutiny of biological concepts as well as of mathematical structure of models in order to uncover both weak and strong points of models discussed. Mathematical treatment of differential equations in models stressing qualitative and graphical aspects, as well as certain aspects of discretization. Difference equation models.
Prerequisite: Advanced calculus, reasonable background in biology
Typically offered in Fall only
MA 772/ST 772/BMA 772 Biomathematics II (3 credit hours)
Continuation of topics of BMA 771. Some more advanced mathematical techniques concerning nonlinear differential equations of types encountered in BMA 771: several concepts of stability, asymptotic directions, Liapunov functions; different time-scales. Comparison of deterministic and stochastic models for several biological problems including birth and death processes. Discussion of various other applications of mathematics to biology, some recent research.
Prerequisite: BMA 771, elementary probability theory
Typically offered in Spring only

MA 773/OR 773/ST 773/BMA 773 Stochastic Modeling (3 credit hours)
Prerequisite: BMA 772 or ST (MA) 746
Typically offered in Spring only

MA 774/BMA 774/OR 774 Partial Differential Equation Modeling in Biology (3 credit hours)
Prerequisite: BMA 771 or MA/OR 731; BMA 772 or MA 401 or MA 501
Typically offered in Spring only

MA 780/CSC 780 Numerical Analysis II (3 credit hours)
Approximation and interpolation, Fast Fourier Transform, numerical differentiation and integration, numerical solution of initial value problems for ordinary differential equations.
Prerequisite: MA 580
Typically offered in Spring only

MA 784 Nonlinear Equations and Unconstrained Optimization (3 credit hours)
Prerequisite: MA 580
Typically offered in Spring only

MA 785 Numerical Solution of Ordinary Differential Equations (3 credit hours)
Numerical methods for initial value problems including predictor-corrector, Runge-Kutta, hybrid and extrapolation methods; stiff systems; shooting methods for two-point boundary value problems; weak, absolute and relative stability results.
Prerequisite: MA 511 or 512
Typically offered in Spring only

MA 788 Numerical Nonlinear Partial Differential Equations (3 credit hours)
Nonlinear discrete equations; Newton and monotone methods for nonlinear equations; computational algorithms and applications; finite difference method-convergence, stability and error estimates; multiplicity of solutions and bifurcation; asymptotic behavior of solutions; and coupled systems of equations.
Prerequisite: MA 405 or 520 and MA 501 or 534; knowledge of a high level programming language
Typically offered in Spring only

MA 790/ISE 790 Advanced Special Topics System Optimization (1-6 credit hours)
Advanced topics in some phase of system optimization using traditional course format. Identification of various specific topics and prerequisites for each section from term to term.
Typically offered in Fall and Spring

MA 791 Special Topics In Real Analysis (1-6 credit hours)
Typically offered in Fall and Spring

MA 792 Special Topics In Algebra (1-6 credit hours)
Typically offered in Fall and Spring

MA 793 Special Topics In Differential Equations (1-6 credit hours)

MA 796 Special Topics In Combinatorial Analysis (1-6 credit hours)

MA 797 Special Topics In Applied Mathematics (1-6 credit hours)

MA 798 Special Topics In Numerical Analysis (1-6 credit hours)

MA 810 Special Topics (1-6 credit hours)
Typically offered in Fall and Spring

MA 812/ISE 812 Special Topics in Mathematical Programming (1-6 credit hours)
Study of special advanced topics in area of mathematical programming. Discussion of new techniques and current research in this area. The faculty responsible for this course select areas to be covered during semester according to their preference and interest. This course not necessarily taught by an individual faculty member but can, on occasion, be joint effort of several faculty members from this university as well as visiting faculty from other institutions. To date, a course of Theory of Networks and another on Integer Programming offered under the umbrella of this course. Anticipation that these two topics will be repeated in future together with other topics.
Prerequisite: IE(MA,OR) 505
Typically offered in Spring only

MA 816/ISE 816 Advanced Special Topics Sys Opt (1-6 credit hours)
Advanced topics in some phase of system optimization. Identification of various specific topics and prerequisite for each section from term to term.
Typically offered in Fall and Spring

MA 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall and Spring
MAE 890  Doctoral Preliminary Examination  (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

MAE 893  Doctoral Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MAE 895  Doctoral Dissertation Research  (1-9 credit hours)
Dissertation Research
Prerequisite: Doctoral student
Typically offered in Fall and Spring

MAE 896  Summer Dissertation Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Summer only

MAE 899  Doctoral Dissertation Preparation  (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Mechanical & Aerospace Engr (MAE)

MAE 200  Introduction to Mechanical Engineering Design  (1 credit hours)
Introduction to mechanical engineering and its application in professional practice. Includes mechanical engineering vocabulary, measurement concepts, safety training, demonstration of basic machine components and systems, dissection of mechanical engineering devices, simple drawing and sketching, 3d printing, technical communication, design, creation of Online Portfolio. (5-week course)

Restriction: Sophomore standing in Mechanical Engineering
Typically offered in Fall only

MAE 201  Engineering Thermodynamics I  (3 credit hours)
Introduction to the concept of energy and the laws governing the transfers and transformations of energy. Emphasis on thermodynamic properties and the First and Second Law analysis of systems and control volumes. Integration of these concepts into the a
Prerequisite: MA 242, PY 208 or 202
Typically offered in Fall, Spring, and Summer

MAE 206  Engineering Statics  (3 credit hours)
Basic concepts of forces in equilibrium. Distributed forces, frictional forces. Inertial properties. Application to machines, structures, and systems. Credit is not allowed for both MAE 206 and CE 214.
Prerequisite: C or better in both MA 241 and PY 205
Typically offered in Fall, Spring, and Summer

MAE 208  Engineering Dynamics  (3 credit hours)
Kinematics and kinetics of particles in rectangular, cylindrical, and curvilinear coordinate systems; energy and momentum methods for particles; kinetics of systems of particles; kinematics and kinetics of rigid bodies in two and three dimensions; motion relative to rotating coordinate systems.
Prerequisite: MA 242 and C- or better in MAE 206 or CE 214
Typically offered in Fall, Spring, and Summer

MAE 214  Solid Mechanics  (3 credit hours)
Prerequisites: MA 242 and C- or better in (MAE 206 or CE 214)
Typically offered in Fall, Spring, and Summer

MAE 250  Introduction to Aerospace Engineering  (1 credit hours)
The objective of this course is to introduce students to the fundamental concepts associated with aerospace engineering. This will be done through lectures focused on fluid flow, structures, dynamics, and complex system design. Students will also engage in hands-on mini-projects that will provide a design experience. Final efforts will culminate in a design portfolio project. 14AE BS Majors only.
Typically offered in Fall only

MAE 251  Aerospace Vehicle Performance  (3 credit hours)
Introduction to the problem of performance analysis in aerospace engineering. Aircraft performance in gliding, climbing, level, and turning flight. Calculation of vehicle take-off and landing distance, range and endurance. Elementary performance design problems. Introduction to space flight.
Prerequisite: Cumulative GPA 2.0 or higher and a grade of C or better in both MA 241 and PY 205; Corequisite: CSC 113
Typically offered in Fall only

MAE 252  Aerodynamics I  (3 credit hours)
Fundamentals of perfect fluid theory with applications to incompressible flows over airfoils, wings, and flight vehicle configurations.
Prerequisites: MA 242 and C- or better in MAE 251
Typically offered in Spring only

MAE 253  Experimental Aerodynamics I  (1 credit hours)
Subsonic wind tunnel, instrumentation, data acquisition techniques, technical report preparation. Experiments involve pressure and force/momentum measurements of various aerospace vehicle components with supplemental flow visualization.
Corequisites: MA 252
Typically offered in Spring only

MAE 302  Engineering Thermodynamics II  (3 credit hours)
Continuation of Engineering Thermodynamics I with emphasis on the analysis of power and refrigeration cycles and the application of basic principles to engineering problems with systems involving mixtures of ideal gases, psychrometrics, nonideal gases, chemical reactions, combustion, chemical equilibrium cycle analysis, and one-dimensional compressible flow.
Prerequisites: CSC 113, C- or better in MAE 201
Typically offered in Fall, Spring, and Summer
MAE 305  Mechanical Engineering Laboratory I  (1 credit hours)
Theory and practice of measurement and experimental data collection. Laboratory evaluation and demonstration of components of the generalized measurement system and their effects on the final result. Applications of basic methods of data analysis as well as basic instrumentation for sensing, conditioning and displaying experimental qualities. (Instruction and practice in technical report writing.)

Typically offered in Fall, Spring, and Summer

MAE 306  Mechanical Engineering Laboratory II  (1 credit hours)
Continuation of MAE 305 into specific types of measurements. Students evaluate and compare different types of instrumentation for measuring the same physical quantity on the basis of cost, time required, accuracy, etc. (Oral and written presentation of technical material).

Prerequisite: MAE 305
Typically offered in Fall, Spring, and Summer

MAE 308  Fluid Mechanics  (3 credit hours)
Development of the basic equations of fluid mechanics in general and specialized form. Application to a variety of topics including fluid statics; inviscid, incompressible fluid flow; design of Fluid dynamic system.

Prerequisite: MA 242 and C- or better in MAE 208
Typically offered in Fall, Spring, and Summer

MAE 310  Heat Transfer Fundamentals  (3 credit hours)
Analysis of steady state and transient one and multidimensional heat conduction employing both analytical methods and numerical techniques. Integration of principles and concepts of thermodynamics and fluid mechanics to the development of practical convective and radiative heat transfers.

Prerequisite: MA 341 and C- or better in MAE 201
Typically offered in Fall, Spring, and Summer

MAE 315  Dynamics of Machines  (3 credit hours)
Application of dynamics to the analysis and design of machine and mechanical components. Motions resulting from applied loads, and the forces required to produce specified motions. Introduction to mechanical vibration, free and forced response of discrete and continuous systems.

Prerequisite: MA 341 and C- or better in MAE 208
Typically offered in Fall, Spring, and Summer

MAE 316  Strength of Mechanical Components  (3 credit hours)
Analysis and design of mechanical components based on deflection, material, static strength and fatigue requirements. Typical components include beams, shafts, pressure vessels and bolted and welded joints. Classical and modern analysis and design techniques. Computer analysis using the finite element method. Material and manufacturing considerations in design.

Prerequisite: C- or better in MAE 214 or CE 313
Typically offered in Fall, Spring, and Summer

MAE 342  Introduction to Automotive Engineering  (3 credit hours)
Fundamental aspects of automotive engineering. Examines various automotive systems (engine, brakes, suspension etc.) as well as their interactions in such areas as safety and performance. Current practices and development for the future.

Prerequisite: MAE 206, MAE 208, MAE 301, MAE 308, MAE 315
Typically offered in Spring only

MAE 351  Aerodynamics II  (3 credit hours)
Concepts of thermodynamics, compressible fluid flow, and shock waves with application to computing the aerodynamic characteristics of airfoils, wings and flight configurations at high speed.

Prerequisites: MAE 252 and C- or better in MAE 201
Typically offered in Spring only

MAE 352  Experimental Aerodynamics II  (1 credit hours)
Advanced stability and control experiments in the subsonic wind tunnel and external compressible flow experiments in the supersonic wind tunnel.

Prerequisite: MA 253, Corequisite: MAE 351
Typically offered in Spring only

MAE 361  Dynamics & Controls  (3 credit hours)
Dynamics and linear feedback control of aerospace and mechanical systems. Concepts from linear system theory, kinematics, particle dynamics, first- and second-order systems, system dynamics, vibrations, and computational techniques. Feedback control root-locus, Nyquist, Bode plots, servo-mechanisms, gain and phase margin, and compensation. Control system design emphasized.

Prerequisite: MA 341 and C- or better in MAE 208
Typically offered in Fall only

MAE 371  Aeroscpace Structures I  (3 credit hours)
Determination of appropriate analysis techniques for Aerospace Structures. Introduction of governing equations and selected solutions for typical structures. Use of these concepts in the design of a representative structural component.

Prerequisite: C- or better in MAE 214 or CE 313
Typically offered in Fall only

MAE 372  Aerospace Vehicle Structures Lab  (1 credit hours)
Demonstration and application of the concepts that have been presented in MAE 371 and MAE 472. Fabrication techniques and the design and construction of a structural component will be emphasized.

Corequisite: MAE 371
Typically offered in Fall only

MAE 403  Air Conditioning  (3 credit hours)

Prerequisite: MAE 302, MAE 310, MAE 308
Typically offered in Spring only

MAE 405  Controls Lab  (1 credit hours)
Laboratory experiments demonstrate the essential features of classical and modern control theory for single-input and single-output systems.

Corequisite: MAE 435
Typically offered in Fall, Spring, and Summer
MAE 406 Energy Conservation in Industry (3 credit hours)
Application of energy conservation principles to a broad range of industrial situations with emphasis on typical equipment encountered as well as the effect of recent environmental regulations. Topics covered include: steam generators, pollution control, work minimization, heat recovery, steam traps, industrial ventilation, electrical energy management, and economics. Field trip to conduct tests and evaluate operation at three NCSU steam plants.
Prerequisite: MAE 302, MAE 310
Typically offered in Fall only

MAE 407 Steam and Gas Turbines (3 credit hours)
Fundamental analysis of the theory and design of turbomachinery flow passages; control and performance of turbomachinery; gas-turbine engine processes.
Prerequisite: MAE 302 and (MAE 308 or MAE 252)
Typically offered in Spring only

MAE 408 Internal Combustion Engine Fundamentals (3 credit hours)
Prerequisite: MAE 302
Typically offered in Fall only

MAE 410 Modern Manufacturing Processes (3 credit hours)
Introduction to modern manufacturing processes and technologies. Topics to be covered include traditional machining, laser and electrochemical machining, electro-discharge machining, geometric dimensioning & tolerancing, tolerance chart, statistical process control, metal forming, metal casting, rapid prototyping, welding, microfabrication, hybrid processes, and computer aided manufacturing. To relate theory taught in class with practice, the course includes mini projects on machining, rapid prototyping, and material testing.
Prerequisite: MAE 316 or MAE 371
Typically offered in Fall only

MAE 412 Design of Thermal System (3 credit hours)
Applications of thermodynamics, fluid mechanics, and heat transfer to thermal systems with an emphasis on system design and optimization. Design of heat exchangers. Analysis of engineering economics, including time value of money, present and future worth, payback period, internal rates of return, and cost benefit analysis. Review of component model for pipes, pumps, fans, compressors, turbines, evaporators, condensers and refrigerators. Simulation methods for finding the operating point for thermal systems. Design of thermal systems through methods of optimization.
Prerequisite: MAE 302, MAE 308, MAE 310
Typically offered in Fall and Spring

MAE 413 Design of Mechanical Systems (3 credit hours)
Integration of the physical sciences, mathematics, and engineering to solve real-world mechanical engineering design problems. Design of mechanical elements including: fasteners, welds, springs, bearings, gears, belts, brakes, clutches, flywheels, shafts. Emphasis on open-ended problems which contain superfluous information and/or insufficient data. Solution techniques focus on problem definition, reduction to a solvable system, and development of a design response. Team based projects. Formal written communication of results.
Prerequisite: MAE 315 and MAE 316
Typically offered in Fall only

MAE 415 Mechanical Engineering Design I (3 credit hours)
The first course in the sequence of a two-semester capstone senior design project. Teamwork, independent learning and communication skills are emphasized. Team of students practice engineering design process through: problem definition, research, brainstorming, optimization, critical review and analysis. Lectures focus on conceptual design, embodiment design, and quality. Communication skills are developed through reports and presentations.
Prerequisite: MAE 315, MAE 316, MAE 302, MAE 308 and MAE 310
Typically offered in Fall only

MAE 416 Mechanical Engineering Design (4 credit hours)
Teamwork, independent learning and communication skills are emphasized in this capstone course. Teams of students experience mechanical engineering design through: problem definition, investigation, brainstorming, focus, critical review, design, analysis, prototype construction and testing. Design for manufacture is encouraged throughout the process by having students build their own prototypes. Communication skills are developed through reports and presentations.
Corequisite: MAE 415 or MAE 412
Typically offered in Fall and Spring

MAE 420/MAE 520 Dynamic Analysis of Human Movement (3 credit hours)
Topics in movement biomechanics and computational analyses of movement, including muscle physiology and mechanics, advanced muscle modeling, neural control of muscle and motor control theories, and dynamic simulation and optimization. Discussion of fundamental research underpinnings and clinical and sports applications.
P: MAE208 or equivalent
Typically offered in Spring only

MAE 421 Design of Solar Thermal Systems (3 credit hours)
Prerequisite: MAE 302, MAE 310
Typically offered in Spring only
MAE 426/MAE 526 Fundamentals of Product Design (3 credit hours)
Many think of design as more of an art than a science. However, the growing body of research in the engineering design community teaches us ways to navigate the design of consumer products using interdisciplinary design tools and rational decision making. This course introduces students to scientific design techniques that are more effective than "ad hoc" tactics. By exploring how engineering principles integrate with "real world" design challenges, students will learn to solve product design problems that encompass heterogeneous markets, multiple disciplines, and large-scale complex systems.
Prerequisite: MA 241
Typically offered in Spring only

MAE 430 Applied Finite Element Analysis (3 credit hours)
Finite element modeling techniques for solving real-world engineering problems are discussed. Theory of finite element discretization is highlighted by software implementation. Emphasis is given on accurate prescription of boundary conditions that represent actual physical systems, modeling exercises and projects include solid structural problems, heat transfer, structural vibrations, fluid dynamics and contact problems, modeling is carried out using commercial software packages.
Prerequisite: MA 201 and (MAE 316 or MAE 371)
Typically offered in Spring only

MAE 435 Principles of Automatic Control (3 credit hours)
Prerequisites: MAE 315 or MAE 361
Typically offered in Fall, Spring, and Summer

MAE 440 Non-Destructive Testing and Evaluation (3 credit hours)
NDT/NDE is a 3-credit elective course covering the general defect and damage types in materials and structures, principles of NDT/NDE techniques, and NDT/NDE applications. Associated lab modules (3 weeks) provide hands-on opportunities to students on often used NDT/NDE methods including magnetic particle, ultrasonics, and eddy current methods. A final project team will work on research and industrial NDT/NDE solutions.

Junior or Senior standing in the College of Engineering
Typically offered in Fall only

MAE 451 Experimental Aerodynamics III (1 credit hour)
Laboratory experiments in internal compressible flow and boundary layers in conjunction with MAE 458. Topics include nozzle flows, constant area duct flows, component/overall performance of a gas turbine, and boundary layer analysis.
Prerequisite: MAE 352, Corequisite: MAE 458
Typically offered in Fall only

MAE 452 Aerodynamics of V/STOL Vehicles (3 credit hours)
Typically offered in Fall only

MAE 455 Boundary Layer Theory (3 credit hours)
Introduction to the Navier-Stokes Equations and boundary layer approximations for incompressible flow. Calculation techniques for laminar and turbulent boundary layer parameters which affect lift, drag, and heat transfer on aerospace vehicles. Discussions of compressible flows.
Prerequisite: MAE 252 or MAE 308
Typically offered in Fall only

MAE 456 Computational Methods in Aerodynamics (3 credit hours)
Introduction to computational methods for solving exact fluid equations. Emphasis on development of the fundamentals of finite difference methods and their application to viscous and inviscid flows.
Prerequisite: MAE 252
Typically offered in Fall only

MAE 457 Flight Vehicle Stability and Control (3 credit hours)
Longitudinal, directional and lateral static stability and control of aerospace vehicles. Linearized dynamic analysis of the motion of a six degree-of-freedom flight vehicle in response to control inputs and disturbance through use of the transfer function concept. Control of static and dynamic behavior by vehicle design (stability derivatives) and/or flight control systems.
Prerequisite: MAE 252 and (MAE 361 or MAE 315)
Typically offered in Spring only

MAE 458 Propulsion (3 credit hours)
One-dimensional, internal, compressible flow including: isentropic flow, normal shocks, flow with friction and simple heat addition. Applications to air-breathing aircraft propulsion systems. Performance, analysis and design of components and overall performance of air-breathing engines.
Prerequisite: MAE 351
Typically offered in Fall only

MAE 459 Rocket Propulsion (3 credit hours)
Study of chemical rockets. This includes nozzle theory, flight performance, thermochemical calculations, and component and system analysis and design.
Prerequisite: MAE 351 or MAE 302
Typically offered in Fall only

MAE 467 Introduction to Space Flight (3 credit hours)
Fundamental aspects of space flight including launch vehicle performance and design, spacecraft characteristics, two-body orbital mechanics, earth satellites, interplanetary trajectories, atmospheric entry, and atmospheric heating.
Prerequisites: MAE 361 or MAE 315
Typically offered in Spring only

MAE 472 Aerospace Structures II (3 credit hours)
A continuation of MAE 371; deflection of structures, indeterminate structures, minimum weight design fatigue analysis and use of matrix methods in structural analysis. Selection of materials for aircraft construction based on mechanical, physical, and chemical properties.
Prerequisite: MAE 371
Typically offered in Spring only
MAE 480 Aerospace Vehicle Design I (3 credit hours)
A synthesis of previously acquired theoretical and empirical knowledge and application to the design of practical aerospace vehicle systems.
Prerequisites: (MAE 457 or MAE 467) and MAE 252 and MAE 371; Restrictions: Senior standing and Aerospace Engineering Majors
Typically offered in Fall only

MAE 481 Aerospace Vehicle Design II (3 credit hours)
A continuation of MAE 480. Designs are refined and vehicles constructed and instrumented by students. A flight test program is designed and carried out in cooperation with MAE 525 students.
Prerequisite: MAE 480
Typically offered in Spring only

MAE 482/ECE 482 Engineering Entrepreneurship and New Product Development I (3 credit hours)
Applications of engineering, mathematics, basic sciences, finance, and business to the design and development of prototype engineering products. This course requires a complete written report and an end-of-course presentation. This is the first course in a two semester sequence. Students taking this course will implement their designed prototype in ECE 483: Senior Design Project in Electrical Engineering and Computer Engineering II-Engineering Entrepreneurs. Departmental approval required.
Typically offered in Fall only

MAE 483/ECE 483 Engineering Entrepreneurship and New Product Development II (3 credit hours)
Applications of engineering, science, management and entrepreneurship to the design, development and prototyping of new product ideas. Based on their own new product ideas, or those of others, students form and lead entrepreneurship teams (eTeams) to prototype these ideas. The students run their eTeams as 'virtual' startup companies where the seniors take on the executive roles. Joining them are students from other grade levels and disciplines throughout the university that agree to participate as eTeam members. Departmental approval required.
Prerequisite: ECE 482
Typically offered in Fall and Spring

MAE 484 Engineering Entrepreneurship Senior Design Lab (1 credit hours)
This is the lab for MAE 483. Applications of engineering, science, management, and entrepreneurship to the design, development, and prototyping of new product ideas. Based on their own product ideas, or those of others, students form and lead entrepreneurship teams (eTeams) to prototype these ideas. The students run their eTeams as 'virtual' startup companies where the seniors take on the executive roles. Joining them are students from other grade levels and disciplines throughout the University that agree to participate as eTeam members. Departmental approval required.
Prerequisite: MAE/ECE 482: C; MAE/ECE 483
Typically offered in Spring only

MAE 495 Special Topics in Mechanical and Aerospace Engineering (1-3 credit hours)
Offered as needed to present new or special MAE subject matter.

MAE 496 Undergraduate Project Work in Mechanical and Aerospace Engineering (1-6 credit hours)
Individual or small group project in engineering, comprising the design of an equipment or system stemming from a mutual student-faculty interest; a substantial final report (project) containing calculations, drawings and specifications must be produced. Alternatively, individual or small group undergraduate research evolving from a mutual student-faculty interest; a conference or scientific journal paper must be submitted for publication. Departmental approval required
Prerequisite: Completion of all required MAE-300 level courses,
Corequisite: MAE 415 or MAE 478
Typically offered in Fall, Spring, and Summer

MAE 501 Advanced Engineering Thermodynamics (3 credit hours)
Classical thermodynamics of a general reactive system; conservation of energy and principles of increase of entropy; fundamental relation of thermodynamics; Legendre transformations; phase transitions and critical phenomena; equilibrium and stability concepts
Prerequisite: MAE 302; MA 401 or MA 511
Typically offered in Spring only

MAE 504 Fluid Dynamics Of Combustion I (3 credit hours)
Gas-phase thermochemistry including chemical equilibrium and introductory chemical kinetics. Homogeneous reaction phenomena. Subsonic and supersonic combustion waves in premixed reactants (deflagration and detonation). Effects of turbulence. Introduction
Prerequisite: MAE 201 or MA 252 or MA 308
Typically offered in Fall only

MAE 505 Heat Transfer Theory and Applications (3 credit hours)
Development of basic equations for steady and transient heat and mass transfer processes. Emphasis on application of basic equations to engineering problems in areas of conduction, convection, mass transfer and thermal radiation.
Prerequisite: MAE 310
Typically offered in Fall only

MAE 511 Advanced Dynamics with Applications to Aerospace Systems (3 credit hours)
Basic topics in advanced dynamics and with applications to aerospace systems. Rotating coordinate systems, Euler angles, three-dimensional kinematics and kinetics, angular momentum methods and an introduction to analytical mechanics. Examples are concentrated in the area of aerospace vehicles, but the methods learned will be applicable to land-based vehicles and any engineering system undergoing rigid body rotation, e.g. wind turbines, biomechanical systems, machine tools, robotic systems, etc.
Prerequisite: (MAE 208 or PY 205) and MA 242 and (MA 301 or MA 341)
Typically offered in Fall only

MAE 513 Principles of Structural Vibration (3 credit hours)
Principles of structural vibration beginning from single and multi-degree of freedom systems and extending to distributed systems. Forced system response, vibration of strings, bars, shafts and beams and an introduction to approximate methods.
Prerequisite: MAE 315
Typically offered in Fall only
MAE 515  Advanced Automotive Vehicle Dynamics (3 credit hours)
This course covers advanced materials related to mathematical models and
designs in automotive vehicles as multiple degrees of freedom
systems for dynamic behaviors in acceleration, braking, rollover,
aerodynamics, suspensions, tire, and drive train.
Prerequisite: MAE 208 or MAE 315 or MAE 472 or equivalent; or consent
of the instructor
Typically offered in Spring only

MAE 517  Advanced Precision Manufacturing for Products, Systems
and Processes (3 credit hours)
This is a graduate level course designed for graduate students and
undergraduate seniors. This course examines precision issues for
products, manufacturing machines, processes, and instruments. Modern
manufacturing technologies are distinct in their multifarious nature
in product sizes, materials, energy forms, theories, and information
types; however, the key to their success relies on the management of
precision. This course discusses issues critical to both existing precision
manufacturing and future sub-micron/nano technology. Important topics
include fundamental mechanical accuracies; manufacturing systems and
processes; geometric dimensioning and tolerancing; process planning,
tolerance charts, and statistical process control; principles of accuracy,
repeatability, and resolution; error assessment and calibration; error
budget; reversal principles; joint design and stiffness consideration;
precision sensing and control; precision laser material processing.
Prerequisite: MAE 496 or MAE 415 or equivalent or instructor permission
Typically offered in Fall only

MAE 518  Acoustic Radiation I (3 credit hours)
Introduction to principles of acoustic radiation from vibrating bodies and
their related fields. The radiation of simple sources, propagation of sound
waves in confined spaces and transmission through different media.
Prerequisite: MA 301 and MAE 308 or MAE 356
Typically offered in Fall and Spring

MAE 520/MAE 420  Dynamic Analysis of Human Movement (3 credit
hours)
Topics in movement biomechanics and computational analyses of
movement, including muscle physiology and mechanics, advanced
muscle modeling, neural control of muscle and motor control theories,
and dynamic simulation and optimization. Discussion of fundamental
research underpinnings and clinical and sports applications.
P: MAE208 or equivalent
Typically offered in Spring only

MAE 521  Linear Control and Design For Mimo Systems (3 credit
hours)
Linear Multivariable control and design for multibody engineering systems
(robotics) and aircraft controls and navigation. Emphasis on multi-input
and multi-output (MIMO) system analysis and design using frequency-
based approach. Controllability and observability, transmission zeroes
and pole-zero cancellation, eigenstructures, singular value decomposition
in frequency domain, stability and performance robustness of MIMO
systems.
Prerequisite: MAE 435, MA 341

MAE 522  Non Linear System Analysis and Control (3 credit hours)
Nonlinear system analysis, Lyapunov stability theory, absolute stability,
feedback linearization, sliding mode control, backstepping control
technique, as well as various advanced nonlinear control methods.
Prerequisite: MAE 521 or equivalent

MAE 525  Advanced Flight Vehicle Stability and Control (3 credit
hours)
Preliminary analysis and design of flight control systems to include
autopilots and stability augmentation systems. Study of effects of inertial
cross-coupling and nonrigid bodies on vehicle dynamics.
Prerequisite: MAE 457
Typically offered in Fall only

MAE 526/MAE 426  Fundamentals of Product Design (3 credit
hours)
Many think of design as more of an art than a science. However,
the growing body of research in the engineering design community
teaches us ways to navigate the design of consumer products using
interdisciplinary design tools and rational decision making. This course
introduces students to scientific design techniques that are more effective
than “ad hoc” tactics. By exploring how engineering principles integrate
with “real world” design challenges, students will learn to solve product
design problems that encompass heterogeneous markets, multiple
disciplines, and large-scale complex systems.
Prerequisite: MA 241
Typically offered in Spring and Summer

MAE 528  Experimental Flight Testing (3 credit hours)
Application of engineering methods to experimental flight testing of fixed-
wing aircraft for determination of performance and handling qualities of air
vehicles. Risk minimization techniques are included in the formulation of
a flight test plan. Collect
Prerequisite: Graduate standing, Aerospace Engineering Majors,
MAE 525
Typically offered in Spring only

MAE 531  Engineering Design Optimization (3 credit hours)
Nonlinear optimization techniques with applications in various aspects
of engineering design. Terminology, problem formulation, single and
multiple design variables, constraints, classical and heuristic approaches,
single and multiobjective problems, response surface modeling, and
tradeoffs in complex engineering systems. Numerical optimization
algorithms and implementation of these optimization techniques.
Graduate standing in engineering recommended.
Prerequisite: Graduate standing in Engineering is recommended.
Typically offered in Fall only

MAE 532  Smart Structures and Micro-Transducers (3 credit hours)
This course is designed for graduate students who wish to learn
fundamentals and applications of smart structures and micro transducers.
The course focuses on materials, structures, design, fabrication, and
characterization of micro transducers. It also covers the recent progress
in applications of micro transducers in aerospace, biomedical, civil,
electrical and mechanical engineering.
Prerequisite: MAE 314, MAE 315, or equivalent.
Typically offered in Spring only
MAE 533 Finite Element Analysis I (3 credit hours)
Prerequisite: MAE 316 or MAE 472
Typically offered in Fall only

MAE 534/FB 534 Mechatronics Design (3 credit hours)
Principles of Mechatronics Design, review of logic gates, microprocessor architecture, sensors and actuators, A/D and D/A conversion techniques, real-time multi-tasking programming concepts, direct digital control implementation. "Hands-on" experience through several laboratory assignments and final team project.
Prerequisite: Structured Programming Experience, Senior/Graduate Standing in WPS/MAE.
Typically offered in Fall and Spring

MAE 535/ECE 535 Design of Electromechanical Systems (3 credit hours)
A practical introduction to electromechanical systems with emphasis on modeling, analysis, design, and control techniques. Provides theory and practical tools for the design of electric machines (standard motors, linear actuators, magnetic bearings, etc.). Involves some self-directed laboratory work and culminates in an industrial design project. Topics include Maxwell's equations, electromechanical energy conversion, finite element analysis, design and control techniques.
Prerequisite: MA 341
Typically offered in Spring and Summer

MAE 536 Micro/Nano Electromechanical Systems (3 credit hours)
Fundamentals and applications of micro/nano sensors and actuators. Emphasis upon MEMS/NEMS design, microfabrication techniques, and case studies of MEMS devices. Nanomaterials and NEMS devices also covered. Students have opportunity to learn commercial software packages on design and simulation of MEMS and hear from experts from leading MEMS companies through guest lectures. Previous knowledge of MEMS and nanotechnology is not required. The course is restricted to advanced undergrads and graduate students in engineering, materials science, physics and biomedical fields.
Typically offered in Fall only

MAE 537 Mechanics Of Composite Structures (3 credit hours)
Manufacturing techniques with emphasis on selection of those producing most favorable end result. Classical plate theory, materials properties and failure theories. Micromechanics, repair, plate solutions and elasticity solutions covered as required to meet special interests of students.
Prerequisite: MAE 316 or MAE 472
Typically offered in Spring only

MAE 538 Smart Structures and Materials (3 credit hours)
An application-oriented introduction to smart structures and materials with examples from mechanical, aerospace and biomedical engineering. Experimentally observed phenomena, micromechanisms, and models for material behavior. Team work developing simulation tools for typical applications. Validating results experimentally using PC-based data acquisition systems.
Prerequisite: MAE 415 or MAE 472
Typically offered in Spring only

MAE 539/MSE 539 Advanced Materials (3 credit hours)
Introduces production/structure/property/function relation and application of a number of materials mainly for biomedical, mechanical and aerospace applications. Topics include ultra light materials (production, processing and applications of cellular solids), biomaterials (classes and application of materials in medicine and dentistry), composites (classes and application), refractory materials and coatings for high temperature applications, thin film shape memory alloys for micro-electro mechanical systems (MEMS).
Prerequisite: MSE 201 and MAE 314
Typically offered in Fall only

MAE 540 Advanced Air Conditioning Design (3 credit hours)
Prerequisite: MAE 403, 404
Typically offered in Spring only

MAE 541 Advanced Solid Mechanics I (3 credit hours)
Development of principles of advanced strength of materials and elasticity theory leading to solution of practical engineering problems concerned with stress and deformation analysis. Tensor analysis, coordinate transformations, alternative measures of strain, elastic constitutive equations, stress measures, formulation and solution of two and three dimensional elasticity problems. Examples include advanced beam theory for shear deformation and large deformation, contact mechanics, stress concentration, pressure vessels and compound cylinders, thermal stress analysis, and stresses in layered microelectronic devices.
Prerequisite: MAE 316
Typically offered in Fall only

MAE 543 Fracture Mechanics (3 credit hours)
Concept of elastic stress intensity factor, Griffith energy balance, determination of the elastic field at a sharp crack tip via eigenfunction expansion methods, J integrals analysis, experimental determination of fracture toughness, fatigue crack growth, elastic-plastic crack tip fields. Emphasis on modern numerical methods for determination of stress intensity factors, critical crack sizes and fatigue crack propagation rate predictions.
Prerequisite: MAE 316
Typically offered in Spring and Summer
MAE 544 Real Time Robotics (3 credit hours)
Real-time programming for servo control using an embedded controller. Software and hardware interfacing for control of a D.C. servo device. Introduction of multi-tasking to establish concurrent control of several processes, transforming servo loop into a process executing concurrently on single board computer. Provision for hands-on development systems and software emulators.
Prerequisite: Pascal, C, FORTRAN or Assembly language experience
Typically offered in Spring only

MAE 545 Metrology For Precision Manufacturing (3 credit hours)
Foundations of dimensional metrology and error analysis as applied to accuracy and repeatability in machine design. Plane, length, angle, and roundness metrology. Design of precision systems, Abbe principle, error analysis, measurement, and compensation. Precision instruments and operating principles. Hands-on experience with measurement instruments and techniques.
Prerequisite: Senior standing in MAE or BS in other curriculum
Typically offered in Fall only

MAE 546 Photonic Sensor Applications in Structure (3 credit hours)
Use of optical fiber and other photonic device based sensors to measure strain, temperature and other measurands in aerospace, mechanical, civil and biomedical applications. An introduction to optical waveguide analysis will be provided at the beginning of the course.
Prerequisite: MAE 371 or MAE 316
Typically offered in Fall only

MAE 550 Foundations Of Fluid Dynamics (3 credit hours)
Review of basic thermodynamics pertinent to gas dynamics. Detailed development of general equations governing fluid motion in both differential and integral forms. Simplification of the equations to those for specialized flow regimes. Similarity paramet
Prerequisite: MAE 201 or MAE 252 or MAE 308
Typically offered in Fall and Summer

MAE 551 Airfoil Theory (3 credit hours)
Development of fundamental aerodynamic theory. Emphasis upon mathematical analysis and derivation of equations of motion, airfoil theory and comparison with experimental results. Introduction to super sonic flow theory.
Prerequisite: MAE 252

MAE 552 Introduction to Experimental Fluid Dynamics and Measurement Systems (3 credit hours)
This course educates graduate students in the design of experiments and basis for model testing and scaling laws; uncertainty and error analysis in selecting measurement systems for experiments; qualitative and quantitative technologies for obtaining measurements; analysis, post-processing and visualization techniques of data.
Prerequisite: MAE 308 and MAE 451 or equivalent
Typically offered in Spring only

MAE 553 Compressible Fluid Flow (3 credit hours)
Equations of motion in supersonic flow; unsteady wave motion, velocity potential equation; linearized flow; conical flow. Slender body theory. Methods of characteristics. Shockwave/ boundary layer interactions.
Prerequisite: MAE 351 or MAE 550
Typically offered in Spring only

MAE 554 Hypersonic Aerodynamics (3 credit hours)
Fundamentals of inviscid and viscous hypersonic flowfields. Classical and modern techniques for calculating shock wave shapes, expansions, surface pressures, heat transfer and skin friction. Applications to high speed aircraft, rockets and spacecraft.
Prerequisite: MAE 553

MAE 555 Applications of Acoustic and Elastic Wave Propagation (3 credit hours)
This course covers the principles for acoustic and elastic propagation in fluids and solids. Diffraction theory is developed for finite sources. The notions of wavepacket, dispersion and waveguiding are reviewed. The fundamentals of the theory of elasticity and elastic propagation in solids are introduced, based on tensor analysis. Time reversal of acoustic waves is presented, as well as applications to underwater acoustics, medical imaging and therapy, nondestructive testing, elasticity imaging.
Typically offered in Spring only

MAE 558 Microfluidics and Nanofluidics (3 credit hours)
Macroscale fluid mechanics, heat and mass transfer. Theories of microfluidics and nanofluidics. Applications in mechanical, biomedical, chemical and engineering. Discussions of journal articles and modern fluid dynamics projects. Expert guest lectures on advanced micro/nanotechnology topics.
Prerequisite: MAE 310 and MAE 427
Typically offered in Spring only

MAE 560 Computational Fluid Mechanics and Heat Transfer (3 credit hours)
Introduction to integration of the governing partial differential equations of fluid flow and heat transfer by numerical finite difference and finite volume means. Methods for parabolic, hyperbolic and elliptical equations and application to model equations. Error analysis and physical considerations.
Prerequisite: MAE 501 or MAE 512, MAE 550 or MAE 557, proficiency in the FORTRAN programming language is required
Typically offered in Fall only

MAE 561 Wing Theory (3 credit hours)
Discussion of inviscid flow fields over wings in subsonic flow. Vortex lattice methods, lifting surface theories and panel methods developed for wings with attached flow and leading-edge separation. Calculation of aerodynamic characteristics and determination of effects of planform and airfoil shapes.
Prerequisite: MAE 551
Typically offered in Spring only

MAE 562 Physical Gas Dynamics (3 credit hours)
Prerequisite: MAE 550
Typically offered in Fall only
MAE 573 Hydrodynamic Stability and Transition (3 credit hours)
Conceptual framework and development of hydrodynamic stability theory. Application of the theory to two-dimensional incompressible and compressible subsonic, transonic, supersonic and hypersonic flows. Results for three-dimensional flows. Introduction of mechanisms of transition and discussion of transition models in numerical methods.

Prerequisite: MAE 550
Typically offered in Spring only

MAE 575 Advanced Propulsion Systems (3 credit hours)
The course will focus on non-turbomachinery, air-breathing hypersonic aeropropulsion applications. Specific propulsion systems to be covered include ramjets and scramjets, pulsed detonation engines, and combined cycle engines, with historical perspective.

Prerequisite: Both MAE 458 and MAE 459 or both MAE 302 and MAE 308

MAE 577/NE 577 Multiscale Two-phase Flow Simulations (3 credit hours)
Modeling and simulation of two-phase flows using interface tracking approach and ensemble averaging approaches. Model validation and verification based on interface-tracking data, boiling models. Nuclear reactor applications. The course focuses on interface tracking methods understanding as applied to bubbly flow simulations. Students will develop a simplified solver to track 2D bubbles/droplets throughout the course homework assignments and will learn how to apply this approach for better understanding of multi-phase flow as part of the course project.

Typically offered in Fall only

Typically offered in Fall, Spring, and Summer

MAE 589 Special Topics In Mechanical Engineering (1-6 credit hours)
Faculty and student discussions of special topics in mechanical engineering.

Prerequisite: Advanced Undergraduate standing or Graduate standing
Typically offered in Fall and Spring

MAE 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MAE 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Spring only
MAE 703 Direct Energy Conversion (3 credit hours)
The course is intended to be an introduction to fundamentals of energy transport and energy conversion concepts from nano to macro scales. The course will cover the state of energy carriers (photons, electrons, and phonons) and their transport characteristics. A focus will be on material properties that dictate energy related processes. The foundational concepts will then be applied to direct energy conversion devices including thermoelectrics and photovoltaics. Finally, the course will cover system analysis of solid-state energy conversion applications.

Typically offered in Spring only

MAE 704 Fluid Dynamics of Combustion II (3 credit hours)
Advanced theory of detonation and deflagration. Ignition criteria. Direct initiation of detonation including blast-wave theory. Transition from deflagration to detonation. Combustion wave structure and stability. Liquid droplet and solid particle combus

Prerequisite: MAE 504
Typically offered in Spring only

MAE 707 Advanced Conductive Heat Transfer (3 credit hours)

Prerequisite: MAE 505 or MA 501
Typically offered in Spring only

MAE 708 Advanced Convective Heat Transfer (3 credit hours)
Advanced topics in steady and transient, natural and forced convective heat transfer for laminar and turbulent flow through conduits and over surfaces. Mass transfer in laminar and turbulent flow. Inclusion of topics on compressible flow with heat and mass transfer.

Prerequisite: MAE 550
Typically offered in Spring only

MAE 709 Advanced Radiative Heat Transfer (3 credit hours)
Comprehensive and unified treatment of basic theories; exact and approximate methods of solution of radiative heat transfer and the interaction of radiation with conductive and convective modes of heat transfer in participating and non-participating media.

Prerequisite: MAE 505
Typically offered in Fall only

MAE 718 Acoustic Radiation II (3 credit hours)
Advanced treatment of the theory of sound generation and transmission. Topics include: techniques for solution of the wave equation, radiation from spheres, cylinders and plates, sound propagation in ducts, scattering.

Prerequisite: MAE 518
Typically offered in Spring only

MAE 721 Robust Control with Convex Methods (3 credit hours)
This course emphasizes on control design techniques which result in closed-loop systems that are insensitive to modeling errors and which achieve a prespecified level of performance. Robustness margins against model uncertainty. Robust control design techniques based on linear matrix inequalities. Topics include uncertainty modeling, robust stability and performance, H_inf control, convex optimization technique (LMI), multi-analysis and synthesis, computer-aided analysis and control design.

Prerequisite: Graduate standing in Engineering and Applied Mathematics, MAE 521 or ECE 716
Typically offered in Spring only

MAE 725 Geophysical Fluid Mechanics (3 credit hours)
The principles of fluid mechanics applied to geophysical systems. Special emphasis placed on those features of these systems, such as almost rigid rotation and stable stratification, which produce unique and important effects. The effects of almost rigid rotations on homogeneous and stratified flows examined in detail.

Prerequisite: MAE 725 or equivalent
Typically offered in Spring only

MAE 726 Advanced Geophysical Fluid Mechanics (3 credit hours)
Principles of fluid mechanics applied to geophysical systems. Special emphasis on role of stable stratification on the flows in these systems. Detailed study of generation, interaction, propagation and dissipation of internal gravity waves. Study of other geophysically important flows.

Prerequisite: MAE 725 or equivalent
Typically offered in Spring only

MAE 730 Modern Plasticity (3 credit hours)
Classical theories of plasticity and solutions pertaining to rate-independent and rate-dependent deformations modes in metals, geomaterials and concrete. Ductile failure modes, i.e., shear-strain localization and other failure modes associated with large deformation modes. Inelastic wave propagation, crystalline constitutive formulations and computational aspects of quasi-static and dynamic plasticity.

Prerequisite: Grad. course in elasticity or strength of materials
Typically offered in Fall only

MAE 731/MSE 731 Materials Processing by Deformation (3 credit hours)
Presentation of mechanical and metallurgical fundamentals of materials processing by deformation. Principles of metal working, friction, forging, rolling, extrusion, drawing, high energy rate forming, chipless forming techniques, manufacturing system concept in production.

Prerequisite: Six hrs. of solid mechanics and/or materials
Typically offered in Fall only

MAE 734 Finite Element Analysis II (3 credit hours)
Advanced treatment of finite element analysis for non-linear mechanics problems, including most recent developments in efficient solution procedures. Plate bending and shell elements, computational plasticity and viscoplastic materials, large deformation formulotions, initial stability and buckling, structural vibrations, incompressible elasticity, contact problems, flow in incompressible media, weighted residuals and field problems. Development of efficient algorithms for practical application.

Prerequisite: MAE 533
Typically offered in Spring only
MAE 742 Mechanical Design for Automated Assembly (3 credit hours)
Mechanical design principles important in high volume production using modern automated assembly technology. Production and component design for ease of assembly as dictated by part handling, feeding, orientation, insertion and fastening requirements. Existing product evaluation and redesign for improved assemblage.
Prerequisite: Graduate standing or PBS status in Engineering
Typically offered in Fall only

MAE 766 Computational Fluid Dynamics (3 credit hours)
Advanced computational methods for integrating, by use of finite differences, and finite volume discretizations, non-linear governing equations of fluid flow; the Euler equations and the Navier-Stokes equations. Topics from current literature.
Prerequisite: MAE 560; proficiency in the FORTRAN programming language is required
Typically offered in Spring only

MAE 776 Turbulence (3 credit hours)
Development of governing equations for turbulence and turbulent field motion. Formulations of various correlation tensors and energy spectra for isotropic and nonisotropic turbulence. Introduction to turbulent transport processes, free turbulence, and wall turbulence.
Prerequisite: MAE 550
Typically offered in Spring only

MAE 777 Structural Health Monitoring (3 credit hours)
The course will provide the students with in-depth knowledge of technologies in structural health monitoring using smart materials as sensing and actuating elements to interrogate the structures. Damage detection techniques such as wave, impedance, and vibration-based damage detection techniques will be discussed and applied to different types of structures. Advanced signal processing techniques such as wavelet, neural network, principal component analysis will be used to make the damage more quantifiable.
Prerequisite: MAE 541 or MAE 513 or equivalent
Typically offered in Spring only

MAE 780 Advanced Topics In Mechanical Engineering (1-3 credit hours)
Faculty and graduate student discussions of advanced topics in contemporary mechanical engineering.
Prerequisite: Graduate standing
Typically offered in Fall and Spring

MAE 801 Mechanical Engineering Seminar (1 credit hours)
Faculty and graduate student discussions centered around current research problems and advanced engineering theories.
Typically offered in Fall and Spring

MAE 830 Doctoral Independent Study (1-3 credit hours)
Individual investigation of advanced topics under the direction of member(s) of the graduate faculty.
Typically offered in Spring only

MAE 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

MAE 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

MAE 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

MAE 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MAE 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Summer only

MAE 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Typically offered in Fall, Spring, and Summer

**Mechanical Engineering Systems (MES)**

MES 200 Introduction to Mechanical Engineering Systems (2 credit hours)
This course introduces students to mechanical engineering systems and its application in real-world problem solving. Using Excel and MATLAB, students will structure and solve problems. Through hands-on activities, students will become familiar with basic mechanical components, tools and machines. Students will be introduced to professionalism in engineering and develop a personal professional development plan. This course requires a field trip to a local business and students will be required to provide or arrange for their own transportation. Course contains a required laboratory component.
Corequisite: MAE 206
Typically offered in Fall only
MES 201 Mechanical Engineering Systems Lab I (2 credit hours)
Course provides an introduction to the theory and practice of manual and computer assisted laboratory measurement techniques, data analysis, design of experiments and technical report writing. Students learn to successfully conduct and document an engineering experiment. This course requires a field trip to a local business and students will be required to provide or arrange for their own transportation.
Prerequisite: MAE 206
Typically offered in Spring only

MES 300 Systems Engineering (4 credit hours)
This course provides an introduction to the theory and practice of formal systems engineering. Students are exposed to systems thinking, systems modeling and performing engineering design within a formal systems engineering framework. They will perform requirements definition and analysis, system architecting, test and integration plan development, economic evaluation of alternatives, and formal technical reviews. Requires Junior standing.
Prerequisite: MES 200 and C or better in MAE 206
Typically offered in Fall only

MES 301 Mechanical Engineering Systems Lab II (2 credit hours)
This is the first course in a series of three upper level laboratory courses MES 301, 302, and 400. In each course, students apply the measurement and experimental techniques learned in MES 201 to explore, experience and verify key theoretical mechanical engineering concepts. MES 301 focuses on the fields of fluid mechanics, dynamics of machines, digital design, and electrical engineering. Course requires a field trip to a local business and students will be required to provide or arrange for their own transportation.
Prerequisite: MES 201; Corequisite: MAE 308 and MAE 315
Typically offered in Fall only

MES 302 Mechanical Engineering Systems Lab III (2 credit hours)
This is the second course in a series of three upper level laboratory courses. MES 302 focuses on the fields of fluid mechanics, dynamic systems controls, and instrumentation. Students also experience engineering design by designing, building and testing an instrumentation device for engineering measurements. Course requires a field trip to a local business and students will be required to provide or arrange for their own transportation.
Prerequisite: MES 301; Corequisite: MAE 435
Typically offered in Spring only

MES 305 Mechanical Engineering Systems Lab I (1 credit hours)
Course provides an introduction to the theory and practice of manual and computer assisted laboratory measurement techniques, data analysis, design of experiments and technical report writing. Students learn to successfully conduct and document an engineering experiment. For MES Majors only.
Prerequisite: MSE 201 and MAE 206
Typically offered in Spring only

MES 400 Mechanical Engineering Systems Lab IV (2 credit hours)
This is the final course in a series of three upper level laboratory courses. MES 400 focuses on the fields of fluid mechanics, heat transfer, digital design, and solid mechanics. Students also finish the design experience started in MES 302. Course requires a field trip to a local business and students will be required to provide or arrange for their own transportation.
Prerequisite: MES 302; Corequisite: MAE 310
Typically offered in Fall only

MES 401 MES Capstone Design I (3 credit hours)
This course is first of a two-semester engineering design and manufacturing experience which is the culmination of the MES student's undergraduate education experience. In teams, students design, cost, and build a working prototype to solve a real-world engineering problem supplied by an industry partner. Students follow a systems engineering approach to manage their project through a requirements definition review, a preliminary design review, and the completion of detailed design. Students develop communication skills through reports and presentations and gain insight into engineering design through guest lectures. Students must provide any transportation needed for this class. MES students only.
Prerequisite: MES 300 and MAE 316; Corequisite: MAE 310 and MAE 415
Typically offered in Fall only

MES 402 MES Capstone Design II (4 credit hours)
This course is second in a two semester engineering design and manufacturing experience which is the culmination of the MES student's undergraduate education experience. In teams, students solve a real-world engineering problem supplied by an industry partner. In the two courses, students follow a formal systems engineering approach to manage their project through the following reviews: System Requirements, Conceptual Design, Preliminary Design, and Critical Design. Students develop written and verbal communication skills and gain insight into engineering design practices through guest lectures from local engineers. Students must provide any transportation needed for this class. MES students only.
Prerequisite: MES 401
Typically offered in Spring only

MES 403 MES Capstone Design II (3 credit hours)
This course sequence is the second in the senior capstone engineering design experience. This capstone experience is the culmination of the MES student's undergraduate education experience. Working in teams, students perform engineering design to solve a real-world engineering problem supplied by an industry partner. In MES 401 & MES 403, students follow a formal systems engineering approach to manage their design project through the completion of a System Requirements Review, a Conceptual Design Review, a Preliminary Design Review, a Detailed Design Review, and a Critical Design Review. Students develop written and verbal communication skills through reports and presentations. Students also gain insight into engineering design practices through guest lectures from local engineers. Course requires travel to sponsor and students are required to provide or arrange for their own transportation.
Prerequisite: MES 401
Typically offered in Spring only
MES 405 Mechanical Engineering Systems Lab II (2 credit hours)
In this course, students apply the measurement and experimental techniques learned in MES 305 to explore, experience and verify key theoretical concepts from the fields of thermal science, fluid mechanics, solid mechanics, and dynamics and controls. Students learn to successfully design, conduct, analyze, document and present a statistically sound engineering experiment. For MES students only.
Prerequisite: MES 305 and MAE 314 and MAE 308; Corequisite: MAE 435 and MAE 310
Typically offered in Fall only

Medical Textiles (MT)

MT 105 Introduction to Medical Textiles (3 credit hours)
Introduction to the structures and methods of production of polymers, fibers, yarns and fabrics used in medical applications. Survey of the performance requirements of current medical textiles and healthcare products used in health centers, as surgical implants and as consumer products. Overview of the structure, organization and integration of the medical textile, medical device and pharmaceutical industries within the healthcare sector. Credit not allowed if previous credit for TT 105
Typically offered in Fall and Spring

MT 323 Introduction to Theory and Practice of Medical Fiber and Yarn Formation (3 credit hours)
Introduction to the manufacture of fibers and filament yarns used in medical textiles. It includes the flow behavior of polymeric materials as it relates to fiber formation. It also includes the application of fiber forming theories to synthetic and b
Prerequisite: (PY 211 or (PY 205 and PY 206)) and (PCC 203 or CH 221 or CH 225 or TE 200)
Typically offered in Fall and Spring

MT 366 Biotextile Product Development (3 credit hours)
Overview of the product development process for medical textiles and implantable biotextile devices. FDA classification system for medical and healthcare products. Review steps in identification of healthcare needs, market size and demand, product specifications and design, prototype fabrication and sterilization, in vitro testing of mechanical, chemical, surface and biological properties, in vivo animal testing, regulatory issues, consumer and clinical trials and explant analysis. Examples of medical textiles for personal hygiene, wound care, external support, orthopedic, general surgery, dental and tissue engineering applications. The student will be introduced to the process of new product development as it applies to medical textiles and biotextiles.
Prerequisite: (TT 105 or MT 105 or PCC 105), (TE 200 or CH 223 or 227), and TT 327; Co-requisite: TT 305, TT 341, and TT 351
Typically offered in Spring only

MT 381 Medical Textile and the Regulatory Environment (3 credit hours)
The course will focus on the legal and regulatory environment as it impacts the design, manufacture, marketing and distribution of medical textiles and healthcare products. Fundamentals of legal theory, contract law, intellectual property, licensing, product liability and the Food and Drug Administration will be covered, providing the student with the ability to recognize and understand the legal issues involved with the medical textile supply chain.
Prerequisite: Junior standing.
Typically offered in Fall and Spring

MT 432 Biotextiles Evaluation (3 credit hours)
Evaluation of the performance of biotextiles and medical polymers in biological and microbiological environments, with an emphasis on in vitro and in vivo techniques for testing the biocompatibility and biostability of implantable biomedical products. Related issues will deal with quality assurance systems, inspection and sampling plans, ISO certification, good manufacturing practices, reference materials and organisms, and the use of accelerated tests and animal trials so as to meet regulatory requirements.
Prerequisite: TT 327 or MT 323 and BIO 183; Corequisite: MT 366 or TE 466
Typically offered in Fall only

MT 471/PCC 471 The Chemistry of Synthetic and Natural Bipolymers (3 credit hours)
Introduction to natural and synthetic biopolymers used for biomedical applications. Goals and challenges of biomaterials selection for biomedical engineering. Polymer concepts of polymerization and characterization. Sources/synthesis, chemical and physical properties and degradation mechanisms are described. Polymer classes include: polysaccharides, proteins, polyesters, polyurethanes, polyanhydrides and polyethers.
Prerequisite: CH 220 or 221 or 225
Typically offered in Spring only

Microbiology (MB)

MB 101/BCH 101 Introduction to Microbiology and Biochemistry Laboratory Practices (3 credit hours)
Curricular bridge between high school and college for high school and transitional students. A "hands on" introduction to fundamentals in Microbiology and Biochemistry. Bacterial isolation, identification and growth using aseptic technique, microscopy, and metabolic analysis. Experiments with DNA isolation and analysis, protein isolation, and purification, and enzyme kinetics. Lectures and readings on background, theory and applications of these techniques. Field trips to university and industry research laboratories. This course is part of the Summer College in Bionotechnology and Life Sciences (SCIBLS) as well as other pre-college, transitional and early-college programs and is offered as a 4 week intensive course. Applicants should have completed high school courses in biology and chemistry. Students must have completed no more than 30 credit hours. Departmental approval is required for current NCSU students.
Typically offered in Summer only
MB 103 Introductory Topics in Microbiology (1 credit hours)
Introduction to scope and objectives of university education. Emphasis on microbiology. Career opportunities, computers, university resources.

Typically offered in Fall only

MB 180 Introduction to Microbial Bioprocessing (3 credit hours)
Curricular bridge between high school and college for high school and transitional students. Fundamental cell biology concepts pertaining to biomanufacturing. Students gain an understanding of the basic principles of microbiology, culture preparation, physiology, and genetics of microbial cell cultures. Team-based decisions, collaborations and consideration of multiple perspectives are emphasized. Practical experience in laboratory and culture techniques used in biomanufacturing. Transportation will be provided for field trips. This course is part of the Summer College in Biotechnology and Life Sciences (SCIBLS), as well as other pre-college, transitional and early-college programs. Suitable for students with less than 30 credit hours.

Typically offered in Summer only

MB 200 The Fourth Horseman: Plagues that Changed the World (3 credit hours)
An integrated and in-depth study of select microbial pathogens and their influence on history, public health, and human affairs. Five major pathogens will be examined to identify causative agents of disease, modes of transmission, prevention, and treatment. These pathogens will be framed in the power of plagues to shape human history and their impact on public health.

GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

MB 210/BIT 210 Phage Hunters (3 credit hours)
This course offers first-year students an opportunity for mentored research. Students will apply the scientific method to make novel discoveries. Students will isolate and characterize naturally-occurring bacteriophage (viruses that infect bacteria, but not humans) from the environment. They will present their data to each other, and the genome of one phage will be sequenced. Students have the option to continue in a second semester to annotate that genome, culminating in a submission to genbank and a poster presentation. Students in the course are part of the National Genome Research Initiative funded by The Howard Hughes Medical Institute. Student should have had a high school biology course before taking this course.

GEP Natural Sciences
Typically offered in Fall only

MB 211/BIT 211 Phage Genomics (2 credit hours)
This course offers first-year students an opportunity for mentored research. Students will apply the scientific method to make novel discoveries. Students will build on the work they began in BIT/MB 210: the novel phage isolated in the previous semester will undergo genome sequencing over winter break, and in this course students will learn to analyze and annotate the genome sequence. This semester will culminate in a submission to genbank and a poster presentation. Students in the course are part of the national genome research initiative funded by the Howard Hughes Medical Institute.

Prerequisite: BIT/MB 210
GEP Natural Sciences
Typically offered in Spring only

MB 351 General Microbiology (3 credit hours)
Rigorous introduction to basic principles of microbiology for students in biological and agricultural sciences and for all students planning to take further courses in microbiology.

Prerequisite: One Biology course (BIO 181, BIO 183, ZO 150 or ZO 160) and one Organic Chemistry course (CH 221 or CH 220)
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

MB 352 General Microbiology Laboratory (1 credit hours)
Laboratory experience in general microbiology. Aseptic technique, isolation and identification of bacteria, staining and microscopy. Enumeration of bacteria and viruses. Students who have completed either MB (BEC) 320 or MB 354 may not take this course for credit.

Corequisite: MB 351
Typically offered in Fall, Spring, and Summer

MB 354 Inquiry-Guided Microbiology Lab (1 credit hours)
Inquiry-guided laboratory experience in general microbiology, for microbiology majors and honors students, and those desiring a more rigorous exposure to this topic. Aseptic technique, isolation and identification of bacteria, staining and microscopy, and Koch's postulates. Restricted to microbiology majors and honor's students. Others require departmental permission. Credit is not allowed for both MB 354 and either Mb 320 or MB 352.

Corequisite: MB 351
Typically offered in Fall and Spring

MB 360 Scientific Inquiry in Microbiology: At the Bench (3 credit hours)
Scientific questions, controls and variables, designing, preparing for and carrying out experiments, keeping a notebook, interpreting results, and presenting their findings: i.e. the pragmatic things a student must know in order to work efficiently in a research lab regardless of the discipline. Prior or current enrollment in MB 352 or MB 354 recommended.

Prerequisite: CH 101 and BIO 183 (both with a C- or better)
Typically offered in Fall only

MB 405/FS 505/MB 505/FS 405 Food Microbiology (3 credit hours)
Microorganisms of importance in foods and their metabolic activities. Source of microbial contamination during food production, processing and storage. Microbial spoilage; foods as vectors of human pathogens. Physical and chemical destruction of microorganisms in foods and the kinetics involved. Conversions of raw foods by microorganisms into food products. Microbiological standards for regulatory and trade purposes. Credit will not be given for both FS/MB 405 and FS/MB 505.

Prerequisite: MB 351
Typically offered in Spring only

MB 406/FS 506/MB 506/FS 406 Food Microbiology Lab (1 credit hours)
Laboratory experience to complement FS/MB 405. Skills in detecting and quantitating microorganisms and their toxins in foods. Application of colony and direct microscopic counts, most probable numbers, enzyme immunoassays, nucleic acid probes and computer modeling are used to understand the numbers and types of microorganisms or microbial end products in foods. Laboratory safety and oral and written reports are emphasized.

Prerequisite: MB 351 and Corequisite: FS 405 or FS 505
Typically offered in Spring only
**MB 411 Medical Microbiology** (3 credit hours)
Comprehensive study of microbial pathogenesis and mammalian host resistance. Diagnosis, prevention, and therapy of common human diseases of microbial origin.
Prerequisite: MB 351
Typically offered in Fall and Spring

**MB 412 Medical Microbiology Laboratory** (1 credit hours)
Laboratory experience to complement MB 411. Techniques of detection, growth and identification of bacteria and viruses relevant in clinical microbiology laboratories. Good laboratory practices (GLP) and safety stressed.
Prerequisite: MB 352 or MB 354 and Corequisite: MB 411
Typically offered in Fall only

**MB 414 Microbial Metabolic Regulation** (3 credit hours)
An integrative perspective on bacterial physiology and metabolism through an analysis of metabolic regulatory functions.
Prerequisite: MB 351 and either BCH 351 or 451
Typically offered in Fall only

**MB 420/MB 520 Fundamentals of Microbial Cell Biotransformations** (2 credit hours)
This is a half-semester course. Basic microbial cell culture theory and practice: cell physiology, mass balances, and metabolic control as seen in a dynamic bioreactor process to be scalable, consistent, and robust. The lab portion of the course provides students with hands-on experience in culture techniques using bioreactors. Students who have completed MB(BEC) 520 may not take BEC (MB) 420 for credit.
Prerequisite: MB 352 OR Corequisite of BEC(MB) 320
Typically offered in Fall only

**MB 435/MB 535 Bacterial Pathogenesis** (3 credit hours)
Focuses on basic principles of bacterial pathogenesis, including mechanisms utilized by these microbes to attach/adhere, internalize or invade, and disseminate through their animal hosts. Bacterial strategies to subvert host defenses and persist within their animal hosts defense mechanisms, and virulence gene regulation will also be discussed.
Students cannot get credit for both MB 435 and MB 535. Graduate status required for MB 535.
Prerequisite: MB 411, Graduate standing
Typically offered in Spring only

**MB 441 Immunology** (3 credit hours)
Introduction to principles of molecular immunology. Overview of immune system development and function, and discussions of ongoing scientific research regarding immune regulation.
P: C- or better in (MB 351 or BCH 351 or BCH 451 or BIO 414 or PB 414 or BIO 421)
Typically offered in Fall and Spring

**MB 451 Microbial Diversity** (3 credit hours)
Molecular, biochemical, and evolutionary diversity of the microbial world, including Bacteria, Archaea, and Eukaryotes. Evolutionary perspective on microbial relationships, molecular methods of study and classical and modern biotechnological methods utilizing this genetic diversity to explore the microbial world and use the resulting insight to meet the needs of our own species.
Prerequisite: MB 411 and (GN 311 or BCH 351 or BCH 451)
Typically offered in Spring only

**MB 452 Microbial Diversity Lab** (2 credit hours)
This lab course is project-oriented. Students perform a series of classical enrichments and isolations, starting from environmental samples collected by the students themselves. Some of these isolations serve as the starting materials for a series of modern molecular biology experiments, in which students purify DNA, amplify ribosomal DNA by PCR, and have a portion of this gene sequenced. This sequence information is the starting point for the term project, a detailed molecular phylogenetic analysis of the isolated organisms. Students will be required to provide their own transportation during non-scheduled class time for local field sample collection.
Prerequisite: MB 412; Corequisite: MB 451
Typically offered in Fall only

**MB 455 Microbial Biotechnology** (3 credit hours)
Introduction to industrial microbiology with focus on biotechnology including developments employing recombinant nucleic acid and monoclonal antibody techniques. Bioremediation, industrial enzymes, transgenic plants, biopesticides, medical diagnostics, recombinant vaccines production of important secondary metabolites, and other topics. Field trips to local biotechnology companies.
Prerequisite: MB 351 and GN 311
Typically offered in Spring only

**MB 461 Molecular Virology** (3 credit hours)
Introduction to principles of molecular virology. Overview of classification and nomenclature, virus structure, interaction of viruses with cells, organisms (immunology, pathology), and populations (epidemiology). Detailed case studies from major groups of viruses: picornaviruses, togaviruses, orthomyxoviruses, retroviruses, polyomaviruses, and herpesviruses.
Prerequisite: MB 351, MB 411
Typically offered in Spring only

**MB 470 Emerging and Re-emerging Infectious Diseases** (3 credit hours)
Human behavior plays a big part in the emergence and reemergence of infectious diseases. Humanity encroaches consistently into previously uninhabited parts of the planet increasing the risk of exposure to novel pathogens that have the potential to jump.
Prerequisite: MB 351
Typically offered in Spring only
MB 479/MB 579  Microbial Symbiosis & Microbiomes  (3 credit hours)
Microbial symbioses affect all life on earth. A recent surge of research has identified the critical role of microbial symbionts in maintaining host health and well-being, for example by mediating the breakdown of food for host nutrition, priming the immune system and directly fighting off pathogenic bacteria, and triggering key physiological outcomes associated with behavior and development. This course explores core topics in the study of microbial symbioses, including partner recognition and communication, adaptations to host association, the role of symbiosis in genome evolution and ecology, and the effects of microbial symbiosis on host health. Lectures and discussions will draw heavily from the primary literature in the field of microbiome/symbiosis research, focusing on the most recent discoveries, key methodological advancements, and on diverse associations ranging from marine symbioses to the human microbiome.
Prerequisite: MB 351 General Microbiology
Typically offered in Fall only

MB 480  Current Issues in Microbiology  (1 credit hours)
Library research on current topics in all areas of microbiology. Presentation of research results orally and in the form of a major term paper.
Prerequisite: SMB majors or minors, Senior standing, and MB 351
Typically offered in Fall and Spring

MB 492  External Learning Experience  (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.
Prerequisite: Sophomore standing
Typically offered in Fall and Spring

MB 501/PP 501/PB 501  Biology of Plant Pathogens  (3 credit hours)
Biology of microbes that cause plant diseases. The ecology, genetics, physiology, taxonomy, and mechanisms of parasitism, pathogenicity and virulence of bacteria (and other prokaryotes), fungi (and oomycetes), nematodes, and viruses that cause plant diseases. Prepares graduate students for advanced courses in plant pathology, host-parasite interactions, and provides a knowledge base for students in other disciplines involved with plant pathogens or who seek to broaden their knowledge of microbes.
Prerequisite: PP 315, or PP 318, or an introductory course in microbiology
Typically offered in Fall only

MB 505/FS 405/MB 405/FS 505  Food Microbiology  (3 credit hours)
Microorganisms of importance in foods and their metabolic activities. Source of microbial contamination during food production, processing and storage. Microbial spoilage; foods as vectors of human pathogens. Physical and chemical destruction of microorganisms in foods and the kinetics involved. Conversions of raw foods by microorganisms into food products. Microbiological standards for regulatory and trade purposes. Credit will not be given for both FS/MB 405 and FS/MB 505.
Prerequisite: MB 351
Typically offered in Spring only

MB 506/FS 406/MB 406/FS 506  Food Microbiology Lab  (1 credit hours)
Laboratory experience to complement FS/MB 405. Skills in detecting and quantitating microorganisms and their toxins in foods. Application of colony and direct microscopic counts, most probable numbers, enzyme immunoassays, nucleic acid probes and computer modeling are used to understand the numbers and types of microorganisms or microbial end products in foods. Laboratory safety and oral and written reports are emphasized.
Prerequisite: MB 351 and Corequisite: FS 405 or FS 505
Typically offered in Spring only

MB 520/MB 420  Fundamentals of Microbial Cell Biotransformations  (2 credit hours)
This is a half-semester course. Basic microbial cell theory and practice: cell physiology, mass balances, and metabolic control as seen in a dynamic bioreactor process to be scalable, consistent, and robust. The lab portion of the course provides students with hands-on experience in culture techniques using bioreactors. Students who have completed MB(BEC) 520 may not take BEC (MB) 420 for credit.
Prerequisite: MB 352 OR Corequisite of BEC(MB) 320
Typically offered in Fall only

MB 532/SSC 532  Soil Microbiology  (4 credit hours)
Soil as a medium for microbial growth, the relation of microbes to important mineral transformations in soil, the importance of biological equilibrium and significance of soil microbes to environmental quality.
Prerequisite: MB 351, CH 220

MB 535/MB 435  Bacterial Pathogenesis  (3 credit hours)
Focuses on basic principles of bacterial pathogenesis, including mechanisms utilized by these microbes to attach/adhere, internalize or invade, and disseminate through their animal hosts. Bacterial strategies to subvert host defenses and persist within their animal hosts defense mechanisms, and virulence gene regulation will also be discussed. Students cannot get credit for both MB 435 and MB 535. Graduate status required for MB 535.
Prerequisite: MB 411, Graduate standing
Typically offered in Spring only

MB 555  Microbial Biotechnology  (3 credit hours)
Overview of industrial microbiology focusing on current biotechnology methods (bacteria, yeast, fungi) employing rDNA, optimization of heterologous gene expression, microbial metabolic pathway engineering, metabolomics, protein engineering and recombinant antibodies. Genetic and pathway engineering strategies for developing new microbes to screen for new therapeutic compounds or overproduce: primary metabolites, antibiotics, biopharmaceutical proteins, industrially useful enzymes, medical diagnostics, recombinant vaccines, biopolymers. Utilization of biofilms, methods to immobilize biocatalysts, and microbial kinetics are also covered. Field trip to local biotechnology company. Students cannot receive credit for both 455 and 555.
Prerequisite: Undergraduate microbiology, genetics, and biochemistry course: MB351, BCH 351, and GN 311
Typically offered in Spring only
MB 575/PP 575/PB 575  Introduction to Mycology  (4 credit hours)
A survey of the fungal kingdom in context of phyla and classes.
Systematics, ecology, biology and utilization. Illustrative material, cultural techniques in laboratories. Collection and paper required.
Prerequisite: BS 125 or BS 181 and 183 or BO 200 or PP 315 or PP 318
Typically offered in Fall only

MB 579/MB 479  Microbial Symbiosis & Microbiomes  (3 credit hours)
Microbial symbioses affect all life on earth. A recent surge of research has identified the critical role of microbial symbionts in maintaining host health and well-being, for example by mediating the breakdown of food for host nutrition, priming the immune system and directly fighting off pathogenic bacteria, and triggering key physiological outcomes associated with behavior and development. This course explores core topics in the study of microbial symbioses, including partner recognition and communication, adaptations to host association, the role of symbiosis in genome evolution and ecology, and the effects of microbial symbiosis on host health. Lectures and discussions will draw heavily from the primary literature in the field of microbiome/symbiosis research, focusing on the most recent discoveries, key methodological advancements, and on diverse associations ranging from marine symbioses to the human microbiome.
Prerequisite: MB 351 General Microbiology
Typically offered in Fall only

MB 585  Industry Case Studies in Microbial Biotechnology  (3 credit hours)
Project-based course directly working with biotechnology and pharmaceutical companies. Students work in teams on a company-specific project. Projects range from developing business or marketing plans for new products; writing Small Business Innovation Research (SBIR) grants or white papers; creating procedures, protocols, and/or process improvements for a company-specific process; and studying intellectual property issues. Written and oral communication skills as well as teamwork, flexibility, and ambiguity management are emphasized. Restricted to MBT students.
Typically offered in Fall and Spring

MB 590  Topical Problems  (1-3 credit hours)
Informal group discussion of prepared topics assigned by instructor.
Prerequisite: Graduate standing

MB 601  Seminar  (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.
Typically offered in Fall and Spring

MB 610  Special Topics Microbiology  (1-6 credit hours)
The study of special problems and selected topics of current interest in microbiology and related fields.
Typically offered in Fall, Spring, and Summer

MB 620  Special Problems  (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in microbiology.
Typically offered in Fall, Spring, and Summer

MB 624  Topical Problems  (1-3 credit hours)
Prerequisite: Graduate standing
Typically offered in Spring only

MB 670  Laboratory Research Methods  (1-3 credit hours)
Directed research of microbiology graduate students in departmental laboratories prior to selecting thesis research topic. Selection of a minimum of three laboratories for research experience lasting 3 to 5 weeks. Acquisition of research methods relevant
Typically offered in Fall only

MB 685  Master's Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MB 686  Teaching Experience  (1 credit hours)
Faculty mentoring in didactic and methodological aspects of teaching, including instructional technology as well as design and grading of assessment instruments. Provision of individual performance evaluations to encourage enhancement of teaching skills. Microbiology graduate students only.
Prerequisite: Microbiology Graduate student
Typically offered in Fall, Spring, and Summer

MB 688  Non-Thesis Masters Continuous Registration - Full Time  (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.
Prerequisite: Master's student
Typically offered in Spring and Summer

MB 689  Non-Thesis Master Continuous Registration - Full Time  (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree except preparing for and taking the final master's exam.
Prerequisite: Master's student
Typically offered in Spring and Summer

MB 690  Master's Examination  (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MB 693  Master's Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer
MB 695 Master's Thesis Research (1-9 credit hours)
Thesis research.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MB 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master's student
Typically offered in Summer only

MB 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MB 714 Microbial Metabolic Regulation (3 credit hours)
An integrative perspective on bacterial physiology and metabolism through analysis of metabolic regulatory functions.
Prerequisite: MB 351 and either BCH 351 or 451
Typically offered in Fall only

MB 715/PP 715 Applied Evolutionary Analysis of Population Genetic Data (3 credit hours)
This course will introduce nonparametric and model-based methods for making inferences on population processes (mutation, migration, drift, recombination, and selection). The goal is to provide a conceptual overview of these methods and hands-on training on how to implement and interpret the results. Sample data sets in computer laboratories will integrate summary statistic, cladistic, coalescent, and bayesian approaches to examine population processes in different pathosystems with specific emphasis on eukaryotic microbes, viruses and bacteria.

MB 718 Introductory Virology (3 credit hours)
Introduction to principles of virology including: classification and nomenclature, epidemiology, structure, genome replication, gene expression strategies and cellular infection cycle. Major groups of viruses including those with DNA genomes and positive-sense or negative-sense RNA genomes.
Prerequisite: BCH 451 or GN 411 or MB 351
Typically offered in Fall only

MB 725/FS 725 Fermentation Microbiology (3 credit hours)
Fermentation bioprocessing and characteristics, function and ecology of responsible microorganisms. Fermentative activities, growth responses and culture interactions related to metabolism, physiology and genetics of lactic acid bacteria and selected yeasts and molds. Current developments in starter culture technology and genetics; application to food and industrial fermentations.
Prerequisite: BCH 451, MB 351
Typically offered in Spring only

MB 730/PP 730/PB 730/GN 730 Fungal Genetics and Physiology (3 credit hours)
Basic concepts of genetics and physiology of fungi, with emphasis on saprophytic and plant pathogenic mycelial fungi. Current literature on evolution, cell structure, growth and development, gene expression, metabolism, sexual and asexual reproduction and incompatibility systems. Laboratory exercises on mutant isolation, sexual and parasexual analysis, genetic transformation, and RFLP and isozyme analysis.
Prerequisite: BCH 451, BO 775, GN 311 or PP 501
Typically offered in Spring only

MB 751/IMM 751 Immunology (3 credit hours)
Introduction to mechanisms of immunity in man and animals. Emphasis on interactions between cells of the immune system in production of immune responses and the molecules in control of these interactions.
Prerequisite: BCH 451, GN 411, MB 351
Typically offered in Spring only

MB 758/GN 758 Microbial Genetics & Genomics (3 credit hours)
Structure and function in microbial genetics, with emphasis on microbial genome organization, stable maintenance and evolution. DNA mutation and repair pathways, transcriptional and translational regulation, DNA replication and recombination and characterization of recombinant DNA molecules. Applications of genetic and genomic analysis methods to microbial processes, including strain construction, genome manipulation, and enhancement of gene expression.
Prerequisite: BCH 451 or GN 311
Typically offered in Spring only

MB 774/PB 774 Phycology (3 credit hours)
Introduction to taxonomy, morphology, reproduction and ecological importance of organisms which may be included in the algae. Attention to local freshwater flow and physiology of selected species in relation to algal blooms, water quality and nutrient loading in aquatic habitats.
Typically offered in Spring only

MB 783/CBS 783/IMM 783 Advanced Immunology (3 credit hours)
In depth study of the basic cellular and molecular mechanisms of immunity, including antigen processing and presentation, T cell development, initiation of the immune response, effector mechanisms, and immunological memory. The course is designed for advanced graduate students who wish to focus on the current concepts in immunology.
Prerequisite: MB (IMM) 751
Typically offered in Fall only

MB 790 Topical Problems (1-3 credit hours)
Typically offered in Fall, Spring, and Summer

MB 801 Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.
Typically offered in Fall and Spring

MB 810 Special Topics Microbiology (1-6 credit hours)
The study of special problems and selected topics of current interest in microbiology and related fields.
Typically offered in Fall, Spring, and Summer
MB 820 Special Problems (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in microbiology.

Typically offered in Spring and Summer

MB 824 Topical Problems (1-3 credit hours)
Prerequisite: Graduate standing
Typically offered in Spring only

MB 870 Doctoral Lab Rotations (1-3 credit hours)
Directed research of microbiology graduate students in departmental laboratories prior to selecting thesis research topic. Selection of a minimum of three laboratories for research experience lasting 3 to 5 weeks. Acquisition of research methods relevant

Typically offered in Fall only

MB 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MB 886 Teaching Experience (1 credit hour)
Faculty mentoring in didactic and methodological aspects of teaching, including instructional technology as well as design and grading of assessment instruments. Provision of individual performance evaluations to encourage enhancement of teaching skills. Microbiology graduate students only.

Prerequisite: Microbiology Graduate student
Typically offered in Fall, Spring, and Summer

MB 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MB 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MB 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MB 896 Summer Dissertation Research (1 credit hour)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

MB 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Military Science (MS)

MS 101 Introduction to Leadership and Values I (1 credit hour)
This course introduces students to fundamental components of service as an officer in the United State Army. Initial lessons form building blocks of progressive lessons in values, fitness, leadership and officership. Classroom instruction includes "life skills" including physical and mental fitness, communication theory, and interpersonal relationships. Upon completion, students will be prepared to receive more complex leadership instruction.

Prerequisite: Freshman standing or Sophomore standing
Typically offered in Fall only

MS 102 Basic Military Leadership (1 credit hour)
Familiarizes students with the fundamentals of map reading, land navigation techniques, small unit tactics and leadership, personal goal setting, Army Leadership and values, ethical decision making as well as Army basics.

Typically offered in Spring only

MS 201 Intermediate Leadership Theory I (2 credit hours)
Instruction is orientated on communication and leadership theory using practical exercise to apply communications and leadership concepts. Critical "life skills" and their relevance to success in the Army are stressed. Upon completion of this course, students will understand fundamental principles of leadership, and be prepared to intensity practical application in subsequent coursework.

Typically offered in Fall only

MS 202 Intermediate Leadership Theory II (2 credit hours)
This course focuses on the purpose, roles, and obligations of commissioned officers. Coursework will include origins of Army institutional values and practical application in decision making and leadership. Upon completion of this course, students will possess and understanding of leadership and officership, demonstrate the ability to apply these skills, and be prepared for the Advanced Military Science Program.

Prerequisite: MS 101
Typically offered in Spring only

MS 295 Special Topics in Military Leadership (3 credit hours)
Intensive supervised study in applied military leadership and management in an organization or historically applied scenario. Departmental approval required.

Typically offered in Fall and Spring
MS 301 Military Leadership and Training Management (3 credit hours)
Organizational leadership and processes in the Army; leadership activities and key management functions. Management and conduct of group training activities.

Prerequisite: ROTC advanced course cadet
Typically offered in Fall only

MS 302 Applied Leadership in Small Unit Operations (3 credit hours)
This course covers the fundamentals of Army Leadership, Officership, Army Values and Ethics, Personal Development, and small unit tactics at the platoon level. At the conclusion of this course, students will be capable of planning, coordinating, navigating, motivating and leading a squad and platoon in the execution of a mission during a classroom PE, a Leadership Lab, or during a Field Training Exercise (FTX). Students will write peer evaluations and receive feedback on his/her abilities as a leader and how to improve those leader skills that can further develop into a successful Army Officer.

Prerequisite: MS 301, MS 302
Typically offered in Fall only

MS 401 Advanced Military Science - Leadership and Systems Management (3 credit hours)
A course designed to familiarize the student with the fundamentals of staff operations and procedures, military correspondence, and the U.S. Army training management system. Also included are the Officer Personnel Management and Officer Evaluation Report systems (OPMS/OER), the Army logistics system, mobilization and deployment, and intelligence/electronic warfare.

Prerequisite: MS 301, MS 302
Typically offered in Fall only

MS 402 Advanced Military Science - Military Justice, Ethics and Professionalism (3 credit hours)
The role of military justice, the Uniform Code of Military Justice (UCMJ) and the procedures for accomplishing certain legal actions. Ethics and professionalism of the officer corps. Also included are counseling techniques and continued preparation for the transition from cadet to commissioned officer. Emphasis on student interaction and small group exercise practical application.

Prerequisite: MS 401
Typically offered in Spring only

MS 495 Special Topics in Military Science (3 credit hours)
Individualized readings/research of Company Command level issues and implementation of the Uniform Code of Military Justice, DOD Policies, and additional duties required of company grade officers. Departmental approval required-advanced course students only.

Typically offered in Fall and Spring

Multidisciplinary Studies (MDS)

MDS 595 Special Topics in Multidisciplinary Studies (1-6 credit hours)
Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

Music (MUS)

MUS 103 Theory and Musicianship I (3 credit hours)
This course is a continuation of MUS 120 (Introduction to Music Theory). Topics include rhythm and meter, modes and non-diatonic scales, harmonic analysis, cadences, non-harmonic tones, and phrase structure. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus musical event not to exceed $20. Prerequisite: C- or better in MUS 120 or Rudiments Placement Test. This course may not be audited, and music minors may not take this class for S/U credit.

Prerequisite: C- or better in MUS 120 or Rudiments Placement Test; Co-requisite: Students must take MUS 103 either prior to or concurrently with MUS 104

GEP Visual and Performing Arts
Typically offered in Fall and Spring

MUS 104 Theory and Musicianship Lab I (1 credit hours)
This course develops aural perception skills in tonal harmony through sight-singing and rhythm reading; scale, interval, and chord identification; melodic, harmonic, and rhythmic dictation; and computer-based music learning. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus event not to exceed $20.

Prerequisite: MUS 120 or aural skills placement test; Co-requisite: Students must take MUS 103 either prior to or concurrently with MUS 104
Typically offered in Fall and Spring

MUS 105 Introduction to Music in Western Society (3 credit hours)
Introduction to the art of music in Western society, for the general student. Focuses on the western art music tradition, including stylistic periods from medieval to post-modern. Begins with the study of basic musical elements, formal principles and compositional techniques. This course may require students to provide their own transportation to and cover the cost of an on- or off-campus event not to exceed $20.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall and Spring

MUS 107 Class Piano I (1 credit hours)
Introduction to playing the piano by learning the basics of music notation, five-finger scales, and beginner's repertoire based on hand position.

Typically offered in Fall and Spring

MUS 112 Men's Choir (1 credit hours)
Rehearsal and performance of choral repertoire for men's voices. Includes instruction in individual vocal techniques, rehearsal protocols, and discussion of historical and musical significance of repertoire. May be repeated for credit. Possible charge for concert dress. Students may be asked to provide their own transportation to a local performance venue.

Typically offered in Fall and Spring

MUS 113 Women's Choir (1 credit hours)
Rehearsal and performance choral repertoire for women's voices. Includes instruction in individual vocal techniques, rehearsal protocols, and discussion of historical and musical significance of repertoire. May be repeated for credit. Possible charge for concert dress. Students may be asked to provide their own transportation to a local performance venue. Audition required. May be repeated up to 10 semesters.

Typically offered in Fall and Spring
MUS 114 Chamber Singers (1 credit hours)
Rehearsal and performance of choral repertoire for small vocal ensemble. Includes instruction in individual vocal techniques, rehearsal protocols, and discussion of historical and musical significance of repertoire. May be repeated for credit. Possible charge for concert dress. Students may be asked to provide their own transportation to a local performance venue. Audition required. May be repeated up to 10 semesters.

Typically offered in Fall and Spring

MUS 115 State Chorale (1 credit hours)
Rehearsal and performance of advanced choral repertoire from all eras. Includes instruction in individual vocal techniques, rehearsal protocols, and discussion of historical and musical significance of repertoire. May be repeated for credit. Possible charge for concert dress. Students may be asked to provide their own transportation to a local performance venue. Audition required. May be repeated up to 10 semesters.

Typically offered in Fall and Spring

MUS 116 African American Choral Ensemble (1 credit hours)
Students study and perform vocal music of the African diaspora, including spirituals, folk forms, traditional and contemporary gospel, and formally-composed choral works by composers of African descent. This course includes instruction in individual vocal techniques, rehearsal protocols, and discussion of the historical and musical significance of assigned repertoire. There may be a charge for concert dress not to exceed $100, and students may be asked to provide individual transportation to off-campus performances. This course may be taken for up to 10 semesters for credit. An audition is required.

Typically offered in Fall and Spring

MUS 120 Introduction to Music Theory (3 credit hours)
Introduction to Music Theory is designed for students with minimal or no music theory background and covers the fundamentals of music, including note reading in treble and bass clefs, rhythm, meter, scales, key signatures, intervals, triads, and basic keyboard skills. This course prepares students for entry into Music Theory I (MUS 103) and Aural Skills I (MUS 104), although students may elect to test out by means of a placement test. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus event. Auditing is not permitted. Prerequisites: None.

GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

MUS 121 Raleigh Civic Symphony (1 credit hours)
Rehearsal and performance of significant repertoire for symphony orchestra from the 18th-21st centuries, including individual practice techniques, rehearsal protocols, discussion of historical and musical significance of repertoire, and public performances. May be repeated for credit. Possible charge for concert dress. Students may be asked to provide individual transportation to an off-campus local performance.

Typically offered in Fall and Spring

MUS 122 Raleigh Civic Chamber Orchestra (1 credit hours)
Rehearsal and performance of significant repertoire for chamber orchestra from the 17th-21st centuries, including individual practice techniques, rehearsal protocols, discussion of historical and musical significance of repertoire, and public performances. May be repeated for credit. Possible charge for concert dress. Students may be asked to provide individual transportation to an off-campus local performance. Audition required. May be repeated for up to 10 semesters.

Typically offered in Fall and Spring

MUS 131 Marching Band (1 credit hours)
Rehearsal and performance of repertoire for marching band. Study of drill and instrumental techniques, memorization, and repertoire of varying styles for large ensemble. May be repeated for credit. There is a band uniform charge; transportation to performances will

Typically offered in Spring only

MUS 132 Varsity Band (1 credit hours)
Rehearsal and performance of repertoire for varsity or athletic band. Study of instrumental techniques and repertoire of varying styles for large ensemble. May be repeated for credit. There is a band uniform charge; transportation to performances will

Typically offered in Fall only

MUS 133 British Brass Band (1 credit hours)
British Brass Band provides an ensemble performing experience in a wide range of musical styles in the British Brass Band musical medium. Music is selected to provide a challenging opportunity for musical growth. Students must provide their own transp

Prerequisite: Audition required
Typically offered in Spring only

MUS 134 Wind Ensemble (1 credit hours)
Rehearsal and performance of significant repertoire for wind ensemble, including individual practice techniques, rehearsal protocols, discussion of historical and musical significance of repertoire, and public performances. May be repeated for credit. Possible charge for concert dress. Students may be asked to provide individual transportation to an off-campus local performance. Audition required. May be repeated for up to 10 semesters.

Typically offered in Fall and Spring

MUS 135 Symphonic Band (1 credit hours)
Students rehearse and publicly perform repertoire for symphonic band, which includes a study of individual practice techniques, rehearsal and performance protocols, and the historical and musical significance of the repertoire. There may be a nominal charge for concert dress and instrument rental, and students may be asked to provide individual transportation to off-campus performances. Although auditions are not required, students must have had at least one year of lessons or performance experience on their instrument. This course may be taken for up to 10 semesters for credit.

Typically offered in Fall and Spring

MUS 140 Jazz Improvisation (1 credit hours)
Study of basic and advanced techniques for jazz improvisation, including in-class performance and study of historical models. May be repeated for credit up to ten semesters. Audition required.

Typically offered in Fall only
MUS 141 Jazz Combo II (1 credit hours)
Rehearsal and performance of basic to advanced repertoire for small jazz ensemble, including individual practice techniques, improvisation, rehearsal protocols, discussion of historical and musical significance of repertoire, and public performances. May be repeated for credit. Students may be asked to provide individual transportation to an off-campus local performance. Audition required. May be repeated up to 10 semesters.

Typically offered in Fall and Spring

MUS 142 Jazz Ensemble II (1 credit hours)
Rehearsal and performance of basic to advanced repertoire for jazz ensemble, including individual practice techniques, improvisation, rehearsal protocols, discussion of historical and musical significance of repertoire, and public performances. May be repeated for credit. Students may be asked to provide individual transportation to an off-campus local performance. Audition required. May be repeated up to 10 semesters.

Typically offered in Fall and Spring

MUS 143 Jazz Combo I (1 credit hours)
Rehearsal and performance of advanced repertoire for small jazz ensemble, including individual practice techniques, improvisation, rehearsal protocols, discussion of historical and musical significance of repertoire, and public performances. May be repeated for credit. Students may be asked to provide individual transportation to an off-campus local performance. Audition required. May be repeated up to 10 semesters.

Typically offered in Fall and Spring

MUS 144 Jazz Ensemble I (1 credit hours)
Rehearsal and performance of advanced repertoire for jazz ensemble, including individual practice techniques, improvisation, rehearsal protocols, discussion of historical and musical significance of repertoire, and public performances. May be repeated for credit. Students may be asked to provide individual transportation to an off-campus local performance. Audition required. May be repeated up to 10 semesters.

Typically offered in Fall and Spring

MUS 150 Vocal Techniques (1 credit hours)
Development and practice of vocal techniques suitable to solo and ensemble singing in a variety of musical styles, both historical and contemporary.

Typically offered in Fall and Spring

MUS 152 Beginning Bag piping (1 credit hours)
Instruction in bagpiping, including individual practice techniques and traditional performance practices. Prepares students for advancement into the NC State Pipes and Drums Band. Students will be required to purchase a bagpipe chanter and to provide individual transportation to off-campus performances. The ability to read music is not required upon entry. This course may be taken up to 6 semesters for credit.

Typically offered in Fall and Spring

MUS 153 Theory and Musicianship II (3 credit hours)
This course is a continuation of the principles taught in MUS 103. Topics include part-writing in four voices, harmonic progression, harmonic rhythm, seventh chords, secondary functions, modulation, and simple binary and ternary forms. This course may not be audited, and music minors may not take this class for S/U credit.

Prerequisites: Music Theory Placement Test or C- or better in Theory and Musicianship I (MUS 103); Co-requisite: MUS 154 either after or simultaneously with MUS 153

Typically offered in Spring only

MUS 154 Theory and Musicianship Lab II (1 credit hours)
Continuation of the principles taught in MUS 104. Emphasis is placed on sight-singing and melodic dictation involving all diatonic intervals, diatonic triads and 7th chords in open positions, harmonic progressions, counterpoint in two voices, and computer-based music learning.

Prerequisite: MUS 104 or Aural Skills Placement Test; Co-requisite: MUS 153 either before or simultaneously with MUS 154

Typically offered in Spring only

MUS 155 Introduction to Musical Experiences (3 credit hours)
Examination of western musical materials, forms, styles and history through the primary musical experiences of composing, performing, and listening. Course designed for students with no formal musical training.

GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

MUS 180 Exploring Music Theory (3 credit hours)
Exploring music theory provides the student insight into Basic theoretical elements of music from Western civilization, which are fundamental to analysis and creation of musical compositions. The course will cover tonality, rhythm, intervals, triads, composition of melodies, harmonic progressions, and lead sheets. This course will enrich the student who performs, sings, composes, and enjoys listening to music.

Prerequisite: Ability to read music
GEP Visual and Performing Arts
Typically offered in Fall and Spring

MUS 190 Preparatory Applied Music Lessons (1 credit hours)
This course offers individual instruction in voice or instrumental performance that includes the development of basic technique as well as the advancement of artistry, musicianship, and repertoire. An end-of-semester evaluation serves as a measure of progress for continuation of applied study. A lesson charge of $300.00 is assessed at the beginning of each semester. Students may be required to provide their own transportation to and cover the minimal cost of an on- or off-campus event. This course may be taken for up to 8 semesters for credit.

Prerequisite: Department Approval

Typically offered in Fall and Spring
MUS 193  Applied Music Lessons I  (1 credit hours)
Designed for the first two semesters of a four-semester program of study, this course offers individual instruction in voice or instrumental performance that includes the development of basic technique as well as the advancement of artistry, musicianship, and repertoire. An end-of-semester performance jury serves as a measure of progress for continuation of applied study. A lesson charge of $300.00 is assessed at the beginning of each semester. Students may be required to provide their own transportation to and cover the minimal cost of an on- or off-campus event.

Requisite: Music Minors Only
Typically offered in Fall and Spring

MUS 200  Understanding Music: Global Perspectives  (3 credit hours)
Understanding Music is a semester-long exploration of music's materials, contexts, and purposes. We will consider music as a global phenomenon and commonality of human social experience. Through videos, readings and listening to both recorded and live music from diverse world regions, we will examine the occasions and purposes of music making and listening. We will explore the ways in which traditions, values, belief systems, and patterns of social change are encoded and made manifest in musical practices. The ability to read music is not expected. This course can fulfill either the Interdisciplinary Perspectives (IP) or Visual & Performing Arts (VPA) GEP requirements, and the Global Knowledge (GK) co-requisite requirement.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

MUS 201  Introduction to Music Literature I  (3 credit hours)
Survey of Western art music from antiquity to the mid-18th century, with an emphasis on the characteristic forms and styles of the medieval, Renaissance, and Baroque eras. This course examines the major composers and representative works in light of social, political, and cultural influences. The ability to read music is required.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

MUS 202  Introduction to Music Literature II  (3 credit hours)
Survey of Western art music from the mid-18th century to the present, with an emphasis on the characteristic forms and styles of the late Baroque, Classical, Romantic, and Contemporary eras. This course examines the major composers and representative works in light of social, political, and cultural influences. The ability to read music is required. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus event.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

MUS 203A  Theory and Musicianship III  (3 credit hours)
As a continuation of MUS 153 (Theory and Musicianship II), this course examines compositional processes in chromatic harmony and musical form. Students acquire fluency in the written comprehension of these processes through analysis, problem solving, and notation. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus musical event not to exceed $20.

Prerequisite: MUS 153 (Theory and Musicianship II); Corequisite: MUS 204 either before or simultaneously with MUS 203
Typically offered in Fall only

MUS 204A  Theory and Musicianship Lab III  (1 credit hours)
As a continuation of MUS 154 (Theory and Musicianship Lab II), this course examines compositional processes in chromatic harmony and musical form. Students acquire fluency in the aural comprehension of these processes through rhythmic, melodic, and harmonic dictation; contextual listening and identification; composition; sight-singing; and rhythm-reading. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus event not to exceed $20.

Prerequisite: MUS 154 (Theory and Musicianship Lab II); Corequisite: MUS 203 either before or simultaneously with MUS 204
Typically offered in Fall only

MUS 206  America's Music  (3 credit hours)
Historical survey of music in the United States, including classical and popular, secular and religious, vocal and instrumental music genres and styles from the 18th to 21st centuries, studied in the context of relevant social and cultural issues. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus event.

GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Spring only

MUS 207  Class Piano II  (1 credit hours)
The study and performance of intermediate piano repertoire.

Prerequisite: MUS 107
Typically offered in Fall and Spring

MUS 208  Piano Pedagogy  (2 credit hours)
This course is designed to prepare students to teach piano at the elementary level. Topics discussed are the history of piano pedagogy; principles of pedagogy; age- and level-based learning types; technical, artistic and performance problems; music pedagogy as career; reference and teaching materials; and introduction in MIDI technology. Requirement for music minors in the piano performance emphasis. Prerequisite: MUS 390, 207, or instructor's consent.

Prerequisite: MUS 390 or MUS 207; C: MUS 390
Typically offered in Spring only

MUS 210  Introduction to Popular Music: 1950s-1970s  (3 credit hours)
This course examines the stylistic evolution and cultural impact of popular music in the United States from the 1950s through the 1970s. Musical styles discussed include American and British rock, R&B, country, folk, soul, funk, reggae, disco, and punk. No prior musical knowledge is necessary. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus event. This course fulfills GEP requirements in Visual and Performing Arts.

GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Fall and Summer
**MUS 211 Introduction to Popular Music: 1980s-Present (3 credit hours)**

The course examines the stylistic development and cultural impact of popular music in the United States from the 1980s to the present. Musical styles discussed include mainstream and alternative rock, metal, pop, country, contemporary R&B, rap, hip-hop, dance music, and electronica. No prior musical knowledge is necessary. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus event. This course fulfills GEP requirements in Visual and Performing Arts.

**GEP U.S. Diversity, GEP Visual and Performing Arts**

**Typically offered in Fall and Spring**

**MUS 230/AFS 230 Introduction to African-American Music (3 credit hours)**

Comprehensive survey of African-American music in the United States from Colonial times to the present, with emphasis on its unique features and contributions to American culture.

**GEP U.S. Diversity, GEP Visual and Performing Arts**

**Typically offered in Fall only**

**MUS 240 Introduction to the Music Industry (3 credit hours)**

This course provides an introduction to the commercial music industry, including its history and development in the context of multiple popular and traditional genres in the United States. Introduction to the Music Industry will increase a student's understanding of common business practices and related knowledge concerning the music industry. It will also assist those students considering further study of the music industry to effectively maintain a professional music career. Students may be required to provide their own transportation to and cover the cost of on- and off-campus events.

**GEP Visual and Performing Arts**

**Typically offered in Fall only**

**MUS 253 Theory and Musicianship IV (3 credit hours)**

As a continuation of MUS 203 (Theory and Musicianship III), this course examines compositional processes in 20th- and 21st-century music. Students acquire fluency in the written comprehension of these processes through analysis, problem solving, and notation. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus musical event not to exceed $20.

Prerequisite: MUS 203A (Theory and Musicianship III); Corequisites: MUS 254 either after or simultaneously with MUS 253

**Typically offered in Spring only**

**MUS 254 Theory and Musicianship Lab IV (1 credit hour)**

As a continuation of MUS 204 (Theory and Musicianship Lab III), this course examines compositional processes in 20th- and 21st-century music. Students acquire fluency in the aural comprehension of these processes through rhythmic, melodic, and harmonic dictation; contextual listening and identification; composition; sight-singing; and rhythm-reading. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus musical event not to exceed $20.

Prerequisite: MUS 203A (Theory and Musicianship III); Corequisite: MUS 253 either before or simultaneously with MUS 254

**Typically offered in Spring only**

**MUS 260/AFS 260 History of Jazz (3 credit hours)**

History of jazz and the contributions of major artists. Emphasis of the various styles that have contributed to this American art form. Investigation of structural forms in the jazz idiom.

**GEP U.S. Diversity, GEP Visual and Performing Arts**

**Typically offered in Spring and Summer**

**MUS 270 Songwriting using Digital Audio Workstations (2 credit hours)**

A class specifically for songwriters, musicians, beat makers, sample manipulators and scratch artists using digital audio workstations (DAWs) as composition tools. This course will also introduce basic audio engineering, gain structure, and signal flow from interface to DAW. The goal is to explore the broader DAW platform as a tool in the songwriting process. Students will explore editing, looping, effects, equalization, plugins and rack hardware. No specific prior mathematics, engineering, or computer training required. Students may be asked to provide their own transportation to and cover the cost of an on- or off-campus event.

**GEP Visual and Performing Arts, GEP Visual and Performing Arts**

**Typically offered in Fall and Spring**

**MUS 293 Applied Music Lessons II (1 credit hour)**

Designed for the second two semesters of a four-semester program of study, this course offers individual instruction in voice or instrumental techniques. Students acquire fluency in the written comprehension of these processes through analysis, problem solving, and notation. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus performance event. Prerequisite: Music Minors only; two semesters of MUS 193 or departmental approval.

**Typically offered in Fall and Spring**

**MUS 295 Special Topics in Music (1-3 credit hours)**

Special Topics in Music

**MUS 300 Chamber Music Performance (1 credit hour)**

Performance of chamber music. Emphasis on chamber literature from the sixteen through the twentieth centuries written for a wide variety of combinations ranging from string quartets to pieces written for specific instruments and voices.

**Typically offered in Fall and Spring**

**MUS 305 Music Composition (3 credit hours)**

Study and creation of musical works. Emphasis on writing original music and works imitative of conventional and contemporary musical styles. Students may have to provide their own transportation to an on- or off-campus event and to cover the cost of the performance that includes the development of basic technique as well as the advancement of artistry, musicianship, and repertoire. An end-of-semester performance jury serves as a measure of progress for continuation of applied study. A lesson charge of $300.00 is assessed at the beginning of each semester. Students may be required to provide their own transportation to and cover the minimal cost of an on- or off-campus event. Prerequisite: Music Minors only; two semesters of MUS 193 or departmental approval.

Requisite: Music Minors Only and Two Semesters of MUS 193 or Departmental Approval

**Typically offered in Fall and Spring**

**MUS 325 Advanced Performance III (3 credit hours)**

Advanced study and performance techniques. Performance of repertoire that includes the development of basic technique as well as the advancement of artistry, musicianship, and repertoire. An end-of-semester performance jury serves as a measure of progress for continuation of applied study. Special emphasis on the music of a particular nation or era. A lesson charge of $300.00 is assessed at the beginning of each semester. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus event. Prerequisite: Satisfactorily passing audition

**Typically offered in Fall and Spring**

**MUS 350/AFS 350 Music Theory and Composition (3 credit hours)**

Study and creation of musical works. Emphasis on writing original music and works imitative of conventional and contemporary musical styles. Students may have to provide their own transportation to an on- or off-campus event and to cover the cost of the performance that includes the development of basic technique as well as the advancement of artistry, musicianship, and repertoire. An end-of-semester performance jury serves as a measure of progress for continuation of applied study. A lesson charge of $300.00 is assessed at the beginning of each semester. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus event. Prerequisite: Satisfactorily passing audition

**GEP Visual and Performing Arts**

**Typically offered in Fall and Spring**

**MUS 370 Music Technology (3 credit hours)**

Investigation of structural forms in the jazz idiom. Students will explore editing, looping, effects, equalization, plugins and rack hardware. No specific prior mathematics, engineering, or computer training required. Students may be asked to provide their own transportation to and cover the cost of an on- or off-campus event. Prerequisite: Music Minors only; two semesters of MUS 193 or departmental approval.

**Typically offered in Fall and Spring**

**MUS 392 Advanced Performance IV (3 credit hours)**

Performance of repertoire that includes the development of basic technique as well as the advancement of artistry, musicianship, and repertoire. An end-of-semester performance jury serves as a measure of progress for continuation of applied study. Special emphasis on the music of a particular nation or era. A lesson charge of $300.00 is assessed at the beginning of each semester. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus event. Prerequisite: Satisfactorily passing audition

**Typically offered in Fall and Spring**

**MUS 395 Special Topics in Music (1-3 credit hours)**

Special Topics in Music

**MUS 425 Advanced Performance V (3 credit hours)**

Advanced study and performance of repertoire that includes the development of basic technique as well as the advancement of artistry, musicianship, and repertoire. An end-of-semester performance jury serves as a measure of progress for continuation of applied study. Special emphasis on the music of a particular nation or era. A lesson charge of $300.00 is assessed at the beginning of each semester. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus event. Prerequisite: Satisfactorily passing audition

**Typically offered in Fall and Spring**

**MUS 455/AFS 455 Music Production (3 credit hours)**

Specialized training in the creation of music video, film, and television audio. Includes basics of music technology, recording, editing, mixing, and mastering. Students will explore editing, looping, effects, equalization, plugins and rack hardware. No specific prior mathematics, engineering, or computer training required. Students may be asked to provide their own transportation to and cover the cost of an on- or off-campus event. Prerequisite: Music Minors only; two semesters of MUS 193 or departmental approval.

**Typically offered in Fall and Spring**

**MUS 525/AFS 525 Music Production and Performance (3 credit hours)**

Performance of chamber music. Emphasis on chamber literature from the sixteen through the twentieth centuries written for a wide variety of combinations ranging from string quartets to pieces written for specific instruments and voices.

**Typically offered in Fall and Spring**

**MUS 555/AFS 555 Music Production and Performance (3 credit hours)**

Performance of chamber music. Emphasis on chamber literature from the sixteen through the twentieth centuries written for a wide variety of combinations ranging from string quartets to pieces written for specific instruments and voices.

**Typically offered in Fall and Spring**

**MUS 575 Special Topics in Music (1-3 credit hours)**

Special Topics in Music
MUS 306/ARS 306  Music Composition with Computers  (3 credit hours)
Survey of the theory and history of computer music, compositional algorithms, digital synthesis techniques, composition of at least one computer music work -- a computer-assisted composition for traditional instruments, a piece for computer music on tape, a real-time piece, or a piece that combines tape and instrument(s).
Prerequisite: Some knowledge of music or computer science (e.g. CSC 200).
GEP Visual and Performing Arts
Typically offered in Fall and Spring

MUS 310  Music of the 17th and 18th Centuries  (3 credit hours)
Evolution of European music from 1600 to 1820, with emphasis on characteristics of Baroque and Classical form and style. Examination of major composers and representative works in light of social, political and cultural influences. Students may be required to attend an on- or off-campus event at their own cost and to provide their own transportation.
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall and Spring

MUS 315  Music of the 19th Century  (3 credit hours)
A survey of 19th century European music, including analysis of its texts, forms and composers, and its relations to other art forms of the period. This course fulfills GEP categories in Visual and Performing Arts and Global Knowledge. Students may be required to attend an on- or off-campus musical event at their own cost and to provide their own means of transportation.
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall and Spring

MUS 320  Music of the 20th Century  (3 credit hours)
This course is a study of Western Art Music from 1900 to the present, emphasizing significant composers, repertoire, and compositional procedures and trends, including traditional, atonal, serial, aleatoric, electronic and computer music. The ability to read music is not required. Students may be required to attend and cover the cost of an on-campus event. This course fulfills GEP categories in Visual and Performing Arts and Global Knowledge.
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

MUS 330  Survey of Musical Theater  (3 credit hours)
Survey of staged musical works spanning four centuries. Emphasis on large-scale dramatic works in the genres of opera, operetta, and musical. Designed for students with musical and/or theatrical experience. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus event.
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

MUS 350  Music of Asia  (3 credit hours)
Examination of music from a variety of Asian traditions including India and Pakistan, Japan and Korea, Thailand and Indonesia. Emphasis place on philosophical, social and religious contexts from which music emerges and in which it is experienced by native performers and listeners. No previous formal training in music is required.
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

MUS 360/WGS 360  Women In Music  (3 credit hours)
The role of women in music as patrons, teachers, composers, and performers, placing them within the social, economic, and political framework to which they belong. Emphasis on Western Art Music and the role of women in popular music. No previous formal training in music is required.
GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Spring only

MUS 370  Intermediate Songwriting using Digital Audio Workstations  (2 credit hours)
This class is designed for intermediate songwriters, musicians, beat makers, sample manipulators, and scratch artists using digital audio workstations (DAWs) as composition tools. Intended as a continuation of MUS 270, this course provides intermediate audio engineering and applied technical knowledge, such as equalization, compression, digital signal processing and mixing. Weekly assignments demonstrate command of the sonic and technical aspects of digital audio as well as the craft of songwriting. Students may be asked to provide their own transportation to and cover the minimal cost of an on- or off-campus event. Prerequisite: MUS 270 or departmental approval.
Prerequisite: MUS 270 or Departmental approval
Typically offered in Fall and Spring

MUS 393  Recital  (1 credit hours)
The recital is the capstone for students in the Music Minor performance concentration. Students receive weekly individual instruction culminating in a public solo recital. Students also receive instruction in organizing the recital. A lesson charge of $300.00 is assessed at the beginning of the semester. Pending departmental approval, this course may be taken for up to two semesters for credit. Students may be required to provide their own transportation to and cover the minimal cost of an on- or off-campus event. Prerequisite: two semesters of MUS 293 or departmental approval.
Prerequisite: two semesters of MUS 293 or departmental approval
Typically offered in Fall and Spring

MUS 495  Special Topics in Music  (3 credit hours)
Examination of selected topics in music.
Typically offered in Fall and Spring

MUS 498  Independent Study in Music  (1-3 credit hours)
Directed independent study of selected topics for students with specialized interests in music and/or advanced musical ability. Credit and content determined by faculty member in consultation with Director of Music. Individualized/Independent Study and

Natural Resources (NR)

NR 219  Natural Resource Markets  (3 credit hours)
A brief overview of financial markets relevant to natural resources and real assets. An introduction to traditional and non-traditional markets including timber markets, carbon and bioenergy markets, conservation banking, and wetland and stream mitigation credits. Investment analysis criteria and market and non-market valuation of natural resources.
GEP Social Sciences
Typically offered in Spring only
NR 293 Independent Study in Natural Resources (1-6 credit hours)
Independent Study for Natural Resources students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed.

Typically offered in Fall, Spring, and Summer

NR 294 Independent Study in Natural Resources (1-6 credit hours)
Independent Study for Natural Resources students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed.

Typically offered in Fall, Spring, and Summer

NR 295 Special Topics in Natural Resources (1-3 credit hours)
Special Topics in Natural Resources at the 200 level for offering of courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

NR 300 Natural Resource Measurements (4 credit hours)
Theory and practice of measuring, analyzing, and describing the characteristics of natural ecosystems. Surveying and mapping, inventory of vegetation, soils, wildlife habitat, and hydrology. Sampling, data analysis, and presentation of data. Use of geographic information systems to store, analyze, and present environmental data. Intensive instruction and practice in communication of technical information.

Prerequisite: (PB 360 or BIO 360) and ST 311
Typically offered in Spring only

NR 301 Practicum for Professional Development I (1 credit hours)
Instruction in professional report writing and presentation, resume preparation and interview techniques, professional ethics and practices, job search skills; review and critique of professional seminars and documents from NR 501 students; preparation for summer work experience.

Prerequisite: Junior standing, NR Majors
Typically offered in Fall only

NR 303/IDS 303 Humans and the Environment (3 credit hours)
Interactions among human populations in the biophysical system and the environment. Emphasis on current issues, ecological principles and their relationships to basic biophysical processes; considers food, population dynamics, public land and common resources, renewable natural resources, pollution, water resources, energy and non-renewable resources.

GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

NR 350 International Sustainable Resource Use (4 credit hours)
Study of sustainable use of natural resources in a global economy with consideration of consumption choices, sustainable production issues, conservation of various managed landscapes, and cross cultural perspectives. Specific topics vary somewhat by year and study location. Travel in North America in even years and to Sweden in odd years. Domestic or international travel overnight. Depending upon travel location, possible additional expense for passport, health certificate, insurance and domestic or international travel.

Prerequisite: Sophomore standing
Typically offered in Summer only

NR 360 Internship Experience (3 credit hours)
Internship experience with a natural resource agency or company. Most internships require working and living off-campus. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed.

Prerequisite: NR 301 and Junior standing
Typically offered in Fall, Spring, and Summer

NR 400/NR 500 Natural Resource Management (4 credit hours)
Theory and practice of integrated natural resource management. Quantitative optimization, economics of multiple-use, compounding and discounting, optimal rotations, linear programming. Public and private management case studies and team projects.

Prerequisite: Senior standing in NR or ES or ETM or FOM or FWCB
Typically offered in Spring only

NR 406 Conservation of Biological Diversity (3 credit hours)
Population biology concepts fundamental to understanding the properties of the objects of conservation. Genetic diversity in agriculture, forestry, and animal breeding; the ethical and international policy issues in conservation and management.

Prerequisite: Junior standing
GEP Interdisciplinary Perspectives
Typically offered in Fall only

NR 420/FOR 520/NR 520/FOR 420 Watershed and Wetlands Hydrology (4 credit hours)
Principles of hydrologic science; classification and assessment of watersheds and stream networks; hydrologic, erosion, and water quality processes in natural and managed watersheds; wetlands hydrology; hydrologic measurements and data analysis; applications of hydrology and water quality management for forest agriculture, urban ecosystems; watershed restoration. Emphasis field study of watersheds and hydrologic measurements. Two weekend field trips are required. Credit will not be given for both FOR(NR)420 and FOR(NR)520.

Prerequisite: SSC 200 and (FOR 260 or PB 360 or AEC 360)
Typically offered in Fall only

NR 421/NR 521 Wetland Assessment, Delineation and Regulation (3 credit hours)
Wetland definitions and systems of classification and functional assessment; methods for assessing ecological functions of wetlands; identification and delineation of jurisdictional wetlands in accordance with US Army Corps of Engineers procedures; application.

Prerequisite: SSC 200, (PB 360 or BIO 360), and (FOR 339 or PB 405)
Typically offered in Spring only

NR 460/NR 560 Renewable Natural Resource Management and Policy (3 credit hours)
The interaction of legal principles and governmental institutions in the development and implementation of natural resource policy and management. Legal principles, constitutional provisions and the location and organization of governmental programs. Examples from both historic and current case studies.

Prerequisite: Junior standing
GEP Social Sciences
Typically offered in Fall only
NR 484 Environmental Impact Assessment (4 credit hours)
Impact assessment principles, practices, and their evolution. Lectures and field practicums concerning problems addressed by environmental assessment practitioners. Practical implications of current regulatory requirements, especially endangered species and wetlands.

Prerequisite: Senior standing
Typically offered in Fall only

NR 491/FOR 491 Special Topics in Forestry and Related Natural Resources (1-4 credit hours)
Independent (or group) study or research of a forestry or related natural resources topic with a faculty supervisor of the student's choice. Also courses offered on a trial basis.

Typically offered in Fall only

NR 493 Independent Study in Natural Resources (1-6 credit hours)
Independent Study for Natural Resources students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses"

Typically offered in Fall and Spring

NR 494 Independent Study in Natural Resources (1-6 credit hours)
Independent Study for Natural Resources students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses"

Typically offered in Fall, Spring, and Summer

NR 500/NR 400 Natural Resource Management (4 credit hours)
Theory and practice of integrated natural resource management. Quantitative optimization, economics of multiple-use, compounding and discounting, optimal rotations, linear programming. Public and private management case studies and team projects.

Prerequisite: Senior standing in NR or ES or ETM or FOM or FWCB
Typically offered in Spring only

NR 510 Military Land Sustainability (3 credit hours)
An introduction and overview of the factors that influence natural resource conservation and management on Department of Defense lands within a temporal, geographic, and environmental context and perspective. Students will gain knowledge of natural resource management and military land sustainability by reviewing (1) military land uses and training/test requirements, (2) major policies/laws impacting training/testing activities on DoD lands, and (3) planning approaches to military sustainability.

Typically offered in Fall only

NR 511 Managing Natural Resources in an Arena of Conflict (3 credit hours)
Public policy issues, such as management of natural resources, are pervasive with conflicts. Surpassing political, jurisdictional, institutional, and geographic boundaries, natural resources and environmental issues can represent multiple dimensions of uncertainties and complexities. Effective management of public issues then is an important task (and topic) for natural resource professionals who are often required to develop management strategies to resolve or at best, reduce the level of the conflict. This course examines theories and approaches for managing natural resource conflict, with emphasis on the field of public or alternative dispute resolution (ADR) and its spectrum of collaborative approaches. Undergraduate degree or instructor approval required.

Typically offered in Fall only

NR 512 Land Use Policy & Management (3 credit hours)
Graduate course reviewing the history, formation and implementation of major natural resource laws and policies that impact land uses. This course will provide an overview of federal laws and policies that affect decision making by land managers. Weekly lectures will be followed by student presentations of a selected case study of their choosing in the final weeks of the course. Current natural resource / land management (including forestry, air, water, wildlife, climate change and energy) programs and institutions are discussed, analyzed and related to current land use and management policy challenges.

Restriction: undergraduate degree or instructor approval

Typically offered in Spring only

NR 520/FOR 420/NR 420/FOR 520 Watershed and Wetlands Hydrology (4 credit hours)
Principles of hydrologic science; classification and assessment of watersheds and stream networks; hydrologic, erosion, and water quality processes in natural and managed watersheds; wetlands hydrology; hydrologic measurements and data analysis; applications of hydrology and water quality management for forest agriculture, and urban ecosystems; watershed restoration. Emphasis field study of watersheds and hydrologic measurements. Two weekend field trips are required. Credit will not be given for both FOR(NR)420 and FOR(NR)520.

Prerequisite: SSC 200 and (FOR 260 or PB 360 or AEC 360)
Typically offered in Fall only

NR 521/NR 421 Wetland Assessment, Delineation and Regulation (3 credit hours)
Wetland definitions and systems of classification and functional assessment; methods for assessing ecological functions of wetlands; identification and delineation of jurisdictional wetlands in accordance with US Army Corps of Engineers procedures; appl

Prerequisite: SSC 200, (PB 360 or BIO 360), and (FOR 339 or PB 405)
Typically offered in Spring only

NR 548 Historical Environments (3 credit hours)
Course examines how we know and what we know about historical environments. Compares and contrasts contributions by various disciplines and interdisciplinary approaches to historical ecology and environmental history. Readings drawn from science, social science and humanities literature. Individual investigation projects required.

Typically offered in Spring only
NR 554  Introduction to Data Analysis in Natural Resources  (3 credit hours)
Data examination, cleaning, summary and visualization, statistical analyses options using various procedures of the SAS software and R with an emphasis on natural resource applications. Interpretation of statistical analyses outputs. Discussions of individual data problems. Hands-on use of computers and the SAS and R software.
Pre or Co-requisite of ST512
Typically offered in Spring only

NR 560/NR 460  Renewable Natural Resource Management and Policy  (3 credit hours)
The interaction of legal principles and governmental institutions in the development and implementation of natural resource policy and management. Legal principles, constitutional provisions and the location and organization of governmental programs. Examples from both historic and current case studies.
Prerequisite: Junior standing.
GEP Social Sciences
Typically offered in Fall only

NR 571  Current Issues in Natural Resource Policy  (3 credit hours)
Seminar providing an overview of current natural resource issues for the world and the U.S. Population, sustainable development, food and agriculture, forests, rangelands, biodiversity, energy resources, water resources, atmosphere and climate, international policies and instructions.
Typically offered in Fall only

NR 595  Special Topics in Natural Resources  (1-6 credit hours)
Individual students or groups of students, under direction of a faculty member, may explore natural resources related topics of special interest not covered by existing courses. Format may consist of readings and independent study, problems, or research not related to thesis. Also used to develop and test new 500-level courses.
Typically offered in Fall and Spring

NR 601  Graduate Seminar  (1 credit hours)
Weekly seminar in which students registered for course present the results of research and special projects. Invitation to all graduate students and faculty in department to attend and join discussion.
Typically offered in Fall and Spring

NR 610  Special Topics in Natural Resources  (1-6 credit hours)
Individual students or groups of students, under direction of a faculty member, may explore natural resources related topics of special interest not covered by existing courses. Format may consist of readings and independent study, problems, or research not related to thesis. Also used to develop and test new 600-level courses.
Typically offered in Fall and Spring

NR 685  Master's Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

NR 693  Master's Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

NR 695  Master's Thesis Research  (1-9 credit hours)
Thesis Research
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

NR 696  Summer Thesis Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master's student
Typically offered in Summer only

Natural Sciences (NSGE)

NSGE 295  Natural Sciences Special Topics  (1-4 credit hours)
Special topics course offering for the general education Natural Sciences category.
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

Natural Sciences and Global Knowledge (NSGK)

NSGK 295  Natural Sciences and Global Knowledge Special Topics  (3 credit hours)
Special topics course offering for the general education Natural Sciences and Global Knowledge categories. This course may be used for the Global Knowledge (GK) co-requisite and/or for the Natural Sciences (NS) requirement.
GEP Global Knowledge, GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

Naval Science (NS)

NS 100  Naval Science Lab  (0 credit hours)
Military drill, courtesies and honors, elements of unit leadership, physical fitness and professional development of the prospective Naval/Marine Corps Officer. Required for all Naval ROTC students.
Typically offered in Fall and Spring

NS 110  Introduction to Naval Science  (2 credit hours)
Fundamental orientation to the Naval Service emphasizing the mission, organization, regulations, customs and traditions, broad warfare components of Navy and the major challenges facing today's Navy and Marine Officers.
Typically offered in Fall only
**NS 210 Leadership and Management** (3 credit hours)  
Assists students in acquiring knowledge and developing the cognitive processes necessary to make decisions in the practice of management. The student will learn the traditional foundations of management while developing decision skills to apply this knowledge in a real-world setting. The major focus is centered upon global management, ethics and social responsibility, total quality management, and cultural diversity.

**GEP Social Sciences**
*Typically offered in Fall only*

**NS 225 Navigation** (4 credit hours)  
A broad yet thorough education in basic ship navigation. Course includes a study of various navigation methods, weather, the laws of the sea, and navigational rules. Practical work includes chart plotting and understanding relative motion.

*Typically offered in Spring only*

**NS 315 Naval Engineering** (3 credit hours)  
Introduction to the application of engineering principles in the research, development, design, construction, and operation of ships, weapons systems, and ocean structures, with emphasis on thermodynamic processes and energy conversions.

*Typically offered in Spring only*

**NS 325 Naval Weapons Systems** (3 credit hours)  
An introduction to the concepts and properties of electronic, physical, electromagnetic and mechanical systems to foster an understanding of the theory and principles of operation of shipboard weapons systems, course emphasizes types of weapons and fire control systems, capabilities and limitations, theory of target acquisition, identification and tracking, trajectory and ballistics principles, and basic theory of radar and sonar.

*Typically offered in Fall only*

**NS 330 Evolution of Warfare** (3 credit hours)  
A survey of the evolution of warfare through the study of selected campaigns and classic battles with special emphasis on the principles of war, the military impact of leadership, and the evolution of tactics, weapons, and weaponry.

*Typically offered in Spring only*

**NS 415 Naval Operations** (4 credit hours)  
A thorough exploration of the operations conducted by the U.S. Navy. Course includes a study of U.S. Naval evolutions, operations, command & control, communication, and an introduction to naval warfare doctrine. Practical applications include the determination of advanced maneuvering methods through and in-depth understanding of relative motion.

Prerequisite: NS 225 Navigation

*Typically offered in Fall only*

**NS 420 Naval Leadership and Ethics** (3 credit hours)  
An intellectual exploration of Western moral traditions and ethical philosophy with a variety of topics, such as military leadership, core values, and professional ethics; the Uniform Code of Military Justice and Navy Regulations; and discussions relating to the roles of enlisted members, junior and senior officers, command relationships, and the conduct of warfare. The course provides students with a foundation of moral traditions, combined with a discussion of actual current and historical events in the United States navy and Marine Corps, to prepare them for the role and responsibilities of leadership in the naval service of the 21st century.

**GEP Humanities, GEP Interdisciplinary Perspectives**
*Typically offered in Spring only*

**NS 430 Amphibious Warfare** (3 credit hours)  
A survey of the projection of sea power ashore with special emphasis on the evolution of and innovation in amphibious warfare in the 20th Century through the study of historical amphibious landings and campaigns.

*Typically offered in Spring only*

**NC Global Training Initiative (GTI)**

**GTI 401 US Culture and Education Colloquium** (3 credit hours)  
Overview of US Culture, Higher Education in America, and Student Success Skills for degree or non-degree international students. Guest faculty lectures, media presentations, field trips, and required readings form basis for discussion groups, assignments, and capstone paper (reflection on issues discussed in class, personal development, and required community involvement). Includes break-out discussion groups, field trips, personal projects and research. Students may have additional travel cost associated with field trips. Enrollment limited to first year international students, participants in NC Global Training Initiative Certificate Programs, or by permission of the instructor.

*Typically offered in Fall only*

**Nonprofit Studies (NPS)**

**NPS 340 Fundamentals of Grant Development for Nonprofits** (3 credit hours)  
The focus of this class is on obtaining grant funding for nonprofit organizations. This course covers the skills and strategies essential to the grants development process including basic strategies for researching funding sources and developing success

*Typically offered in Spring only*

**NPS 395 Special Topics in Nonprofit Studies** (1-6 credit hours)  
Offered as needed to present material not normally available in regular departmental course offerings or for offering of new courses on a trial basis.
NPS 490  Service Learning Internship in Nonprofit Studies  (3 credit hours)
The 150 hour (3 credit hour) online service learning internship course provides students with the opportunity to apply the knowledge, skills, and abilities gained through their coursework in the Nonprofits Studies Minor to a nonprofit organizational work setting. The online course builds on previous coursework in the minor and focuses learning from these courses on application to a service learning work setting by requiring students to reflect on the applicability of the Five Leadership Challenges studied throughout the minor to their real work experience. Students are expected to be active participants in work place discussions, lending expertise, ideas and knowledge from their course work to the organizations and their leaders.
Prerequisite: PS 203 and COM 466 and HI 380. Restricted to Nonprofit Studies Minor Students Only.
Typically offered in Fall, Spring, and Summer

NPS 498  Capstone Seminar in Nonprofit Studies  (1 credit hours)
This capstone seminar integrates the knowledge, skills, and abilities gained through coursework in the minor in Nonprofit Studies through class discussions and reflective writings where students draw upon previous service-learning experiences to reflect on challenges facing nonprofit leaders. Case studies and articles that focus on the themes of the minor are used to stimulate class discussions. Nonprofit leaders serve as discussants. In addition, students complete and submit a Nonprofit Studies portfolio, which documents successful achievement of program objectives. Departmental approval required
Prerequisite: PS 203, COM 466, Corequisite: NPS 490
Typically offered in Fall and Spring

Nonwovens (NW)

NW 408/TT 408/TT 508/NW 508  Nonwoven Product Development  (3 credit hours)
Prerequisites: TT 405 and TT 407
Typically offered in Spring only

NW 503/TT 503  Materials, Polymers, and Fibers used in Nonwovens  (3 credit hours)
Fundamentals of raw material used in nonwoven processes. Raw material production, chemical and physical properties of nonwoven raw materials and assessment of material properties. Introduction of structure/property relationships for these materials and how these relationships influence end use applications.
Prerequisite: MA 141, PY 205, PCC 203
Typically offered in Fall and Spring

NW 504/NW 404/TT 404/TT 504  Introduction to Nonwovens Products and Processes  (3 credit hours)
This course introduces the fundamentals of nonwoven structures, process, and products. It provides performance criteria, raw materials, manufacturing methods, and market outlooks of major nonwoven application segments including hygiene, wipes, filters, medical, automotive, and geotextile. Emphasis is placed on building basic understandings of process/structure/property relationship in nonwoven product and the economic justification for process and production.
Prerequisite: (MA 131 or 141), PY 205; Corequisite: TT 503
Typically offered in Fall only

NW 505/NW 405/TT 405/TT 505  Advanced Nonwovens Processing  (3 credit hours)
Mechanisms used in the production of nonwoven materials. Design and operation of these mechanisms. Process flow, optimization of process parameters, influence of process parameters on product properties.
Prerequisite: MA 231 or MA 241, PY 211 or (PY 205 and PY 206) , TT 305 or TT 404
Typically offered in Spring only

NW 506  Bonding Principles in Nonwovens  (3 credit hours)
Fundamentals of fluid mechanics and heat transfer mechanisms during the bonding nonwovens. Provide engineering and in-depth description of hydroentangling, thermal bonding and needle punching techniques. Modeling methods and laboratory work are assigned.
Prerequisite: MAE 308, MAE 310, TT /NW505
Typically offered in Fall and Summer

NW 507/TT 507  Nonwoven Characterization Methods  (3 credit hours)
Prerequisite: ST 361, Corequisite: TT/NW 505
Typically offered in Spring only
**Nuclear Engineering (NE)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NE 201</td>
<td>Introduction to Nuclear Engineering</td>
<td>2</td>
<td>An introduction to the concepts, systems and application of nuclear processes. Topics include radioactivity, fission, fusion, reactor concepts, biological effects of radiation, nuclear propulsion, and radioactive waste disposal. Designed to give students a broad perspective of nuclear engineering and an introduction to fundamentals and applications of nuclear energy.</td>
</tr>
<tr>
<td>NE 202</td>
<td>Radiation Sources, Interaction and Detection</td>
<td>4</td>
<td>Introduction to nuclear energy. Topics include radioactivity, radiation detection, interaction of radiation with matter, nuclear reactions, fission, fusion, nuclear reactors, radiation safety and protection, and laboratory measurement of nuclear radiation.</td>
</tr>
<tr>
<td>NE 235</td>
<td>Nuclear Reactor Operations Training</td>
<td>2</td>
<td>Principles of nuclear reactor operations. Lectures to cover basic nuclear engineering theory pertaining to fission reactor operations; laboratory sessions to provide hands on training with the PULSTAR nuclear reactor including facility pre-startup checks, approach to criticality, steady state operations, and measurement of various operating parameters. Qualified students may opt to enter training and study for the U.S. Nuclear Regulatory Commission exam to become federally licensed nuclear Reactor Operators. Does not count towards NE graduation requirements.</td>
</tr>
<tr>
<td>NE 290</td>
<td>Introduction to Health Physics</td>
<td>3</td>
<td>Fundamentals of ionizing radiation safety. The course will review basic physical principles, radiation sources, introductory radiation dosimetry, radiation safety guidelines, evaluation of safety measures, and basic radiation control principles for contamination and radioactive material safety to include measurement physics, counting statistics and basic radiobiology principles.</td>
</tr>
<tr>
<td>NE 301</td>
<td>Fundamentals of Nuclear Engineering</td>
<td>3</td>
<td>Introductory course in nuclear engineering. Neutron physics, reactor operation, and reactor dynamics. Basic principles underlying the design and operation of nuclear systems, facilities and applications.</td>
</tr>
<tr>
<td>NE 400</td>
<td>Nuclear Reactor Energy Conversion</td>
<td>4</td>
<td>Introduction to the concepts and principles of heat generation and removal in reactor systems. Power cycles, reactor heat sources, analytic and numerical solutions to conduction problems in reactor components and fuel elements, heat transfer in reactor fuel bundles and heat exchangers. Problem sets emphasize design principles. Heat transfer lab included. Credit will not be given for both NE 400 and NE 500.</td>
</tr>
<tr>
<td>NE 401</td>
<td>Reactor Analysis and Design</td>
<td>3</td>
<td>Elements of nuclear reactor theory for reactor core design and operation. Includes one-group neutron transport and multigroup diffusion models, analytical and numerical criticality search, and flux distribution and calculations for homogeneous and heterogeneous reactors, slowing down models, introduction to perturbation theory.</td>
</tr>
<tr>
<td>NE 402</td>
<td>Reactor Engineering</td>
<td>4</td>
<td>A course in thermal-hydraulic design and analysis of nuclear systems. Single and two-phase flow, boiling heat transfer, modeling of fluid systems. Design constraints imposed by thermal-hydraulic considerations are discussed. A thermal-hydraulics laboratory included. Credit will not be given for both NE 402 and NE 502.</td>
</tr>
<tr>
<td>NE 403</td>
<td>Nuclear Reactor Laboratory</td>
<td>2</td>
<td>Nuclear reactor laboratory. A laboratory course performed on the NCSU PULSTAR reactor. Topics include reactor startup and approach to critical. Neutron flux distributions. Reactivity balances. Control rod worth and power coefficients of reactivity.</td>
</tr>
<tr>
<td>NE 404</td>
<td>Radiation Safety and Shielding</td>
<td>3</td>
<td>Radiation safety and environmental aspects of nuclear power generation. Radiation interaction, photon attenuation, shielding theory and design project, external and internal dose evaluation, reactor effluents and release of radioactivity into the environment, transportation and disposal of radioactive waste; and environmental impact of nuclear power plants.</td>
</tr>
<tr>
<td>NE 405</td>
<td>Reactor Systems</td>
<td>3</td>
<td>Nuclear power plant systems: design criteria, design parameters, and economics. Topics covered include: PWR, BWR, core design, primary loops, auxiliary and emergency systems; containment, reactor control and protection systems, accident and transient behaviors.</td>
</tr>
</tbody>
</table>

**NW 508/NW 408/TT 408/TT 508 Nonwoven Product Development** (3 credit hours)

Prerequisites: TT 405 and TT 407
Typically offered in Spring only

Prerequisite: Grade of C or better in MA 241, PY 205
Typically offered in Fall only

Prerequisites: C- or better in MA 242 and PY 208
Typically offered in Spring only

Prerequisites: TT 405 and TT 407
Typically offered in Spring only

Prerequisite: MAE 201 and a C- or better in NE 301
Typically offered in Fall only

Typically offered in Spring only

Prerequisites: TT 405 and TT 407
Typically offered in Spring only

Prerequisites: NE 301 with a grade of C- or better or NE 419
Typically offered in Fall only

Prerequisites: NE 301 with a grade of C- or better or NE 419
Typically offered in Fall only

Typically offered in Spring only

Typically offered in Spring only

Typically offered in Spring only
NE 406 Nuclear Engineering Senior Design Preparation (1 credit hour)
Preliminary design phase in nuclear engineering systems to prepare for the final phase design. Preliminary designs developed by teams with advice of faculty, with reports presented in oral and written form. Current and future systems emphasized, and use of computers encouraged.
Prerequisite: NE 401, Corequisite: NE 402
Typically offered in Fall only

NE 408 Nuclear Engineering Design Project (3 credit hours)
Projects in design of practical nuclear engineering systems. Preliminary designs developed by teams with advice by faculty as needed, with reports presented in oral and written form. Current and future systems emphasized, and use of computers encouraged.
Prerequisite: NE 406
Typically offered in Spring only

NE 409/MSE 409/NE 509/MSE 509 Nuclear Materials (3 credit hours)
Introduces students to properties and selection of materials for nuclear steam supply systems and to radiation effects on materials. Implications of radiation damage to reactor materials and materials problems in nuclear engineering are discussed. Topics include an overview of nuclear steam supply systems, crystal structure and defects, dislocation theory, mechanical properties, radiation damage, hardening and embrittlement due to radiation exposure and problems concerned with fission and fusion materials. Students cannot receive credit for both 409 and 509.
Prerequisite: MSE 201
Typically offered in Fall only

NE 412 Nuclear Fuel Cycles (3 credit hours)
Processing of nuclear fuel with descriptions of mining, milling, conversion, enrichment, fabrication, irradiation, reprocessing, and waste disposal. In-core and out-of-core nuclear fuel management design, including objectives, constraints, decisions, and methodologies. Nuclear power plant and fuel cycle economics.
Prerequisite: NE 401
Typically offered in Fall only

NE 418 Nuclear Power Plant Instrumentation (3 credit hours)
Instrumentation and supporting systems required for control and protection of a nuclear power plant. Radiation measurement, process measurement, and reactor operating principles used to develop instrumentation requirements and implementation aspects. Requirements and implementations of instrumentation, control and protection systems for pressurized and boiling water reactors. Design and implementation issues include power supplies, signal transmission, redundancy and diversity, response time, and reliability.
Prerequisite: ECE 221 or ECE 331
Typically offered in Spring only

NE 419 Introduction to Nuclear Energy (3 credit hours)
Electrical power generation from nuclear fission, fundamental aspects of fission chain reaction, and reactor design. Reactor types, their static and dynamic characteristics and instrumentation. Reactor operation and safety. Nuclear fusion and fusion reactor development. Not open to majors in Nuclear Engineering.
Prerequisite: PY 202 or PY 208
Typically offered in Fall and Spring

NE 431/NE 531 Nuclear Waste Management (3 credit hours)
Scientific and engineering aspects of nuclear waste management. Management of spent fuel, high-level waste, uranium mill tailings, low-level waste and decommissioning wastes. Fundamental processes for the evaluation of waste management systems with emphasis on the safety assessment of waste disposal facilities to include nuclear criticality safety, free release and transportation. There is also a required research project for the graduate version of the course.
Prerequisite: MA 341 and PY 208 (or any equivalent)
Typically offered in Fall only

NE 490/NE 590 Health Physics and Radiological Emergency Response (3 credit hours)
This is an advanced health physics course encompassing internal and external radiological dosimetry along with control of radiation fields including airborne radioactivity. Students will learn basic interactions and response functions, biological effects as well as natural and manmade sources allowing emphasis on the final coverage of nuclear emergency response.
Prerequisite: MA 341 and PY 208 (or equivalent)
Typically offered in Fall only

NE 491 Special Topics in Nuclear Engineering (1-4 credit hours)
Detailed coverage of special topics.

NE 500 Advanced Energy Conversion in Nuclear Reactors (3 credit hours)
A course which introduces concepts and principles of heat generation and removal in reactor systems. Power cycles, reactor heat sources, analytical and numerical solutions to conduction problems in reactor components and fuel elements, heat transfer in reactor fuel bundles and heat exchangers. Design principles are emphasized in homework and in-class problems. Course project is required. Credit will not be given for both NE 400 and NE 500.
Prerequisite: MAE 201
Typically offered in Spring only

NE 501/NE 401 Reactor Analysis and Design (3 credit hours)
Elements of nuclear reactor theory for reactor core design and operation. Includes one-group neutron transport and multigroup diffusion models, analytical and numerical criticality search, and flux distribution and calculations for homogeneous and heterogeneous reactors, slowing down models, introduction to perturbation theory.
Prerequisites: MA 401 and C- or better in NE 301
Typically offered in Spring only

NE 502 Reactor Engineering (3 credit hours)
Thermal-hydraulic design and analysis of nuclear systems. Single and two-phase flow, boiling heat transfer, modeling of fluid systems. Design constraints imposed by thermal-hydraulic considerations are discussed. Credit will not be given for both NE 402 and NE 502.
Prerequisite: MAE 308
Typically offered in Fall only
NE 504 Radiation Safety and Shielding (3 credit hours)
A basic course in radiation safety and environmental aspects of nuclear power generation. Topics include radiation interaction, photon attenuation, shielding, internal and external dose evaluation, reactor effluents and release of radioactivity into the environment, transportation and disposal of radioactive waste; and environmental impact of nuclear power plants. Term-long project.
Prerequisite: NE 401 or NE 520
Typically offered in Fall only

NE 505 Reactor Systems (3 credit hours)
Nuclear power plant systems: PWR, BWR and advanced concepts. Design criteria, design parameters, economics, primary and secondary loops, safety systems, reactor control and protection systems, containment, accident and transient behaviors, core design, and reactivity control mechanisms. Term-long project. Credit for both NE 405 and NE 505 is not allowed
Prerequisite: NE 401, NE 402
Typically offered in Spring only

NE 509/MSE 509/NE 409/MSE 409 Nuclear Materials (3 credit hours)
Introduces students to properties and selection of materials for nuclear steam supply systems and to radiation effects on materials. Implications of radiation damage to reactor materials and materials problems in nuclear engineering are discussed. Topics include an overview of nuclear steam supply systems, crystal structure and defects, dislocation theory, mechanical properties, radiation damage, hardening and embrittlement due to radiation exposure and problems concerned with fission and fusion materials. Students cannot receive credit for both 409 and 509.
Prerequisite: MSE 201
Typically offered in Fall only

NE 512 Nuclear Fuel Cycles (3 credit hours)
Processing of nuclear fuel with description of mining, milling, conversion, enrichment, fabrication, irradiation, shipping, reprocessing and waste disposal. Fuel cycle economics and fuel cost calculation. In-core and out-of-core nuclear fuel management, engineering concepts and methodology. Term-long project. Credit for both NE 412 and NE 512 is not allowed
Prerequisite: NE 401
Typically offered in Fall only

NE 520 Radiation and Reactor Fundamentals (3 credit hours)
Basics of nuclear physics and reactor physics that are needed for graduate studies in nuclear engineering. Concepts covered include, atomic and nuclear models, nuclear reactions, nuclear fission, radioactive decay, neutron interactions, nuclear reactors, neutron diffusion in non-multiplying and multiplying systems, and basic nuclear reactor kinetics.
Prerequisite: MA 341 and PY 208
Typically offered in Fall only

NE 521 Principles of Radiation Measurement (3 credit hours)
Radiation detection measurement methods employed in nuclear engineering. Topics include: physics of nuclear decay and nuclear reactions, interaction of charged particles, photons, and neutrons with matter, fundamental properties of radiation measurement systems, statistical analysis of radiation measurements, common radiation detectors (gas-filled detectors, scintillators, and semiconductor detectors), data acquisition and processing methods, and radiation measurement applications.
Prerequisites: Graduate standing in Nuclear Engineering or instructor permission
Typically offered in Fall only

NE 523 Computational Transport Theory (3 credit hours)
Derivation of the nonlinear Boltzmann equation for a rarefied gas and linearization to the equation of transport of neutral particles. Deterministic methods for solving the neutron transport equation: Multigroup energy discretization; Discrete Ordinates angular discretization; various spatial discretization methods. Convergence of numerical solutions with discretization refinement. Iterative solution algorithms: inner, outer, and power iterations. Spectral analysis of inner iterations convergence and acceleration. Selection of advanced topics.

NE 401/501: Reactor Analysis and Design Advanced math & moderate programming skills are necessary. Permissible programming languages: Fortran or C++
Typically offered in Spring only

NE 528/PY 528 Introduction to Plasma Physics and Fusion Energy (3 credit hours)
Concepts in plasma physics, basics of thermonuclear reactions; charged particle collisions, single particle motions and drifts, radiation from plasmas and plasma waves, fluid theory of plasmas, formation and heating of plasmas, plasma confinement, fusion devices and other plasma applications.
Prerequisite: MA 401 and PY 208
Typically offered in Fall only

NE 529/PY 529 Plasma Physics and Fusion Energy II (3 credit hours)
This course expands on the treatment of plasmas as a system of coupled fluids and introduces the foundations of plasma kinetic theory. Derivation of the plasma kinetic equation and the Vlasov equation serve as the starting point to introduce the kinetic study of plasma systems. From this introduction of the governing equations for full kinetic treatment, methods for analyzing plasma response to electromagnetic and electrostatic perturbations using the linearized Vlasov model for uncorrelated plasmas are introduced. Kinetic stability of Vlasov plasmas is introduced and the Nyquist method is used to determine conditions for kinetic stability. The concept of correlated plasmas is then introduced through the introduction of reduced distribution functions and the BBGKY hierarchy. Finally, simple correlated systems and the Liouville model for two-system correlation is covered to look at the impact of particle correlation due to collisions and coulomb interaction.
Prerequisite: NE 528
Typically offered in Spring only
NE 531/NE 431 Nuclear Waste Management (3 credit hours)
Scientific and engineering aspects of nuclear waste management. Management of spent fuel, high-level waste, uranium mill tailings, low-level waste and decommissioning wastes. Fundamental processes for the evaluation of waste management systems with emphasis on the safety assessment of waste disposal facilities to include nuclear criticality safety, free release and transportation. There is also a required research project for the graduate version of the course.

Prerequisite: MA 341 and PY208 (or any equivalent)
Typically offered in Fall only

NE 541 Nuclear Nonproliferation Technology and Policy (3 credit hours)
Technology and policy challenges and solutions to prevent the spread of nuclear weapons. Topics include: issues of nuclear proliferation inherent to civilian nuclear power development; technologies, processes, and policies for safeguarding nuclear materials and technology; integrating the preceding subjects to strengthen the global nuclear nonproliferation regime. Includes a field trip to Oak Ridge National Laboratory during Spring Break to gain hands-on experience with safeguards measurements of nuclear material. The field trip is required; there is no cost to the student.

Graduate standing in Nuclear Engineering or instructor consent.
Typically offered in Spring only

NE 550 Introduction to Atomistic Simulations (3 credit hours)
NE 550 is an introductory course on molecular dynamics simulations. The course covers the principles of classical and statistical mechanics that underpin the simulation methods. Emphasis is placed on writing computer programs for determining thermodynamic, structural and transport properties of different types of materials.

Typically offered in Spring only

NE 551 Nuclear Laboratory Fundamentals (3 credit hours)
Labratory experiments and techniques that are useful and instructive to a Nuclear Engineer. The labs include experiments on radiation detectors and detection techniques, Gamma-and X-ray spectroscopy, and use of the thermal neutron beam of the nuclear reactor for neutron imaging. All state-of-the art radiation detectors are taught and used. Restricted to Nuclear Engineering Graduate Students.

Typically offered in Fall only

NE 557/MAE 577 Multiscale Two-phase Flow Simulations (3 credit hours)
Modeling and simulation of two-phase flows using interface tracking approach and ensemble averaging approaches. Model validation and verification based on interface-tracking data, boiling models. Nuclear reactor applications. The course focuses on interface tracking methods understanding as applied to bubbly flow simulations. Students will develop a simplified solver to track 2D bubbles/droplets throughout the course homework assignments and will learn how to apply this approach for better understanding of multi-phase flow as part of the course project.

Typically offered in Spring only

NE 569/NE 469 Health Physics and Radiological Emergency Response (3 credit hours)
This is an advanced health physics course encompassing internal and external radiological dosimetry along with control of radiation fields including airborne radioactivity. Students will learn basic interactions and response functions, biological effects as well as natural and manmade sources allowing emphasis on the final coverage of nuclear emergency response.

Typically offered in Fall only

NE 592 Special Topics In Nuclear Engineering I (1-6 credit hours)
Credits Arranged
Typically offered in Fall and Spring

NE 590/NE 490 Health Physics and Radiological Emergency Response (3 credit hours)
This is an advanced health physics course encompassing internal and external radiological dosimetry along with control of radiation fields including airborne radioactivity. Students will learn basic interactions and response functions, biological effects as well as natural and manmade sources allowing emphasis on the final coverage of nuclear emergency response.

Typically offered in Fall and Spring

NE 591 Special Topics In Nuclear Engineering I (1-6 credit hours)
Credits Arranged
Typically offered in Spring only
NE 722 Reactor Dynamics and Control  (3 credit hours)
Methods of describing and analyzing dynamic behavior of systems. These methods applied to reactor systems and the effects of feedbacks. Methods of measuring the behavior of reactor systems and development of logic systems for control and safety.
Prerequisite: NE 401 or NE 520
Typically offered in Fall only

NE 723 Neutron Transport Theory  (3 credit hours)
Advanced theory of neutron transport and computational methods of solving particle transport (linear Boltzmann) equation for reactor physics problems. Principle topics: models of neutron transport; analytic methods for solving transport equation; asymptotic diffusion limit; PN and SPN methods, homogenization methodology; numerical methods for multidimensional problems; computational methods for multiphysics problems. Objective is to enable students to read literature and perform relevant analysis of neutron transport and reactor-physics problems.
Prerequisite: NE 401 or NE 520
Typically offered in Fall only

NE 724 Reactor Heat Transfer  (3 credit hours)
Consideration of heat generation and transfer in nuclear power reactors. Topics include reactor heat generation, steady-state and transient heat combustion in reactor fuel elements, boiling heat transfer and single and two-phase flow.
Prerequisite: NE 402 and NE 401 or NE 520
Typically offered in Fall only

NE 726 Radioisotopes Measurement Applications  (3 credit hours)
Introduction to the student to measurement applications using radioisotopes and radiation. Discussion of all major tracing, gauging and analyzer principles and treatment of several specific applications in detail. Objective is to familiarize student with design and analysis of industrial measurement systems using radioisotopes and/or radiation.
Prerequisite: NE 401 or NE 520
Typically offered in Spring only

NE 727 Nuclear Engineering Analysis  (3 credit hours)
Fundamental material on: (1) numerical methods for solving the partial differential equations pertinent to nuclear engineering problems, (2) Monte Carlo simulation of radiation transport and (3) data and error analysis techniques including estimation of linear and nonlinear model parameters from experimental data.
Prerequisite: NE 401 or NE 520
Typically offered in Spring only

NE 729 Reactor Theory and Analysis  (3 credit hours)
Theoretical aspects of neutron diffusion and transport related to the design computation and performance analysis of nuclear reactors. Principal topics: a unified view of the neutron cycle including slowing down, resonance capture and thermalization; reactor dynamics and control; fuel cycle studies; and neutron transport methods. Background provided for research in power and test reactor analysis.
Prerequisite: NE 723, NE 727
Typically offered in Spring only

NE 730 Radiological Assessment  (3 credit hours)
Principles of analyzing environmental radiation transport and resulting human exposure and dose and dose management. Sources term of radiation exposure, the radon problem, transport or radionuclides in the atmosphere, surface water, and groundwater, pathways modeling, radiation dosimetry, probabilistic models for environmental assessment, uncertainty analysis, and radiation risk management. A package of computer codes is developed as a class project.
Prerequisite: NE 404 or NE 504
Typically offered in Spring only

NE 732 Principles of Industrial Plasmas  (3 credit hours)
Theory and fundamental physical principles of industrial plasmas. Applications in plasma processing, plasma manufacturing technology, arcs and torches, plasma sprayers, high-voltage high-current switching devices, plasma-driven devices and plasma-aided technology. Emphasis on particle transport and plasma flow.
Prerequisite: NE/PY 528
Typically offered in Spring only

NE 740 Laboratory Projects In Nuclear Engineering  (3 credit hours)
Enhancement of laboratory skills pertinent to nuclear engineering research through projects that requiring student to design the experiment, assemble equipment, carry out the measurements and analyze and interpret data. Students work in groups of two and perform to completion two laboratory projects.
Prerequisite: NE 721
Typically offered in Spring only

NE 745 Plasma Laboratory  (3 credit hours)
Experimental plasma generation and plasma diagnostic techniques. Lecture topics include high vacuum techniques, perturbing and non-perturbing probe techniques, and laser and emission spectroscopy. Laboratories utilize various methods of measuring plasma parameters discussed in lectures.
Prerequisite: NE 528 or PY 508 or PY 509
Typically offered in Spring only

NE 746 Fusion Energy Engineering  (3 credit hours)
Description and analysis of the technologies of devices necessary to produce fusion energy including vacuum technology, plasma heating and fueling, magnetics, special energy conversion, neutronics, materials, environment and safety. Stress upon design integration and ensuing technological constraints.
Prerequisite: NE 528
Typically offered in Fall only

NE 751 Nuclear Reactor Design Calculations  (3 credit hours)
Application of digital computer to problems in reactor core nuclear design. Study and exercise of available reactor core physics computer modules. Description of systems and programs used by industry for power reactor core design and core follow. A review
NE 752 Thermal Hydraulic Design Calculations  (3 credit hours)
Advanced presentation of thermal-hydraulic analysis of nuclear power systems. Topics including development of single phase and two-phase fluid flow equations, subchannel analysis, interphase phenomena and numerical solution methods relevant to design and safety analysis codes.
Prerequisite: NE 724
Typically offered in Fall only

NE 753 Reactor Kinetics and Control  (3 credit hours)
The control of nuclear reactor systems. Development of basic control theory including the use of Bode, Nyquist and S-plane diagrams and state-variable methods. Analysis of reactor and reactor systems by these methods and development of control methods and optimum-control methods. Discussion of models of reactors and reactor-associated units, such as heat exchangers. Presentation of effects of nonlinearities.
Prerequisite: NE 722
Typically offered in Spring only

NE 755 Reactor Theory and Analysis  (3 credit hours)
Theoretical aspects of neutron diffusion and transport related to the design computation and performance analysis of nuclear reactors. Principal topics: a unified view of the neutron cycle including slowing down, resonance capture and thermalization; reactor dynamics and control; fuel cycle studies; and neutron transport methods. Background provided for research in power and test reactor analysis.
Prerequisite: NE 723, NE 727
Typically offered in Spring only

NE 757 Radiation Effects On Materials  (3 credit hours)
Interaction of radiation with matter with emphasis on microstructural modification, physical and mechanical effects. Defects generation and annealing, void swelling, irradiation growth and creep, and irradiation induced effects in reactor materials are discussed. Current theories and experimental techniques are discussed.
Typically offered in Spring only

NE 761 Radiation Detection  (3 credit hours)
Advanced aspects of radiation detection such as computer methods applied to gamma-ray spectroscopy, absolute detector efficiencies by experimental and Monte Carlo techniques, the use and theory of solid state detectors, time-of-flight detection experiments and M’ssbauer and other resonance phenomena.
Prerequisite: NE 726
Typically offered in Fall only

NE 762 Radioisotope Applications  (3 credit hours)
Presentation of advanced principles and techniques of radioisotope applications. Topics include radiotracer principles; radiotracer applications to engineering processes; radioisotope gauging principles; charged particle, gamma ray and neutron radioisotope gauges.
Prerequisite: NE 726
Typically offered in Fall only

NE 770 Nuclear Radiation Attenuation  (3 credit hours)
Advanced course in computational methods for neutron and photon transport. Methods include Monte Carlo and deterministic solutions to the transport equation for both fixed source and eigenvalue problems. Digital computers employed in the solution of problems.
Prerequisite: NE 723 or equivalent
Typically offered in Fall only

NE 772/CE 772 Environmental Exposure and Risk Analysis  (3 credit hours)
Course covers the identification, transport, and fate of hazardous substances in the environment; quantification of human exposures to such substances; dose-response analysis; and uncertainty and variability analysis. The general risk assessment framework, study design aspects for exposure assessment, and quantitative methods for estimating the consequences and probability of adverse health outcomes are emphasized.
Prerequisite: ST 511 or 515
Typically offered in Fall only

NE 780 Magnetohydrodynamics & Transport in Plasmas  (3 credit hours)
Advanced fluid description of plasmas for magnetic fusion, space and industrial plasmas, and other applications. Emphasis on a first principles approach to transport, equilibria, and stability.
Prerequisite: NE 528, NE/PY 414 and 415
Typically offered in Fall only

NE 781 Kinetic Theory, Waves, & Non-Linear Effects in Plasmas  (3 credit hours)
Kinetic theory, waves, and non-linear phenomena in magnetized plasmas. First principles approach to the treatment of instabilities and other collective effects.
Prerequisite: NE 528, NE/PY 414 and 415, Corequisite: MA 775
Typically offered in Fall only

NE 795 Advanced Topics In Nuclear Engineering I  (1-3 credit hours)
A study of recent developments in nuclear engineering theory and practice.
Typically offered in Fall and Spring

NE 796 Advanced Topics In Nuclear Engineering II  (3 credit hours)
A study of recent developments in nuclear engineering theory and practice.
Typically offered in Fall and Spring

NE 801 Seminar  (1 credit hours)
Discussion of selected topics in nuclear engineering.
Typically offered in Fall and Spring

NE 885 Doctoral Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

NE 890 Doctoral Preliminary Examination  (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Fall and Spring
NE 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

NE 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

NE 896 Summer Dissertation Research (1 credit hour)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Summer only

NE 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

Nutrition (NTR)

NTR 210 Introduction to Community Food Security (3 credit hours)
This introductory interdisciplinary course teaches students about the many facets of food security in the United States, including historical impacts of race and social class on food security; food justice and food accessibility; the roles of non-profit organizations, government agencies, and disciplinary experts in developing food security efforts; and approaches to developing programs and policies, federal to local, to address the problem. In addition, service-learning experiences in students own communities allow them to gain knowledge about the specific agencies approaches to community food security, critically reflecting upon the experience and creating their own community food security action plan.
GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Summer only

NTR 220 Food and Culture (3 credit hours)
This course explores traditional food cultures around the world; highlighting foodways, flavor profiles, and commonly used ingredients. This course focuses on how and to what extent traditional foodways of US immigrants are impacted by the majority culture and how regional cuisines have been impacted by historical migration patterns. Students will examine their own food culture, biases, and how these impact personal interactions with others through a semester-long project. Food tastings and sensory experiences will expose students to a variety of global and US regional cuisines allowing students to compare and contrast flavor profiles and commonly used ingredients. Course is available to all majors.
GEP Global Knowledge
Typically offered in Summer only

NTR 301/FS 301 Introduction to Human Nutrition (3 credit hours)
Functions, dietary sources, digestion and absorption, deficiencies and excesses of essential nutrients in humans; dietary guidelines; food labels; the study of diet-disease relationships; the role of diet in heart disease, diabetes, hypertension, osteoporosis; energy balance and weight control; dietary supplement regulation; diet and athletic performance.
Prerequisite: Sophomore standing
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

NTR 302 Introduction to Nutrition Research, Communication, and Careers (3 credit hours)
This course exposes students to scientific literature, communication, and careers in the field of nutrition. Students will learn how to critically evaluate scientific literature and communicate that information both orally and in writing. Course topics include: research design, nutritional epidemiology, statistics, scientific writing, professionalism, and current nutrition-related "hot topics." Class time will be a combination of lecture and small or large group discussions and individual or group in-class assignments. Student evaluations include in-class assignments, writing assignments, oral presentations, and exams.
Prerequisite: NTR 301
Typically offered in Fall and Summer

NTR 320 Nutrition Education (3 credit hours)
This course exposes students to the principles behind the development, implementation, and evaluation of nutrition education programs in the United States. Course topics will cover behavior change models, educational pedagogies, nutrition needs assessments, curricular and tool development, social marketing, and social media and technology related to nutrition education. The course is a flipped-course design with course content posted online through pre-recorded lectures and reading assignments. In-class lecture time will be reserved for class discussion and in-class assignments. Student evaluations include exams, in-class assignments, and a term paper.
Prerequisite: NTR 301
Typically offered in Fall only

NTR 330 Public Health Nutrition (3 credit hours)
Students will explore factors that affect the health and nutrition of the population as well as how those factors are identified, studied, and applied to improve health issues. Students will identify services and programs available to address nutrition and health issues. Students will analyze current events related to public health, evaluate nutrition related policy, and advocate for issues related to nutrition.
Typically offered in Fall and Summer

NTR 401/FS 401/NTR 501/FS 501 Advanced Nutrition and Metabolism (3 credit hours)
Nutritional biochemistry and physiology as it relates to establishment of nutrient requirements and Dietary Reference Intakes. Digestion, absorption, metabolism, storage, and excretion of nutrients and other markers of nutritional adequacy or excess with emphasis on micronutrients. Functions of nutrients, in bone muscle, blood, growth and development and communication. Credit will not be awarded for both NTR (FS) 401 and NTR (FS) 501.
Prerequisite: (NTR 301 or NTR 415) and (CH 221 or CH 220 or CH 225)
Typically offered in Fall and Summer
NTR 410/NTR 510 Maternal and Infant Nutrition (3 credit hours)
Students will explore the current research, controversies, and biological mechanisms related to nutrition for women before, during, and after pregnancy, as well as for infants in utero and after birth.
Prerequisite: NTR 301
Typically offered in Fall and Summer

NTR 415/PO 415/PO 515/NTR 515/ANS 515/ANS 415 Comparative Nutrition (3 credit hours)
Principles of nutrition, including the classification of nutrients and the nutrient requirements of and metabolism by different species for health, growth, maintenance and productive functions.
Prerequisite: ANS 225 or ANS 230 or CH 220 or CH 223 or CH 227
Typically offered in Fall, Spring, and Summer

NTR 419 Human Nutrition and Chronic Disease (3 credit hours)
Current concepts regarding, and physiological bases of the roles of nutrition in the prevention and treatment of acute and chronic disease states in humans with emphasis on the process of scientific discovery, reading of original research and transformation of research findings to public policy.
Prerequisite: Junior standing, ANS 230, or ANS/FS/NTR 301 or ANS/ NTR/PO 415
Typically offered in Spring only

NTR 420 Applied Nutrition Education (3 credit hours)
In this service-learning course, students will develop nutrition education, lesson planning, conflict management, and knife safety skills through implementation of a nutrition education course in a community-based setting. Students will team-teach the nutrition education course at an established community partner location, gaining experience collaborating with nonprofit organizations to teach the clients they serve. Through critical reflection assignments and discussions, students will set goals to improve teaching, honing nutrition education and communication skills. Students are expected to provide their own transportation to community partner locations in the greater Raleigh area. Junior standing, NTR 301 and NTR 320 prerequisites.
Prerequisites: NTR 301 and NTR 320, and junior standing or greater required
Typically offered in Spring only

NTR 421/NTR 521 Life Cycle Nutrition (3 credit hours)
This course focuses on the physiologic changes and nutritional needs throughout the life cycle. Additionally, students will explore psychosocial and environmental influencers on food consumption and diet quality at each stage of life. Pregnancy and lactation, fetal development, infancy, early childhood, childhood, adolescence, young and middle adulthood, and geriatrics will be examined. Student will apply course content to real-world settings through individual and/or group service-learning projects. Credit will not be given for both NTR 421 and NTR 521.
Prerequisite: NTR 301 and junior standing required
Typically offered in Spring only

NTR 425/ANS 425/FM 425/PO 425/NTR 525/FM 525/ANS 525/ PO 525 Feed Manufacturing Technology (3 credit hours)
Feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture.
Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225
Typically offered in Fall, Spring, and Summer

NTR 454/ANS 554/ANS 454 Lactation, Milk and Nutrition (3 credit hours)
Nutritional properties of milk as a high-quality food with nutritional diversity. Principles of physiology, biochemistry and cell biology in the mammary gland. Procedures of milk production and milk collection for milk quality and nutrition. Human lactation vs. that of domestic animals. Impacts of biotechnology and food safety on dairy production. Credit will not be given for both ANS 454 and 554.
Prerequisite: ANS 230 or FS/NTR 400; BCH 451 or ZO 421
Typically offered in Spring only

NTR 490 Senior Capstone Experience in Nutrition (4 credit hours)
In this capstone course, students will work in groups to complete research and service projects for community partners while gaining professional experiences in nutrition. Students will be expected to apply their knowledge and skills gained throughout their nutrition coursework to develop solutions to problems in public health and community nutrition. Students will complete comprehensive written and poster presentations about their work as a group, in addition to individual reflection(s) about their learnings. Students must provide their own transportation when visiting their community partner site. Students should complete this course in the last semester (or year) of their degree. NTS and NTA Majors only; Senior status required.
Prerequisite: NTR 301, NTR 302, and NTR 401; Nutrition Science majors only; Senior status required
Typically offered in Fall and Spring

NTR 492 Professional Internship Experience in Nutrition Science (1-3 credit hours)
This course provides an opportunity for students to gain real-world experience relevant to their academic and career goals. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience. The experience must be arranged by the student and approved by the Undergraduate Teaching Coordinator for Nutrition prior to the start of the experience. To gain approval, a student must submit the completed NTR 492 contract and have it approved by his/her experience supervisor, academic advisor and the undergraduate teaching coordinator/course instructor. In addition to the work described in the contract, a student will complete a series of reflective assignments during and at the end of the experience.
Typically offered in Fall, Spring, and Summer
NTR 493 Research Experience in Nutrition Science (1-3 credit hours)
This course provides an opportunity for students to gain real-world experience in a scientific research program. A minimum of 42 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience. The experience must be arranged by the student and approved by the Undergraduate Teaching Coordinator for Nutrition prior to the start of the experience. To gain approval, a student must submit the completed NTR 493 contract and have it approved by his/her research supervisor, academic advisor and the NTR 493 coordinator. In addition to the work described in the contract, a student will complete a series of reflective assignments during and at the end of the experience.

Typically offered in Fall, Spring, and Summer

NTR 494 Teaching Experience in Nutrition Science (1-3 credit hours)
This course provides an opportunity for students to gain teaching experience relevant to their academic and career goals. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience. The experience must be arranged by the student and approved by the Undergraduate Teaching Coordinator for Nutrition prior to the start of the experience. To gain approval, a student must submit the completed NTR 494 contract and have it approved by his/her experience supervisor, academic advisor and the undergraduate teaching coordinator/course instructor. In addition to the work described in the contract, a student will complete a series of reflective assignments during and at the end of the experience.

Typically offered in Fall, Spring, and Summer

NTR 495 Special Topics in Nutrition (1-6 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

NTR 500 Principles of Human Nutrition (3 credit hours)
Overview of fields of Nutritional Sciences; functions of nutrients in the human body; sources and properties of nutrients; relationships of food industry practices to nutrition. Credit will not be given for both NTR (FS)400 and NTR 500

Prerequisite: CH 220 and (CH 221 or CH 223) and (ZO 160 or BIO 181/183)

Typically offered in Fall and Summer

NTR 501/FS 501/NTR 401/FS 401 Advanced Nutrition and Metabolism (3 credit hours)
Nutritional biochemistry and physiology as it relates to establishment of nutrient requirements and Dietary Reference Intakes. Digestion, absorption, metabolism, storage, and excretion of nutrients and other markers of nutritional adequacy or excess with emphasis on micronutrients. Functions of nutrients, in bone muscle, blood, growth and development and communication. Credit will not be awarded for both NTR (FS) 401 and NTR (FS) 501.

Prerequisite: (NTR 301 or NTR 415) and (CH 221 or CH 220 or CH 225)

Typically offered in Fall and Summer

NTR 510/NTR 410 Maternal and Infant Nutrition (3 credit hours)
Students will explore the current research, controversies, and biological mechanisms related to nutrition for women before, during, and after pregnancy, as well as for infants in utero and after birth.

Prerequisite: NTR 301

Typically offered in Spring and Summer

NTR 515/ANS 515/ANS 415/NTR 415/PO 415/PO 515 Comparative Nutrition (3 credit hours)
Principles of nutrition, including the classification of nutrients and the nutrient requirements of and metabolism by different species for health, growth, maintenance and productive functions.

Prerequisite: ANS 225 or ANS 230 or CH 220 or CH 223 or CH 227

Typically offered in Fall, Spring, and Summer

NTR 521/NTR 421 Life Cycle Nutrition (3 credit hours)
This course focuses on the physiologic changes and nutritional needs throughout the life cycle. Additionally, students will explore psychosocial and environmental influencers on food consumption and diet quality at each stage of life. Pregnancy and lactation, fetal development, infancy, early childhood, childhood, adolescence, young and middle adulthood, and geriatrics will be examined. Student will apply course content to real-world settings through individual and/or group service-learning projects. Credit will not be given for both NTR 421 and NTR 521.

Prerequisite: NTR 301 and junior standing required

Typically offered in Spring only

NTR 525/FM 525/ANS 525/PO 525/NTR 425/ANS 425/FM 425/PO 425 Feed Manufacturing Technology (3 credit hours)
Feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture.

Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225

Typically offered in Fall and Spring

NTR 550/ANS 550 Applied Ruminant Nutrition (3 credit hours)
Applied concepts in ruminant nutrition for the practicing agricultural professional. Protein, energy, vitamin and mineral nutrition in relation to the nutritional needs and practical feeding of beef cattle, dairy cattle, sheep, and goats. New developments in feeding systems, feed additives and the prevention and treatment of metabolic disorders. Emphasis on solving problems in case studies. Permission given to undergraduates

Prerequisite: ANS 230 or ANS(NTR,PO) 415. Permission given to undergraduates

Typically offered in Fall only

NTR 554/FS 554 Lactation, Milk, and Nutrition (3 credit hours)
Nutritional properties of milk as a high-quality food with nutritional diversity. Principles of physiology, biochemistry and cell biology in the mammary gland. Procedures of milk production and milk collection for milk quality and nutrition. Human lactation vs. that of domestic animals. Impacts of biotechnology and food safety on dairy production. Credit will not be given for both ANS 454 and 554.

Prerequisite: ANS 230 or FS/NTR 400; BCH 451 or ZO 421

Typically offered in Spring only
NTR 555/FS 555 Exercise Nutrition  (3 credit hours)
Metabolism of macro- and micronutrients as affected by exercise and physical activity. Effects of dietary patterns, specific foods, dietary supplements and ergogenic aids on sports performance. Reading and discussion of current literature and individual or group projects.

Prerequisite: NTR 400/500
Typically offered in Spring only

NTR 557/FS 557 Nutraceuticals and Functional Foods  (3 credit hours)
This course evaluates the weight of evidence from peer-reviewed scientific literature relating food bioactives, whole foods, and diets to disease prevention, athletic performance, and cognitive development/ enhancement. Data are viewed in the context of processing effects, global food and supplement regulations, as well as commercial marketing claims. Key concepts include dose-response, signal transduction, and the use of advanced technologies such as genomics, proteomics and metabolomics. Students will work in teams to develop and write a critical review manuscript suitable for publication.

Typically offered in Fall only

NTR 561/ANS 561 Equine Nutrition  (3 credit hours)
This course explores concepts in equine nutrition including digestive physiology of horses, nutrient requirements for different classes of horses and feed management. Ration evaluation and balancing, as well as problem solving will be a core component to this course.

Prerequisite:NTR 500 or NTR/FS 501 or NTR/PO 515
Typically offered in Spring only

NTR 565/ANS 565 Advanced Canine and Feline Nutrition  (3 credit hours)
This course is about the advanced principles of nutrition within canines and felines. The course focuses on the unique gastro- intestinal tracts for the two species as well as their specific nutrient requirements and how the animal industry addresses th

Restriction: Graduate Student or Senior with 3.35 GPA; Prerequisite: 400-level Nutrition Course
Typically offered in Fall only

NTR 594 Special Topics in Nutrition  (1-6 credit hours)
The study of special problems and selected topics of current interest in nutrition and related fields.

Typically offered in Fall, Spring, and Summer

NTR 601 Master’s Seminar  (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

NTR 624 Topical Problems In Nutrition  (1-6 credit hours)
Analysis of current problems in nutrition. Also entails the scientific appraisal and solution of a selected problem designed to provide training and experience in research.

Prerequisite: Graduate standing or Senior standing
Typically offered in Fall, Spring, and Summer

NTR 625 Advanced Special Problems In Nutrition  (1-6 credit hours)
Directed research in a specialized phase of nutrition designed to provide experience in research methodology and philosophy.

Prerequisite: Graduate standing
Typically offered in Spring only

NTR 685 Master’s Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master’s student
Typically offered in Fall and Spring

NTR 690 Advanced Special Problems In Nutrition  (1-6 credit hours)
Directed research in a specialized phase of nutrition designed to provide experience in research methodology and philosophy.

Prerequisite: Graduate standing
Typically offered in Fall only

NTR 693 Master’s Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

NTR 695 Master’s Thesis Research  (1-9 credit hours)
Thesis research

Prerequisite: Master’s student
Typically offered in Fall, Spring, and Summer

NTR 696 Summer Thesis Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master’s student
Typically offered in Summer only

NTR 699 Research In Nutrition  (1-9 credit hours)
Original research preparatory to the thesis for Master of Science or Doctor of Philosophy degree.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

NTR 701/ANS 701 Protein and Amino Acid Metabolism  (3 credit hours)
Study of protein and amino acid metabolism, regulation, dietary requirements and techniques for their investigation in human and other animals.

Prerequisite: BCH 453, ZO 421, a 400-level nutrition course
Typically offered in Spring only
NTR 706/FM 706  
**Vitamin Metabolism**  
(3 credit hours)

Structures, chemical and physical properties, functions, distribution, absorption, transport, metabolism, storage, excretion, deficiencies, and toxicity of vitamins in humans and domestic animals. Interactions between vitamins and other factors affecting vitamin metabolism or bioavailability as well as the nutritional significance of essential fatty acids and metabolism of prostaglandins, prostacyclins and leukotrienes. Application of knowledge will include critical review of scientific literature, experimental design, and formulation of vitamin supplements.

Prerequisite: ANS(NTR,PO) 415 and BCH 453  
Typically offered in Fall only

NTR 708  
**Energy Metabolism**  
(3 credit hours)

Relationship of biochemical and physiological events within the cell, tissue, organ and system with the nutrient needs as sources of energy for productive animal life. Digestion, absorption and metabolism of energy sources. Presentation of processes of energy transformations within living structures in relation to energetics, biological oxidations, coupled reactions, anabolic and catabolic systems, metabolic control, partitioning and efficiency.

Prerequisite: BCH 453 and an introductory NTR course  
Typically offered in Fall only

NTR 764/PHY 764/CBS 764  
**Advances in Gastrointestinal Pathophysiology**  
(3 credit hours)

This course will focus on advanced gastrointestinal physiology and the pathophysiology of diseases of relevance to scientists involved in animal-related research. In particular, the course will cover the pathophysiology of ulceration, infectious diarrhea, ischemia, motility disorders, and inflammatory diseases of the gut. An in-depth review paper will be required based on recent literature regarding a specific gastrointestinal disease.

Prerequisite: PHY 503, PHY 504  
Typically offered in Fall only

NTR 775/PO 775  
**Mineral Metabolism**  
(3 credit hours)

Requirements, function, distribution, absorption, excretion and toxicity of minerals in humans and domestic animals. Interactions between minerals and other factors affecting mineral metabolism or availability. Emphasis on mechanisms associated with mineral functions and the metabolic bases for the development of signs of deficiency.

Prerequisite: ANS(NTR,PO) 415, BCH 451 and ZO 421  
Typically offered in Fall only

NTR 785  
**Digestion and Metabolism in Ruminants**  
(3 credit hours)

Advanced concepts in ruminant digestion and metabolism, with emphasis on bovine, ovine, and caprine species. Major topics include voluntary intake, ruminal fermentation, mechanisms and rates of digestion, absorption and passage of dietary components, and postabsorptive metabolism of carbohydrates, lipids, and proteins. New developments in feeding systems, feed additives and the prevention and treatment of metabolic disorders.

Prerequisite: Graduate standing  
Typically offered in Spring only

NTR 790/FM 790  
**Advanced Feed Formulation**  
(3 credit hours)

Principles of feed and ingredient quality assurance and how to develop a comprehensive quality assurance program. The course will include the development of an approved supplier list, ingredient specifications, feed manufacturing quality assurance procedures, and risk based feed safety programs.

Prerequisite: NTR(FM) 525  
Typically offered in Fall only

NTR 794  
**Special Topics in Nutrition**  
(1-6 credit hours)

The study of special problems and selected topics of current interest in nutrition and related fields.

Typically offered in Fall, Spring, and Summer

NTR 801  
**Doctoral Seminar**  
(1 credit hours)

Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

NTR 824  
**Topical Problems in Nutrition**  
(1-6 credit hours)

Analysis of current problems in nutrition. Also entails the scientific appraisal and solution of a selected problem designed to provide training and experience in research.

Prerequisite: Graduate standing or Senior standing  
Typically offered in Fall, Spring, and Summer

NTR 825  
**Advanced Special Problems in Nutrition**  
(1-6 credit hours)

Directed research in a specialized phase of nutrition designed to provide experience in research methodology and philosophy.

Prerequisite: Graduate standing  
Typically offered in Fall only

NTR 885  
**Doctoral Supervised Teaching**  
(1-3 credit hours)

Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student  
Typically offered in Fall and Spring

NTR 890  
**Doctoral Preliminary Examination**  
(1-9 credit hours)

For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student  
Typically offered in Fall, Spring, and Summer

NTR 893  
**Doctoral Dissertation Research**  
(1-9 credit hours)

Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student  
Typically offered in Fall, Spring, and Summer

NTR 895  
**Doctoral Dissertation Research**  
(1-9 credit hours)

Dissertation research.

Prerequisite: Doctoral student  
Typically offered in Fall, Spring, and Summer
NTR 896  Summer Dissertation Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Summer only

NTR 899  Doctoral Dissertation Preparation  (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Operations Research (OR)

OR 433/OR 533/ISE 433/ISE 533  Service Systems Engineering  (3 credit hours)
This course intends to provide a comprehensive treatment on the use of quantitative modeling for decision making and best practices in the service industries. The goal of this class is to teach students to be able to identify, understand, and analyze services; and acquire the quantitative skills necessary to model key decisions and performance metrics associated with services. Students will be exposed both to classical and contemporary examples of challenges and opportunities that arise when working in the service sector.
Prerequisite: ISE 361
Typically offered in Spring only

OR 501/ISE 501  Introduction to Operations Research  (3 credit hours)
OR Approach: modeling, constraints, objective and criterion. Problems of multiple criteria, optimization, model validation and systems design. OR Methodology: mathematical programming; optimum seeking; simulation; gaming; heuristic programming. Examples, OR Applications: theory of inventory; economic ordering under deterministic and stochastic demand. Production smoothing problem; linear and quadratic cost functions. Waiting line problems: single and multiple servers with Poisson input and output. Theory of games for two-person competitive situations. Project management through PERT-CPM.
Prerequisite: MA 421 or ST 421 or ST 371 and ST 372
Typically offered in Fall and Spring

OR 504/MA 504  Introduction to Mathematical Programming  (3 credit hours)
Basic concepts of linear, nonlinear and dynamic programming theory. Not for majors in OR at Ph.D. level.
Prerequisite: MA 242, MA 405
Typically offered in Fall only

OR 505/ISE 505/MA 505  Linear Programming  (3 credit hours)
Introduction including: applications to economics and engineering; the simplex and interior-point methods; parametric programming and post-optimality analysis; duality matrix games, linear systems solvability theory and linear systems duality theory; polyhedral sets and cones, including their convexity and separation properties and dual representations; equilibrium prices, Lagrange multipliers, subgradients and sensitivity analysis.
Prerequisite: MA 405
Typically offered in Fall only

OR 506  Algorithmic Methods in Nonlinear Programming  (3 credit hours)
Prerequisite: MA 301, MA 405, knowledge of computer language, such as FORTRAN or PL1
Typically offered in Fall only
OR 531/MA 531/E 531 Dynamic Systems and Multivariable Control I (3 credit hours)
Introduction to modeling, analysis and control of linear discrete-time and continuous-time dynamical systems. State space representations and transfer methods. Controllability and observability. Realization. Applications to biological, chemical, economic, electrical, mechanical and sociological systems.
Prerequisite: MA 341, MA 405
Typically offered in Fall only

OR 533/ISE 433/ISE 533/OR 433 Service Systems Engineering (3 credit hours)
This course intends to provide a comprehensive treatment on the use of quantitative modeling for decision making and best practices in the service industries. The goal of this class is to teach students to be able to identify, understand, and analyze services; and acquire the quantitative skills necessary to model key decisions and performance metrics associated with services. Students will be exposed both to classical and contemporary examples of challenges and opportunities that arise when working in the service sector.
Prerequisite: ISE 361
Typically offered in Spring only

OR 537/CE 537 Computer Methods and Applications (3 credit hours)
Computational approaches to support civil planning, analysis, evaluation and design. Applications to various areas of civil engineering, including construction, structures, transportation and water resources.
Prerequisite: CSC 112 and (MA 341 or MA 305)
Typically offered in Fall only

OR 560/ISE 560 Stochastic Models in Industrial Engineering (3 credit hours)
ISE/OR 560 will introduce mathematical modeling, analysis, and solution procedures applicable to uncertain (stochastic) production and service systems. Methodologies covered include probability theory and stochastic processes including discrete and continuous Markov processes. Applications relate to design and analysis of problems, capacity planning, inventory control, waiting lines, and service systems.
Typically offered in Fall only

OR 562/ISE 562/TE 562 Simulation Modeling (3 credit hours)
This course concentrates on design, construction, and use of discrete/continuous simulation object-based models employing the SIMIO software, with application to manufacturing, service, and healthcare. The focus is on methods for modeling and analyzing complex problems using simulation objects. Analysis includes data-based modeling, process design, input modeling, output analysis, and the use of 3D animation with other graphical displays. Object-oriented modeling is used to extend models and enhance re-usability.
Typically offered in Spring only

OR 565/CSC 565/MA 565 Graph Theory (3 credit hours)
Prerequisite: CSC 226 or MA 351.
Typically offered in Spring only

OR 579/CSC 579/ECE 579 Introduction to Computer Performance Modeling (3 credit hours)
Workload characterization, collection and analysis of performance data, instrumentation, tuning, analytic models including queuing network models and operational analysis, economic considerations.
Prerequisite: CSC 312 or ECE 206 and MA 421
Typically offered in Fall and Spring

OR 591 Special Topics in Operations Research (1-6 credit hours)
Individual or small group studies of special areas of OR which fit into students' programs of study and which may not be covered by other OR courses. Furthermore, course serves as a vehicle for introducing new or specialized topics at introductory graduate level.
Typically offered in Fall, Spring, and Summer

OR 601 Seminar in Operations Research (1 credit hour)
Seminar discussion of operations research problems. Case analyses and reports. Graduate students with minors or majors in operations research expected to attend throughout period of their residence.
Prerequisite: OR Major or OR Minor
Typically offered in Fall and Spring

OR 610 Special Topics in Operations Research (1-6 credit hours)
Individual or small group studies of special areas of OR which fit into students' programs of study and which may not be covered by other OR courses. Furthermore, course serves as a vehicle for introducing new or specialized topics at introductory graduate level.
Typically offered in Fall, Spring, and Summer

OR 652 Practicum in Operations Research (1-3 credit hours)
Practicum in problem solving in industry applying applicable OR methodologies. Practical experience in diagnosing and solving problems in operational systems at either an industrial site or at NC State.
Prerequisite: OR 501, OR 505, OR 709 and OR 761
Typically offered in Spring and Summer

OR 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

OR 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.
Prerequisite: Master's student
Typically offered in Spring only
OR 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.
Prerequisite: Master's student
Typically offered in Spring only

OR 690 Master's Examination (1-9 credit hours)
For students in non-thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

OR 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall and Spring

OR 695 Master's Thesis Research (1-9 credit hours)
Thesis research.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

OR 696 Summer Thesis Research (1 credit hour)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master's student
Typically offered in Summer only

OR 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

OR 705 Large-Scale Linear Programming Systems (3 credit hours)
Specialized algorithms for efficient solution of large-scale LP problems. Parametric programming, bounded variable algorithms, generalized upper bounding, decomposition, matrix factorization and sparse matrix techniques. Emphasis on gaining firsthand practical experience with current computer codes and computational procedures.
Prerequisite: OR 505 and FORTRAN programming experience
Typically offered in Spring only

OR 706/ST 706/MA 706 Nonlinear Programming (3 credit hours)
An advanced mathematical treatment of analytical and algorithmic aspects of finite dimensional nonlinear programming. Including an examination of structure and effectiveness of computational methods for unconstrained and constrained minimization. Special
Prerequisite: OR(IE,MA) 505 and MA 425
Typically offered in Spring only

OR 708/ISE 708/MA 708 Integer Programming (3 credit hours)
General integer programming problems and principal methods of solving them. Emphasis on intuitive presentation of ideas underlying various algorithms rather than detailed description of computer codes. Students have some "hands on" computing experience
Prerequisite: MA 405, OR (MA,IE) 505, Corequisite: Some familiarity with computers (e.g., CSC 112)
Typically offered in Spring only

OR 709/ISE 709 Dynamic Programming (3 credit hours)
Introduction to theory and computational aspects of dynamic programming and its application to sequential decision problems.
Prerequisite: MA 405, ST 421
Typically offered in Spring only

OR 719/MA 719 Vector Space Methods in System Optimization (3 credit hours)
Introduction to algebraic and function-analytic concepts used in system modeling and optimization: vector space, linear mappings, spectral decomposition, adjoints, orthogonal projection, quality, fixed points and differentials. Emphasis on geometric insight. Topics include least square optimization of linear systems, minimum norm problems in Banach space, linearization in Hilbert space, iterative solution of system equations and optimization problems. Broad range of applications in operations research and system engineering including control theory, mathematical programming, econometrics, statistical estimation, circuit theory and numerical analysis.
Prerequisite: MA 405, 511
Typically offered in Fall only

OR 731/E 731/MA 731 Dynamic Systems and Multivariable Control II (3 credit hours)
Prerequisite: OR(E,MA) 531
Typically offered in Spring only

OR 747/ISE 747 Reliability Engineering (3 credit hours)
Introduction to basic concepts of reliability engineering. Application of probability and statistics to estimate reliability of industrial systems; development of reliability measures; analysis of static and dynamic reliability models; development and a
Prerequisite: ST 511
Typically offered in Fall only

OR 760/ISE 760 Applied Stochastic Models in Industrial Engineering (3 credit hours)
Formulation and analysis of stochastic models with particular emphasis on applications in industrial engineering; univariate, multivariate and conditional probability distributions; unconditional and conditional expectations; elements of stochastic processes; moment-generating functions; concepts of stochastic convergence; limit theorems; homogeneous, nonhomogeneous and compound Poisson processes; basic renewal theory; transient and steady-state properties of Markov processes in discrete and continuous time.
Prerequisite: MA 303, ST 371
Typically offered in Fall only
OR 761/ISE 761 **Queues and Stochastic Service Systems** (3 credit hours)
Introduction of general concepts of stochastic processes. Poisson processes, Markov processes and renewal theory. Usage of these in analysis of queues, from with a completely memoryless queue to one with general parameters. Applications to many engineering problems.

*Typically offered in Spring only*

**OR 762/ISE 762/CSC 762 Computer Simulation Techniques** (3 credit hours)
Basic discrete event simulation methodology: random number generators, simulation designs, validation, analysis of simulation output. Applications to various areas of scientific modeling. Simulation language such as SLAM and GPSS. Computer assignments and projects.

Prerequisite: ST 512 and a scientific programming language

*Typically offered in Fall only*

**OR 766/ISE 766/MA 766 Network Flows** (3 credit hours)
Study of problems of flows in networks. These problems include the determination of shortest chain, maximal flow and minimal cost flow in networks. Relationship between network flows and linear programming developed as well as problems with nonlinear cost functions, multi-commodity flows and problem of network synthesis.

Prerequisite: OR(IE,MA) 505

*Typically offered in Spring only*

**OR 772/ISE 772 Stochastic Simulation Design and Analysis** (3 credit hours)
Advanced topics in stochastic system simulation, including random variate generation, output estimation for stationary and non-stationary models, performance optimization techniques, variance reduction approaches. Student application of these techniques to actual simulations. A current topic research paper required.

Prerequisite: (CSC,ECE,IE,OR) 762 and ST 516

*Typically offered in Spring only*

**OR 773/ST 773/BMA 773/MA 773 Stochastic Modeling** (3 credit hours)

Prerequisite: BMA 772 or ST (MA) 746

*Typically offered in Spring only*

**OR 774/MA 774/BMA 774 Partial Differential Equation Modeling in Biology** (3 credit hours)

Prerequisite: BMA 771 or MA/OR 731; BMA 772 or MA 401 or MA 501

*Typically offered in Spring only*

**OR 791 Advanced Special Topics** (1-6 credit hours)

*Typically offered in Fall and Spring*

**OR 801 Seminar in Operations Research** (1 credit hours)
Seminar discussion of operations research problems. Case analyses and reports. Graduate students with minors or majors in operations research expected to attend throughout period of their residence.

Prerequisite: OR Major or OR Minor

*Typically offered in Fall and Spring*

**OR 810 Special Topics in Operations Research** (1-6 credit hours)
Individual or small group studies of special areas of OR which fit into students' programs of study and which may not be covered by other OR courses. Furthermore, course serves as a vehicle for introducing new or specialized topics at introductory graduate level.

*Typically offered in Fall, Spring, and Summer*

**OR 852 Practicum in Operations Research** (1-3 credit hours)
Practicum in problem solving in industry applying applicable OR methodologies. Practical experience in diagnosing and solving problems in operational systems at either an industrial site or at NC State.

Prerequisite: OR 501, OR 505, OR 709 and OR 761

*Typically offered in Summer only*

**OR 885 Doctoral Supervised Teaching** (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student

*Typically offered in Fall, Spring, and Summer*

**OR 890 Doctoral Preliminary Examination** (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student

*Typically offered in Fall, Spring, and Summer*

**OR 893 Doctoral Supervised Research** (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student

*Typically offered in Fall and Spring*

**OR 895 Doctoral Dissertation Research** (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student

*Typically offered in Fall, Spring, and Summer*

**OR 896 Summer Dissertation Research** (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student

*Typically offered in Summer only*

**OR 899 Doctoral Dissertation Preparation** (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student

*Typically offered in Fall, Spring, and Summer*
Paper Science Engineering (PSE)

**PSE 201 Pulping and Papermaking Technology** (3 credit hours)
Survey of the pulping and papermaking processes. Covers characteristics of wood and different types of fiber, key equipment and process variables for pulping, bleaching and chemical recovery processes, with emphasis on the kraft process. Papermaking variables and equipment, particularly on a Fourdrinier machine, secondary fiber processing, and aspects of printing and converting discussed.

Typically offered in Spring only

**PSE 211 Pulp and Paper Internship** (1 credit hours)
Experience in the pulp and paper industry. Problem solving in an industrial setting to gain insight of pulp and paper technology. Written report required. Engineering ethics discussed in light of the work experience.

Prerequisite: PSE 201
Typically offered in Fall only

**PSE 212 Paper Properties** (4 credit hours)
Measurement and characterization of the structural, mechanical, and optical properties of paper and board. Effect of raw materials and manufacturing processes on structure and properties. Basic concepts of paper physics.

Prerequisite: PSE 201
Typically offered in Fall only

**PSE 220 From Papyrus to Plasma Screens: Paper and Society** (2 credit hours)
The impact of paper and paper products on society, examined from the broad interdisciplinary perspectives of technology/engineering and sociology/communication. How the written word and printing affected human development and history. How paper products affect people with regard to communication, education, commerce, and comfort/hygiene. The history and development of paper making and the paper industry. Important properties of paper. Basic types of paper products, how they are manufactured, and their impacts The environmental impacts of paper and the paper industry. Current issues involving the paper industry.

**GEP Interdisciplinary Perspectives**
Typically offered in Spring only

**PSE 293 Independent Study in Paper Science & Engineering** (1-6 credit hours)
Independent Study for Paper Science & Engineering students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled i

Typically offered in Fall, Spring, and Summer

**PSE 294 Independent Study in Paper Science & Engineering** (1-6 credit hours)
Independent Study for Paper Science & Engineering students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled

Typically offered in Fall, Spring, and Summer

**PSE 295 Special Topics in Paper Science & Engineering** (1-3 credit hours)
Special Topics in Paper Science & Engineering at the 200 level for offering courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

**PSE 322 Wet End and Polymer Chemistry** (4 credit hours)
Prepares students to solve problems related to chemical usage on paper machines. Subjects include water chemistry, paper machine operations, fibers, fillers, alum, sizing agents, polyelectrolytes, colloidal interactions, strength agents, dyes, strategies to optimize retention, dewatering strategies, strategies to achieve more uniform paper, strategies to improve production rates, recycling aqueous coatings, and wet-end chemical process control.

Prerequisite: PSE 212 and (CH 221 or CH 225) and (CH 222 or CH 226)
Typically offered in Fall only

**PSE 332 Wood and Pulping Chemistry** (3 credit hours)
Introduction to carbohydrate chemistry focusing on the structure and reactivity of wood polysaccharides, hemicelluloses and cellulose and on the chemical structure of lignins and wood extractives. Special emphasis on the chemical reaction of wood components occurring in pulping and bleaching processes.

Prerequisite: CH 221/225 and CH 222/226 and CH 223/227 and CH 224/228
Typically offered in Spring only

**PSE 335/CH 335 Principles of Green Chemistry** (4 credit hours)
Introduction to the topic of green chemistry as an emerging field; Identification of hazards and classes; overview of sources; alternative solvents and reagents; sustainability of chemical reactions; alternative chemical reactions and pathways; alternat

Prerequisite: Grade of C or better in CH 101/102, CH 201/202 (or equivalent general chemistry series), and CH 221/22 (or equivalent)
Typically offered in Fall only

**PSE 355 Pulp and Paper Unit Processes I** (3 credit hours)
Selected topics in chemical engineering as applied in the pulp and paper industry. Emphasis on computational practice.

Prerequisite: CHE 205
Typically offered in Fall only

**PSE 360 Pulp and Paper Unit Processes II** (3 credit hours)
Application of chemical engineering principles to the analysis of pulp and paper unit processes. Emphasis on practical problems in fluid dynamics, heat transfer, mass transfer and thermodynamics. Problem solution techniques include hand calculationand computer simulation tools.

Prerequisite: PSE 201, PSE 355 or CHE 311
Typically offered in Spring only

**PSE 370 Pulp and Paper Products and Markets** (3 credit hours)
Major product sectors for pulp and paper. Market outlook and analysis. Critical fiber, pulp, finished product requirements and properties. Special emphasis on packaging grades and emerging markets. Technology intelligence and techno-economic tools to identify and address challenges related to selected pulp and paper products. Laboratory session used for research and development of selected products.

Prerequisites: PSE 201 with a C- or better and PSE 212 with a C- or better
Typically offered in Spring only
PSE 371 Pulping Process Analysis (3 credit hours)
Preparation and evaluation of different types of wood pulp. A new wood raw material is selected each year with the purpose of studying and critically evaluating the principal pulping and bleaching variables.
Prerequisite: PSE 201
Typically offered in Spring only

PSE 415 Paper Industry Strategic Project Analysis (3 credit hours)
Design problems in process and project engineering are analyzed from strategic, economic, and business perspectives. Typical pulp and paper processes are computer modeled and analyzed with regard to feasibility and profitability. Specific capital projects are assessed for capital requirements, total installed cost, operating costs, payback, and cash flow. Traditional business concepts are presented, including: financial analysis; capital allocation; marketing and pricing theory; manufacturing work systems; management systems; leadership; what "good" looks like. Senior Standing.
Typically offered in Fall only

PSE 416 Process Design and Analysis (3 credit hours)
Design, management and analysis of technical projects. Emphasis on concepts and techniques used in economic analysis of projects. Use of computer simulation for process design and cost analyses. Team projects to analyze cost and operating feasibility of proposed major mill modification. Written and oral presentations required throughout the semester.
Prerequisite: PSE 415 and PSE 417
Typically offered in Spring only

PSE 417 Modeling & Simulation of Pulp & Paper Processes (3 credit hours)
Application of modeling and simulation techniques for the analysis of pulping and papermaking processes. Model development and computer simulation using existing models will allow analysis of process interactions and operating/economic feasibility of pulp and paper processes. Computer simulation will be used to solve problems in the pulp and paper industry.
Prerequisite: PSE 360
Typically offered in Fall only

PSE 425 Bioenergy & Biomaterials Engineering (3 credit hours)
This course acquaints students with the basic science, terminology, technology, economic concepts, and engineering concepts associated with the conversion of biomass into energy and materials. Topics include: biomass types and properties; biochemical platforms; thermochemical platforms; unit operations; the biorefinery; biocomposites. Some design content is included. Targeted to engineering students with a suitable background (PSE, CHE, BAE).
Prerequisite: For PSE Majors: (MAE 201 or CHE 316) and PSE 360; For CHE Majors: CHE 312 and CHE 316; For BAE Majors: MAE 201 and BAE 402
Typically offered in Fall only

PSE 465 Process Engineering (3 credit hours)
Advanced use of process engineering tools in process design, improvement and operation. Particular emphasis is placed on pulp and paper industry. Topics include basic statistics, Lean Six Sigma/DMAIC methodology, statistical software, measurement system analysis, process mapping/value stream mapping, statistical process and quality control, control charts, process capability analysis, hypothesis testing, design of experiments, Excel modeling, and big data analysis. An independent project is required, which can lead to Lean Six Sigma Yellow Belt trained status.
Prerequisite: Senior standing in PSE or SMT
Typically offered in Spring only

PSE 472 Paper Process Analysis (3 credit hours)
Product analysis, materials selection, process planning, manufacture of various types of paper using pilot plant equipment, finished product testing and comparison with standard products. Machine unit operations, materials flow balances, energy balances performed on operations. Team assignments with written and oral presentation of results.
Prerequisite: PSE 212, PSE 322, PSE 371
Typically offered in Fall only

PSE 475 Process Control in Pulp and Paper (3 credit hours)
Overview of the various aspects of control including process modeling, design of control loops and stability analysis in pulp and paper. Emphasis on distributed digital control (DDC), including hands-on programming and control loop development on a DDC computer.
Prerequisite: Senior standing in PSE or SMT
Typically offered in Fall only

PSE 476/FB 576 Environmental Life Cycle Analysis (3 credit hours)
Overview of the various aspects of conducting and interpreting an environmental life cycle analysis on a product or service. Students will learn how to construct a life cycle analysis goal and scope, inventory, assessment and interpretation. Skills in the critique and communication of a life cycle analysis will be developed. Includes an overview of the following life cycle stages: raw materials, energy, transportation, production, use, and end of life. Emphasis on systems thinking. Targeted for students in any science or engineering program. Credit not allowed for both PSE 476 and WPS 576.
Typically offered in Fall only

PSE 493 Independent Study in Paper Science & Engineering (1-6 credit hours)
Independent Study for Paper Science & Engineering students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard
Typically offered in Fall, Spring, and Summer

PSE 494 Independent Study in Paper Science & Engineering (1-6 credit hours)
Independent Study for Paper Science & Engineering students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard
Typically offered in Fall, Spring, and Summer
Park Scholars (PRK)

PRK 102  Topics in Scholarship, Leadership, and Service II  (0 credit hours)
Interdisciplinary seminar with distinguished speakers and community leaders. A one-two day, off-campus trip will develop student leadership skills through examination of leadership challenges facing North Carolina. Volunteer work with an off-campus service agency will build awareness of community needs and how to address those needs. Students may need to use public transportation, which is free to NC State students with their id, to perform required public service. Restricted to Park Scholars.

Prerequisite: PRK 101, restricted to Park Scholars
Typically offered in Spring only

PRK 202  Topics in Scholarship, Leadership and Service IV  (0 credit hours)
Interdisciplinary seminar includes speaker seminars and organizing Service Raleigh, a major spring service project. Planning begins for senior year enrichment activities. Students may need to use public transportation, which is free to NC State Students with their id, to perform required public service. Restricted to Park Scholars.

Prerequisite: PRK 201, restricted to Park Scholars
Typically offered in Spring only

PRK 302  Topics in Scholarship, Leadership, and Service VI  (0 credit hours)
Interdisciplinary seminar to develop leadership skills through a Leadership Academy, attendance at various speaker seminars and dinners, and through continued community volunteerism. The Leadership Academy is a half-day workshop in February and builds on the skills from the fall Leadership Academy. Students may need to use public transportation, which is free to NC State Students with their id, to perform required public service. Restricted to Park Scholars.

Prerequisite: PRK 301, restricted to Park Scholars
Typically offered in Spring only

PRK 402  Topics in Scholarship, Leadership and Service VIII  (0 credit hours)
Interdisciplinary seminar will promote understanding of scholarship, leadership, and service. Students hold a dinner with a William Friday Award recipient, establish their class legacy for the campus, and work with younger students on developing their leadership styles. Students continue to volunteer in the community. Students may need to use public transportation, which is free to NC State Students with their id, to perform required public service. Restricted to Park Scholars.

Prerequisite: PRK 401, restricted to Park Scholars
Typically offered in Spring only

Parks, Recreation, and Tourism Management (PRT)

PRT 150  Parks, Recreation and Tourism Management Orientation  (1 credit hours)
Introduction topics related to the department of Parks, Recreation and Tourism Management; The recreation, tourism, sport and golf industries; all PRTM curricula; advising, academic skills, and team work; and research and personnel involved in the department and college. PRT, SMT and PGM Majors Only.

Typically offered in Fall and Spring

PRT 152  Introduction to Parks, Recreation and Tourism  (3 credit hours)
Introduction to the professional field of recreation by presenting the basic principles, fundamentals and concepts of recreation as related to such factors as recreation history and objectives, sociological and economic aspects of recreation, leadership qualities and facility provision; and settings for organized recreation in modern society.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PRT 156  Professional Golf Management Orientation  (3 credit hours)
Overview of the golf industry and introduction to the concepts and practices of effective golf management including turfgrass management, golf shop operations, food & beverage control, customer services, personnel management, and tournament operations. Theoretical foundations for understanding leisure behavior and the parks, recreation and tourism management profession.

Prerequisite: PGM Majors
Typically offered in Fall and Spring

PRT 200  Health, Wellness and the Pursuit of Happiness  (3 credit hours)
Despite having one of the highest standards of living in the world, a growing number of Americans are unhappy. The purpose of this course is to help students understand the behaviors that are personally beneficial and contribute to a healthy and happy life. Students will learn what research says about what makes us happy and healthy, and how to put those strategies into practice. Course modules focus on activities that have been proven to increase happiness along with strategies to build healthy habits.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PRT 210  Golf Management I  (1 credit hours)
Emphasis on concepts, techniques, and practices of teaching golf skills; understanding the Professional Golfers' Association Constitution; rules of golf, golf tournament operations; and golf car fleet management.

Prerequisite: PGM Majors & PRT 156
Typically offered in Spring only

PRT 211  Golf Management II  (1 credit hours)
Advanced concepts, techniques, and practices of teaching golf; golfer development programs, golf club design and repair.

Prerequisite: PGM Majors & PRT 210
Typically offered in Fall only
PRT 212 Golf Instructor Development (2 credit hours)  
Students will learn to teach using a variety of instructional methods including various technological methods. Students will also learn to teach to students with a variety of learning styles including visual, auditory and kinesthetic. The students will learn the fundamental theories and concepts of the golf swing as well as basic ball flight laws.  
Prerequisite: PGM Majors and PRT 156 and PRT 210  
Typically offered in Fall only

PRT 214/HESM 214 Introduction to Adventure Education (3 credit hours)  
History and philosophy, social psychology of adventure, theories of adventure, benefits, risk-taking behavior, current trends and issues, research and evaluation, and model programs. Field trip required.  
Students are responsible for their own transportation for field trip.  
Typically offered in Spring only

PRT 215/HESM 215 Principles and Practices of Outdoor Leadership (3 credit hours)  
Principles and practices of leadership in adventure education and recreation programs: group management, trip planning, staffing, group dynamics, health and safety issues, risk management and other relevant topics.  
Typically offered in Spring only

PRT 220 Commercial Recreation and Tourism Management (3 credit hours)  
Commercial recreation and the tourism industry, including its origin, present characteristics, behavioral foundations and societal impacts. Emphasis on recreation administration in the commercial sector.  
Prerequisite: PRT 152  
Typically offered in Fall and Spring

PRT 238 Diversity and Inclusion in Recreation and Sport (3 credit hours)  
Provides knowledge, attitude awareness and resources needed to provide programs, services and facilities for all people. Students gain an understanding of people's differences and potential barriers to participation. 10 hours of volunteer work with people who have disabilities is required. Students are responsible for providing their own transportation to and from volunteer work. PRT, SMT and PGM Majors Only; PRT minors.  
Prerequisite: PRT 152  
GEP U.S. Diversity  
Typically offered in Fall, Spring, and Summer

PRT 240 Geospatial Applications for Parks, Recreation and Tourism (3 credit hours)  
Geospatial applications have a multitude of uses in both the private and public sectors and are integral to innovative solutions in parks and recreation. Students will gain an understanding of how spatial data are collected, organized, analyzed, and displayed and learn the foundations of representing environmental and social phenomena in a geospatial environment. Student will be able to explain how geospatial tools enable spatial thinking and problem solving for parks, recreation, and tourism applications, such as siting recreation facilities, mapping health-related issues, and creating compelling maps and visuals for destination marketing. Students will apply spatial concepts to hands-on applications, gaining familiarity with commonly used software.  
Typically offered in Fall and Spring

PRT 250 Management of Park and Recreation Facilities (3 credit hours)  
Management principles applied to park, recreation, sport areas and facilities. Emphasis on operational efficiency, quality service, fiscal responsibility and maintenance management. Laboratory provides for application of management and maintenance principles.  
Prerequisite: PRT 152  
Typically offered in Fall and Spring

PRT 256 Introduction to Sport Management (3 credit hours)  
Introduction to concepts and practices of effective sport programming and management at the professional, collegiate and community levels. Overview of various program delivery systems such as fitness, instructional sport, informal sport, and intramural sport. Examination of management elements of sport programming, including planning, personnel, finance, facilities, risk and liability and marketing.  
Typically offered in Fall, Spring, and Summer

PRT 277 Psychological & Cultural Dimensions of Sport (3 credit hours)  
The psychological behavior of the individual in physical activity and sport. The development of sport and the sports industry, political and cultural significance of sport, and sport in international relationships. The relationship between sport, gender, class, ethnicity, health, drugs, violence, education, and life long physical activity.  
Prerequisite: Sport Management or PRT Majors, PRT 266  
Typically offered in Fall, Spring, and Summer

PRT 286 Writing and Speaking in Sports Organizations (3 credit hours)  
Concepts related to effective communication within sport organizations. Including interpersonal communication, group communication, public speaking, use of electronic media, and basic knowledge and understanding of media in sport and sport enterprises.  
Prerequisite: Sport Management or PRT Majors, PRT 266  
Typically offered in Fall, Spring, and Summer

PRT 292 External Learning Experience (1-3 credit hours)  
Learning experience in parks, recreation, tourism, and sports within an academic framework with agencies external to the department. Contact and arrangements with prospective supervisors initiated by the student. Approval by prospective supervisor and departmental undergraduate coordinator necessary. Students can receive between 1 and 3 hours credit for the the learning experience (1 credit = 45 hours) PRT and SMT majors only.  
Prerequisite: PRT 152 and Sophomore Standing  
Typically offered in Fall, Spring, and Summer

PRT 293 Independent Study in Parks, Recreation, & Tourism Management (1-6 credit hours)  
Independent Study for Parks, Recreation, & Tourism Management students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.  
Typically offered in Fall, Spring, and Summer
PRT 294 Independent Study in Parks, Recreation, & Tourism Management (1-6 credit hours)
Independent Study for Parks, Recreation, & Tourism Management students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

PRT 295 Special Topics in Parks, Recreation, and Tourism Management (1-3 credit hours)
Special topics in the Department of Parks, Recreation, and Tourism Management at the 200 level for offering of courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

PRT 311 Golf Course Turf Grass Management (3 credit hours)
Introduction to the roles and responsibilities of the golf course superintendent as well as the practices and procedures associated with golf course turfgrass management. Preparation for completion of Level II Turfgrass Management, elements of the Professional Golfers' Association of America's Professional Golf Management apprentice program. Periodically class/lab meetings require transportation to area golf facilities. Students are expected to provide their own transportation accommodations.

Prerequisite: PGM Majors and PRT 210 and PRT 211
Typically offered in Fall only

PRT 312 Golf Management III (1 credit hours)
Advanced concepts, techniques, and practices of golf management: business analysis, planning and operations, and analysis of the golf swing. Preparation for completion of PGA of America's Professional golf Management Level II knowledge tests and skills simulations.

Prerequisite: PGM Majors and PRT 210 and PRT 211
Typically offered in Spring only

PRT 315 Organization and Administration of Adventure Programs (3 credit hours)
Overview of the organizational and administration of adventure programs and services, professional standards, programming, management, staffing, budgeting, public relations, liability and risk management.

Prerequisite: PRT 152
Typically offered in Spring only

PRT 350 Outdoor Recreation Management (3 credit hours)
This course explores concepts and methods of outdoor recreation planning and management, with emphasis on public lands. Students will examine environmental and social impacts of recreation and develop strategies that promote quality visitor experiences and sustainable resource management.

Typically offered in Fall and Spring

PRT 351 Outdoor Consortium (3 credit hours)
Examines outdoor recreation and resource management approaches and research results from an applied perspective. Students will practice problem-solving techniques and interact with a wide variety of park managers and planners. This course culminates in a

Typically offered in Spring only

PRT 358 Recreation Program Planning (4 credit hours)
The ultimate goal of the recreation and park profession is to improve the quality of life for the people and communities we serve. We often do this by providing programs for people. It is important for the student to realize the breadth of recreation program possibilities and to be able to analyze and apply the program planning principles to deliver services in a variety of recreation settings. As a full-immersion service-learning course, PRT 358 is designed to provide knowledge and tools to enable the student to achieve the above objectives. For many students, this should be one of the most valuable courses in the entire PRT curriculum.

Prerequisite: PRT 152
Typically offered in Fall and Spring

PRT 359 Leadership and Supervision in Recreation (3 credit hours)
Systematic principles for managing human resource component of parks, recreation and tourism organizations. Leadership, group dynamics, human resources planning and organizing, employee recruitment, selection and supervision.

Prerequisite: PRT 250
Typically offered in Fall, Spring, and Summer

PRT 366 Sport Programming (3 credit hours)
Foundations, administrative support systems, delivery systems and desirable practices of sport programming. Program delivery systems overview with emphasis on problems and solutions associated with sport programs. Topics include sport league administration, youth sport delivery issues, sport tournament operations, community based sport delivery issues, college/university recreation sport delivery.

Prerequisite: Sport Management and PRT Majors, PRT 266
Typically offered in Fall only

PRT 375 Professional Development and Internship Orientation (2 credit hours)
The purpose of PRT 375 is to help students adequately prepare for their internship and for their career following graduation. Students will explore internship opportunities and explore the best practices for internship and/or job seeking through resume preparation, practicing interview skills, utilizing social media, and learning job negotiating skills.

Prerequisite: PRT 152
Typically offered in Fall and Spring

PRT 376 Sport Administration (3 credit hours)
Concepts related to policy development, organization and management specific to sport organizations. Including theories and practices of policy development and implementation, management theories, organizational behavior, the strategic management process, organizational design, managing change, and operational planning.

P: PRT 266 and Sports Management students only.
Typically offered in Spring and Summer

PRT 380 Analysis and Evaluation in Parks, Recreation (3 credit hours)
Examination of the steps involved in analyzing and estimating the impact of recreation and parks services. Includes relevant issues and useful approaches for systematic analysis. Emphasis is placed on an understanding and development of various types of

Prerequisite: 300-level Statistics course, PRT 359
Typically offered in Fall, Spring, and Summer
PRT 385 Environmental Education in Practice (3 credit hours)
This course is designed to prepare students to enter the environmental education (EE) profession. Topics will include EE professional standards, program planning and delivery, and program evaluation. A significant portion of the course focuses on securing and completing a field placement involving at least 10 contact hours with learners through teaching or observations. In addition, students are expected to attend an EE professional conference which may require overnight travel. Completion of course activities will provide 50-80 hours toward the NC Environmental Education Certification Program. Only students who have taken EMS 355 (Environmental Education Teaching Methods) will be enrolled, except with permission from the instructor.

Typically offered in Spring only

PRT 406 Sports Law (3 credit hours)
Fundamental principles of law, especially tort and contract law, applied to sports situations. Analysis of liability of sports personnel in various roles including participant, coach, promoter, trainer and official. Analysis of common law court decisions in sports contexts as well as key state and federal statutory legislation such as civil rights and antitrust.

Prerequisite: Junior standing.
Typically offered in Fall and Summer

PRT 407 Services, Facilities and Event Marketing (3 credit hours)
Examination of marketing methods as applied to Parks, Recreation, Tourism and Sport Management facilities and programs. Aspects of advanced marketing: market research, marketing strategy and revenue-generation in both public and private settings. Credit will not be given for both PRT 407 and PRT 507

Prerequisite: PRT 358,
Typically offered in Fall only

PRT 410 Food and Beverage Management (3 credit hours)
Introduction to practices and procedures in food and beverage service. Basics of food service needs, cost controls, legal issues affecting food and beverage service, staffing, and customer satisfaction. Critical elements of food costing, purchasing, inventory control, menu planning, and security. Preparation for completion of Level III Food and Beverage control elements of the Professional Golfers' Association of America's Professional Golf Management apprentice Program

Prerequisite: Junior standing and PRT 152
Typically offered in Spring only

PRT 411 Club Management (3 credit hours)
Introduction to practices and procedures in contemporary club management. Application of general management functions to club environments including human resources, training, financial management marketing; leadership food and beverage service operations facilities and risk management; legal issues; and career planning. Preparation for completion of Club Management elements of the Professional Golfers' Association of America's Professional Golf Management apprentice Program

Prerequisite: Junior standing, PRT 152
Typically offered in Spring only

PRT 412 Golf Course Architecture (3 credit hours)
Basic principles of golf course design. Historical architectural influences on current golf course design trends. Strategic golf course design principles, shot values, construction practices, environmental issues, and maintenance issues. Golf course design and management implications. Restricted to PGM and Landscape Arch. Majors. Junior Standing

Prerequisite: PRT 211
Typically offered in Fall only

PRT 413 Golf Management IV (1 credit hours)
Advanced concepts, techniques, and practices of golf management: swing concepts of teaching, supervising and delegating, merchandising and inventory control. Preparation for completion of PGA of America's Professional Golf Management Level III knowledge tests and skill simulations.

Prerequisite: PGM Majors and PRT 312
Typically offered in Fall only

PRT 414 PGA Apprentice Program Completion (0 credit hours)
Checkpoint mechanism to register the successful completion of the Professional Golfers' Association Apprentice requirement.

Prerequisite: PGM Majors and PRT 312
Typically offered in Fall and Spring

PRT 419 Sustainable Tourism (3 credit hours)
This course introduces the concepts and principles associated with sustainable tourism development, emphasizing on their implications for management and planning purposes. Topics to be addressed include: concept, justification and evolution of sustainable development; socio-cultural, economic, and environmental dimensions of sustainable tourism; positive and negative impacts of tourism development; and principles conducive to sustainable tourism planning and community development. Given that each case of tourism development is unique, examples from the U.S. and around the world will be used to examine and discuss issues and practices of sustainable tourism development within different geo-cultural contexts. This course adopts the Problem-Based Learning Format, which promotes and enhances students' analytical skills, problem solving skill and team working skills. Junior or senior standing.

Typically offered in Spring only

PRT 420 Destination Planning and Management (3 credit hours)
Destination planning, development, and management from a theoretical and applied perspective. Includes an examination the destination experience, destinations as they fit into the tourism system, and contributions made in the development of the tourism industry.

Prerequisite: PRT 152
Typically offered in Spring only
PRT 430  Tourism, Poverty, and Health  (3 credit hours)
Students will learn about the potential role of tourism in fueling equitable development and human health in destination communities, and about the factors that lead to negative social and economic tourism impacts. Students will learn about equitable community development, human health and well-being principles; and about how micro-entrepreneurs and host communities react to the challenges and opportunities posted by tourism development. The course is grounded in scholarly knowledge and is also unreservedly engaged in real life; accordingly, students will work on new ways to help under-resourced individuals pursue dignified livelihoods through tourism. Fieldwork outside of class is required, with a fee of $50.00. PRT majors and PRT minors only.

Typically offered in Fall only

PRT 442  Recreation and Park Interpretive Services  (3 credit hours)
Interpretation is a form of communication in which the technical language of natural sciences and related fields is translated in a way connects people's hearts and minds to a resource. Commonly, interpretation occurs at local, county, state and national parks; state and national forests; other protected areas; as well as natural and cultural history centers and sites. However, these skills can be transferred to any setting in which you are seeking to connect people's hearts and minds to a resource. This course is designed to provide you with fundamental knowledge of environmental and cultural interpretation, as well as develop your practical skills in providing interpretive services. Students will enroll in the National Association of Interpretation Certified Interpretive Guide course and have opportunity to apply for certification ($125 fee). Certification is optional. Students completing this course will also earn a minimum of 20 hours toward NC Environmental Education Certification.

Prerequisite: Junior standing.
Typically offered in Spring only

PRT 449/ES 449  Human Dimensions of Natural Resources in Australia/New Zealand  (3 credit hours)
This 3.5 week study abroad program examines human dimensions of natural and environmental conservation in Australia. The course will involve an orientation and lectures from faculty at James Cook University. Students will explore the natural environments in Australia including Great Barrier Reef, Tropical Rainforest and Outback and be introduced to Australian culture and history through interactions with communities. Educational travel, active participation, lectures, seminars, and reflective exercises facilitate learning to improve understanding of relationships between human societies and the natural environment. Students must pay program fees, airfare, some meals and incidentals.

Corequisite: PRT 450
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Summer only

PRT 450/ES 450  Sustaining Natural Resources in Australia/New Zealand  (3 credit hours)
This 3.5 week study abroad program will examine issues related to natural history and environmental conservation in Australia. This course will involve an orientation and lectures from Australian university faculty. Students will explore natural environments in Australia including the Great Barrier Reef, Tropical Rainforest and Outback; learn about sustainable development and protection of the natural environment through educational travel, field trips, active participation, lecture presentations and seminars, written assignments, research projects and reflective exercises. Students must apply through NCSU Study Abroad Office. Students must pay program fees, airfare, some meals and incidentals.

Corequisite: PRT 449
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Summer only

PRT 451  Principles of Recreation Planning and Facility Development  (3 credit hours)
Planning activities analyzed as decision-making processes. Identification, interpretation, evaluation and utilization of data and resources necessary for recreation planning. Planning principles applied in the analysis of proposed and existing recreation sites.

Prerequisite: PRT 358
Typically offered in Fall and Spring

PRT 454  Parks and Recreation Finance and Administration  (3 credit hours)
Recreation and park fiscal administration, sources of finance for operating and capital expenditures, revenue activities, financial planning, budgeting, expenditure policies, auditing and planning for recreation and park services, decision-making tools, legal aspects of administration.

Prerequisite: PRT 359
Typically offered in Fall, Spring, and Summer

PRT 458  Special Events Planning  (3 credit hours)
Theoretical and applied approaches to the planning of special events. Components and considerations of event planning, applied to various recreational settings. Participation in a community special event is required. Attendance at professional conference also required.

Prerequisite: PRT 358
Typically offered in Spring only

PRT 466  Sport Finance and Economics  (3 credit hours)
Concepts include sources of revenue for financing, principles of budgeting, spreadsheet utilization, and financial management of sport facilities and enterprises. Additional topics include fundraising principles and methods, economic impact principles and their application to sport venues and events, economic theory applied to sport manufacturing, service industries, professional sports, stadiums and arenas, intercollegiate sports, and the sport club industry.

Prerequisite: Sport Management and PRT Majors, PRT 266, ACC 210, and (ARE 201 or EC 201 or EC 205)
Typically offered in Fall, Spring, and Summer
PRT 475 Recreation and Park Internship (8 credit hours)
Provides prospective park, recreation and leisure service professionals a 400-hour (ten week) learning experience in a selected agency or organization, under the joint supervision of a qualified manager and a university internship supervisor. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: PRT 350, PRT 358, PRT 359, PRT 375, PRT 380, 100 hours of approved work experience.
Typically offered in Fall, Spring, and Summer

PRT 476 Sport Marketing (3 credit hours)
Fundamental marketing principles and concepts related to the sport industry. Overview of marketing mix, marketing strategies and the bases of segmentation, sponsorship, licensing, fundraising and merchandising. Special emphasis on the marketing of sport and its strong relationship to research. Credit will not be given for both PRT 476 and PRT 407.

Prerequisite: PRT 486, Sport Management or PRT Majors, PRT 266
Typically offered in Fall and Spring

PRT 478 Sustainable Sport Facility Management (3 credit hours)
In this course, students will examine the development and management of sport facilities, paying particular attention to environmental concerns and the sustainability of the sport stadia. Specifically, the course first focuses on the 3 E's of sustainability (Environment, Equity, Economics) and learn about sustainable systems. From this underpinning, the course is divided into two main frameworks: 1. Development of sport facilities; and 2. Sport facility operations. Each part of the course is enhanced by guest lectures from industry experts and hands on learning experiences.

R: Sport Management Majors only
Typically offered in Fall, Spring, and Summer

PRT 491 Special Topics in Recreation (1-3 credit hours)
Investigation and analysis of a problem associated with recreation resources.

Typically offered in Fall, Spring, and Summer

PRT 493 Independent Study in Parks, Recreation, and Tourism Management (1-6 credit hours)
Independent Study for Parks, Recreation, and Tourism Management students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

PRT 494 Independent Study in Parks, Recreation, and Tourism Management (1-6 credit hours)
Independent Study for Parks, Recreation, and Tourism Management students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

PRT 500 Conceptual Foundations of Recreation (3 credit hours)
Exploration of the conceptual foundations of leisure, recreations, sport, play, and work, the history of ideas in the field and the relationships of these ideas to contemporary professional and social problems. Restricted to PRTM masters and students and others by consent of the instructor. This course will be offered in an accelerated seven-week format.

Restriction: PRT Grad Students Only
Typically offered in Fall only

PRT 501 Research Methods In Recreation (3 credit hours)
Examination and understanding of advanced scientific investigative methods in their application toward explaining recreation and leisure behavioral phenomena and for resolution of recreation management problems.

Restricted to: Graduate-level Statistics
Typically offered in Spring only

PRT 503 Advanced Fiscal Management for Parks, Recreation, Tourism and Sport Organizations (3 credit hours)
This course is intended to provide students with advanced concepts of fiscal management as applied to the unique industries of parks, recreation, tourism and sport management. Emphasis will be placed on understanding how the receipt, disbursement, and utilization of funds can foster sustainability within these types of organizations. Additionally, this course will focus on developing the skills necessary to apply ethical financial analysis principles through financial risk management. This course is restricted to PRTM masters students and others by consent of the instructor. This course will be offered online in an accelerated seven-week format.

Typically offered in Fall only

PRT 504 Data Management and Applications in Parks, Recreation, Tourism and Sport Management (3 credit hours)
Introduction to procedures and techniques used in research and evaluation in parks, recreation, sport, and tourism settings to solve management problems. The course emphasizes techniques for data collection, management, analysis, and communication of research findings. This course is restricted to PRTM masters and students and others by consent of the instructor. This course will be offered online in an accelerated seven-week format.

Typically offered in Fall only

PRT 505 GIS and Spatial Analysis in PRTS (3 credit hours)
Introduction to spatial reasoning and spatial analysis as implemented in geographic information systems (GIS) to perform evaluation and research in parks, recreation, tourism, and sport settings. This course is restricted to PRTM master's degree students or others with consent of the instructor.

Prerequisite: Graduate Standing and MPRTSM
Typically offered in Spring only
PRT 506  Organizational Behavior and Leadership in Parks, Recreation, Tourism and Sport  (3 credit hours)
This course will focus on the organization and administration of public, private and not-for-profit park, recreation, tourism and sports (PRTS) agencies. Emphasis will be placed on understanding the structural, human, political, and cultural factors that impact organizational efficiency and effectiveness - specifically focusing on these environments. The course will primarily address issues related to organization, management, ethical leadership, human personnel supervision, theory, and research. This course is restricted to PRTM master's degree students or by permission of instructor. This course will be offered online in an accelerated seven-week format.

Typically offered in Fall only

PRT 507  Strategic Marketing Management in Parks, Recreation, Tourism and Sport Organizations  (3 credit hours)
This course examines the theoretical principles and applications of marketing and promotion strategies for recreational sport and key marketing concepts and strategies using case studies. There is significant discussion on marketing activation, leveraging strategies of sport/event sponsor brands/companies, and developing a marketing plan. This course is restricted to PRTM master's degree students and others with the content of the instructor. This course will be offered online in an accelerated seven-week format.

Typically offered in Spring only

PRT 508  Risk Management for Parks, Recreation, Tourism and Sport Organizations  (3 credit hours)
This course explores risk management in PRTs organizations with an emphasis on ethical managerial strategies. The topics include legal concepts related to specific managerial functions, impacts on functions in recreation environments that result in more efficient and successful operation and protection for the organization. In addition, effective strategies for risk management related to facilitating active-healthy lifestyles and sustainable communities will be explored. This course is restricted to PRT master's degree students and others by consent of the instructor. This course will be offered online in an accelerated seven-week format.

Typically offered in Summer only

PRT 509  Program Evaluation for Parks, Recreation, Tourism and Sport Organizations  (3 credit hours)
This course focuses on the development of a working knowledge of the rationale, procedures and tools for conducting sound program evaluation assessments in parks, recreation, tourism, and sport organizations. Effective skills for mastering comprehensive program evaluation strategies including formative, summative, and knowledge building strategies are taught. Students explore social science methods specifically appropriate for evaluation of youth programs.

Typically offered in Summer only

PRT 510  Active Recreation and Community Health  (3 credit hours)
This course focuses on the association of active recreation in communities and community health. Students explore individual, social, community, environmental, and policy factors that affect community health and the contribution of recreation and park programs and facilities. This is a seven week course.

Typically offered in Spring only

PRT 511  Sport and Entertainment Venue Management - Facilities  (3 credit hours)
In this course, students will examine the management of sport facilities, paying particular attention to environmental concerns and the sustainability of the event venue. Specifically, we will first focus on the three E's of sustainability (Environment, Equity, Economics) and learn about sustainable systems. From this underpinning, the class will be divided into six critical topic areas of sport facility management: 1. History and role of venues 2. Venue Safety and Security 3. Venue Policy and Procedures 4. Food and Beverage Operations 5. Transportation and Parking Management 6. Ancillary Revenue Sources

Typically offered in Fall, Spring, and Summer

PRT 512  Sport and Entertainment Venue Management - Operations and Services  (3 credit hours)
A thorough background on operations and services is essential for sport and entertainment venue managers. This course examines venue management by covering essential managerial functions. These include management and human resources, customer service and crowd management, managing volunteers, scheduling and booking venues, and ticket office operations.

Typically offered in Spring only

PRT 550  Human Behavior and the Environment  (3 credit hours)
This course helps students understand the variety of cognitive, social, affective, and environmental factors that influence human behavior in natural resource contexts, with an emphasis on nature-based recreation experiences and conservation behaviors. Students will explore behavioral models from different disciplines, examine pathways to promote behavior change, and assess implications for park management, environmental stewardship, and natural resource conservation.

Typically offered in Fall only

PRT 555  Environmental Impacts of Recreation and Tourism  (3 credit hours)
Understanding of environmental impacts of recreation and tourism, and different methods for assessing and managing such impacts. Examination of the scientific and management literature and application of impact assessment techniques.

Typically offered in Fall only

PRT 560  Theory and Practice of Partnerships for Conservation and Community Sustainability  (3 credit hours)
Understanding of collaborative processes and the role of partnerships in public land management, community based conservation, tourism development, and community health and recreation. Examination of literature and evaluation of collaboration and partnerships in practice.

Typically offered in Fall only

PRT 595  Special Topics In Recreation Resources  (1-6 credit hours)
Special topics in various aspects of recreation resources developed under direction of a graduate faculty member on a tutorial basis. Subjects offered under this course listing also used to test and develop new courses.

Prerequisite: Graduate standing
Typically offered in Fall and Spring
PRT 610  Special Topics in Recreation Resources  (1-6 credit hours)
Special topics in various aspects of recreation resources developed under direction of a graduate faculty member on a tutorial basis. Subjects offered under this course listing also used to test and develop new courses.
Prerequisite: Graduate standing
Typically offered in Fall and Spring

PRT 620  Recreation Resources Problems  (1-4 credit hours)
Assign or selected problems in field of recreation administration, planning, supervision, maintenance, operations, financing or program. Special research problems selected on basis of interest of students and supervised by members of graduate faculty.
Prerequisite: Advanced Undergraduate standing or Graduate standing
Typically offered in Fall, Spring, and Summer

PRT 650  Professional Electronic Portfolio for Parks, Recreation and Tourism Management  (1 credit hours)
Students will develop a personalized digital portfolio of the work completed in all required courses in the Masters of Parks, Recreation & Tourism Management program. The portfolio should include evidence, reflection, and critical analysis of core competencies achieved throughout their academic course of study. This course must be taken during a student's last semester after he or she has completed all the required courses.
Prerequisite: Graduate Standing and PRT 500 and PRT 504 and PRT 505 and PRT 506 and PRT 508 and PRT 503 and PRT 507.
Typically offered in Fall and Spring

PRT 685  Master's Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PRT 693  Master's Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PRT 695  Master's Thesis Research  (1-9 credit hours)
Thesis Research
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PRT 696  Summer Thesis Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master's student
Typically offered in Summer only

PRT 699  Master's Thesis Preparation  (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis. Credits Arranged
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PRT 700  Advanced Theories of Leisure  (3 credit hours)
This course is designed to examine theory as it can be applied to understanding of leisure behavior and parks, recreation, and tourism management research. The goal is to provide a foundation for identifying, evaluating, and applying theoretical perspectives to PRTM research. Students are expected to engage in a critical analysis of theory in PRTM.
Ph.D. student
Typically offered in Fall only

PRT 701  Research Methods in Parks, Recreation, & Tourism Management  (3 credit hours)
The overall goal of this course is to provide students with a background in advanced social science research methods commonly used in PRTM-related fields as well as strategies for planning, designing, evaluating, and applying research using the social science framework. This course will also be designed in a way to guide students through the phases of the research design and to develop a research proposal.
Completion of PRT 500/700 or concurrently enrolled; Graduate Status
Typically offered in Fall only

PRT 705  Qualitative Research Methods in Conservation & Community Sustainability  (3 credit hours)
Examination of qualitative research methods and designs in the contexts of human dimensions of natural resources, equitable and sustainable tourism development, and community health and well-being, including data generation, organization, analysis, quality and presentation. A research project will be conducted with the application of qualitative data organization software.
P: Doctoral student status, or with consent of instructor.
Typically offered in Spring only

PRT 730  Tourism, Community Health, and Sustainability  (3 credit hours)
In this course students will examine the potential role of tourism in mitigating or exacerbating health disparities and environmental degradation in rural poor areas. The course endorses an academic ethic of engaged scholarship. Students will be asked to make original contributions to participatory development scholarship, and they will be asked to collaborate with community partners on an applied project addressing tourism, health disparities and environmental degradation in an economically depressed rural community. Consistent with the engaged nature of this course, we will travel to rural communities to meet stakeholders, collect data, and provide coaching/training to tourism micro-entrepreneurs.
Typically offered in Spring only

PRT 795  Special Topics in Recreation Resources  (1-6 credit hours)
Typically offered in Fall, Spring, and Summer
PRT 801 Doctoral Seminar in Parks, Recreation and Tourism Research (1 credit hours)
Research studies, scientific articles and progress reports on research effects presented and critically evaluated. Each student pursuing a doctoral degree is expected to take this offering four times for one hour of credit each time.

Typically offered in Fall and Spring

PRT 810 Special Topics In Recreation Resources (1-6 credit hours)
Special topics in various aspects of recreation resources developed under direction of a graduate faculty member on a tutorial basis. Subjects offered under this course listing also used to test and develop new courses.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

PRT 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PRT 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PRT 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PRT 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

PRT 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

**Philotogy (PHI)**

PHI 205 Introduction to Philosophy (3 credit hours)
Introduction to selected problems of enduring philosophical importance, including such topics as the nature of morality, knowledge, human freedom, and the existence of God. Content varies with different sections.

Credit is not allowed for both PHI 205 and PHI 210.
GEP Humanities
Typically offered in Fall, Spring, and Summer

PHI 210 Representation, Reason and Reality (3 credit hours)
This course is an introduction to philosophical issues concerning topics such as language, thought, knowledge, reason, truth, and reality through the study of problems, puzzles, and paradoxes. Not both PHI 205 and PHI 210 may be used towards satisfaction on PHI major or PHI minor requirements.

Credit is not allowed for both PHI 210 and PHI 205
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

PHI 214 Issues in Business Ethics (3 credit hours)
An analysis and evaluation of major issues in business ethics. Topics include the social responsibility of business; social justice and free enterprise; the rights and duties of employers, employees, manufacturers, and consumers; duties to the environment, the world's poor, future generations, and the victims of past injustices; the moral status of the corporation; and the ethics of advertising.

GEP Humanities
Typically offered in Fall, Spring, and Summer

PHI 221 Contemporary Moral Issues (3 credit hours)
Philosophical analysis and theory applied to a broad range of contemporary moral issues, including euthanasia, suicide, capital punishment, abortion, war, famine relief, and environmental concerns.

GEP Humanities
Typically offered in Fall, Spring, and Summer

PHI 250 Thinking Logically (3 credit hours)
Deductive arguments attempt to guarantee their conclusions. Inductive arguments attempt to make their conclusions more probable. Using a small number of simple, powerful logical techniques, this course teaches you how to find, analyze and evaluate deductive and inductive arguments, and thus how to avoid the most common errors in reasoning.

GEP Mathematical Sciences
Typically offered in Fall and Spring

PHI 298 Special Topics in Philosophy (3 credit hours)
Selected studies in philosophy that do not appear regularly in the curriculum. Topics will be announced for each semester in which the course is offered.

PHI 300 Ancient Philosophy (3 credit hours)
Western philosophy of the ancient world, with special emphasis on Plato and Aristotle.

GEP Humanities
Typically offered in Fall and Spring

PHI 301 Early Modern Philosophy (3 credit hours)
Western philosophy of the 17th and 18th centuries, including such philosophers as Descartes, Hobbes, Leibniz, Locke, Berkeley, Hume, and Kant.

GEP Humanities
Typically offered in Fall and Spring

PHI 302 19th Century Philosophy (3 credit hours)
Western philosophy of the 19th century, including such philosophers as Kant, Hegel, Schopenhauer, Kierkegaard, Marx, and Nietzsche.

GEP Humanities
Typically offered in Fall only
PHI 305 Philosophy of Religion  (3 credit hours)
The existence and nature of God, including such topics as traditional
goals of God, skeptical challenges to religious belief, miracles, the
problem of evil, faith and reason, and religious experience.

GEP Humanities
Typically offered in Fall and Spring

PHI 309 Political Philosophy  (3 credit hours)
Philosophical study of important political ideas and values such as liberty,
equality, justice, rights, and democracy. May include readings from
classical and contemporary sources.
Prerequisite: One PHI course
GEP Humanities
Typically offered in Spring only

PHI 310 Existentialism  (3 credit hours)
Philosophy of Existentialism, including such thinkers as Kierkegaard,
Nietzsche, Doestoevsky, Sartre, Heidegger, and Camus.

GEP Humanities
Typically offered in Spring only

PHI 312 Philosophy of Law  (3 credit hours)
Fundamental legal issues such as what constitutes a law or legal system.
Justifications of legal interference with individual liberty. Philosophical
legal issues illustrated by specific legal cases.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

PHI 313 Ethical Problems in the Law  (3 credit hours)
Explores uses of the legal system, including such topics as the death
penalty, plea bargaining, legalizing euthanasia, censorship, Good
Samaritan laws, the insanity defense, civil disobedience, preferential
treatment.
Prerequisite: PHI 221, or 375
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

PHI 319 Africana Political Philosophy  (3 credit hours)
Africana thought on central issues in political philosophy such as justice,
equality and state authority in the work of select African-American
Philosophers. Material from African and Caribbean traditions may also be
considered.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

PHI 320 Philosophy of Race  (3 credit hours)
Fundamental philosophical questions raised by the concept of race, such
as whether race is a legitimate category for identifying human beings,
and whether the category of race reinforces racism.

GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

PHI 325/STS 325 Bio-Medical Ethics  (3 credit hours)
Interdisciplinary examination and appraisal of emerging ethical and social
issues resulting from recent advances in the biological and medical
sciences. Abortion, euthanasia, physician-assisted suicide, compromised
infants, aids, reproductive technologies, and health care. Focus on
factual details and value questions, fact-value questions, fact-value
interplay, and questions of impact assessment and policy formulation.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

PHI 330 Metaphysics  (3 credit hours)
Problems of metaphysics, including such topics as: possibility and
necessity, paradoxes of time travel, nature of space and time, free will
and determinism, causation, mind-body problem and identity-over-time.
Prerequisite: One PHI course
GEP Humanities
Typically offered in Spring only

PHI 331 Philosophy of Language  (3 credit hours)
Introduction to traditional and modern accounts of the relations between
language and reality, the nature of truth, problems of intentionality and
propositional attitudes.
Prerequisite: One PHI course
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

PHI 332 Philosophy of Psychology  (3 credit hours)
Problems and controversies that overlap the boundary between
philosophy and psychology: the mind/body problem, behaviorism vs.
cognitivism, the prospects for artificial intelligence, and language and the
questions of innate knowledge.
Prerequisite: One PHI course or one PSY course
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

PHI 333 Knowledge and Skepticism  (3 credit hours)
Analysis of such central concepts as knowledge, belief, and truth, and
the investigation of the principles by which claims to knowledge may be
justified.
Prerequisite: One PHI course
GEP Humanities
Typically offered in Spring only

PHI 340 Philosophy of Science  (3 credit hours)
Nature of science highlighted by differences between science and
pseudoscience, relationships between science and religion, and roles of
purpose-directed (teleological) and causal explanation in physical, life
and social sciences.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

PHI 347 Neuroscience and Philosophy  (3 credit hours)
Introduction to principal theoretical, empirical and normative issues at the
intersection of neuroscience and philosophy, including such issues as:
consciousness, the mind's I and the brain's I: free will, moral responsibility
and neuroscience; the ethics of personal enhancement; brains, human
nature and personal identity; neuroscientifically informed evaluation of
well-being.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only
PHI 375 Ethics (3 credit hours)
Examination of traditional questions of philosophical ethics: What are the principles of moral conduct? What sort of life is worthy of a human being? Includes both classic and contemporary literature.

GEP Humanities
Typically offered in Fall and Spring

PHI 376 History of Ethics (3 credit hours)
Topics in the history of ethics. Philosophers to be studied may include Plato, Aristotle, Aquinas, Butler, Hume, Kant, Sidgwick and Nietzsche.

Prerequisite: One PHI course
GEP Humanities
Typically offered in Fall only

PHI 401 Kant’s Critique of Pure Reason (3 credit hours)
A text-based critical study of Kant’s Critique of Pure Reason. Focusing on such topics as perception, judgment, knowledge, space, time, substance, causation and reality. Students cannot receive credit for both PHI 401 and PHI 501.

Prerequisite: 6 credits in PHI. Credit is not allowed for both PHI 401 and PHI 501.
GEP Humanities

PHI 403 Continental Philosophy After 1900 (3 credit hours)
Key themes in continental European philosophy after 1900. Work studied will include selections from writings of authors in at least two major traditions, e.g., phenomenology, hermeneutics, structuralism, and critical theory. Junior standing or above required. Students may not receive credit for both PHI 403 and PHI 503.

R: Junior standing or above
GEP Humanities
Typically offered in Spring only

PHI 420 Global Justice (3 credit hours)
The applications of the ideas of justice and right beyond and across the borders of individual nation states, attending to the facts of globalization and their consequences for political and economic justice and human rights. Topics: skepticism about global justice; transnational distributive justice, pollution, and poverty; national sovereignty, self-determination, and intervention; the ethics of war; international human rights; and global democracy. No one can receive credit for both PHI 420 and PHI 520.

Prerequisite: One PHI course. Credit is not allowed for both PHI 420 and PHI 520.
GEP Humanities

PHI 425/PSY 425 Introduction to Cognitive Science (3 credit hours)
Philosophical foundations and empirical fundamentals of cognitive science, an interdisciplinary approach to human cognition. Topics include: the computational model of mind, mental representation, cognitive architecture, the acquisition and use of language. Students cannot receive credit for both PHI/PSY 425 and PHI/PSY 525.

Prerequisite: One upper-level PHI, PSY, CSC or Linguistics course. Credit is not allowed for PHI 425 and PHI/PSY 525.
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

PHI 440 The Scientific Method (3 credit hours)
Detailed examination of core issues in the philosophy of science: the confirmation of scientific theories, falsification, projectibility, the nature of scientific explanation, laws of nature, and causation. Students cannot receive credit for both PHI 440 and PHI 540.

Prerequisite: One PHI course. Credit is not allowed for both PHI 440 and PHI 540.
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

PHI 447 Philosophy, Evolution and Human Nature (3 credit hours)
This course covers philosophical issues in the evolutionary study of human cognition: the role of adaptationism; the values of psychological vs. behavioral approaches; the phenotypic gambit; the evolution of morality and altruism; the nature of culture and the possibility of cultural evolution; innateness, genetic determinism and development; and case studies of evolutionary explanation of human behavior or psychology. Students cannot receive credit for both PHI 447 and PHI 547.

Prerequisite: One 300 level or higher course in Philosophy, Biology, Psychology or Anthropology. Credit is not allowed for PHI 447 and PHI 547.
GEP Humanities, GEP Interdisciplinary Perspectives

PHI 475 Ethical Theory (3 credit hours)
An introduction to some central themes and issues in ethical theory. Topics in normative and meta-ethics such as consequentialism, deontology, virtue ethics, constructivism, realism, relativism, subjectivism, and expressivism. Readings primarily from contemporary literature.

Prerequisite: PHI 375 or PHI 376. Credit is not allowed for both PHI 475 and PHI 575.

PHI 494 Research and Writing in Ethics (1 credit hours)
A substantial paper in ethics, assigned by the instructor of the corequisite; enrollment subject to departmental approval; may be repeated for credit. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: PHI 250 or LOG/MA 201 or LOG/MA 335 and one other (non PHI 250) PHI course. Corequisite: One of (PHI 298, 309, 310, 313, 319, 325, 375, 376, 420, 475, or 498)
Typically offered in Fall, Spring, and Summer

PHI 495 Research and Writing in History of Philosophy (1 credit hours)
A substantial paper in history of philosophy, assigned by the instructor of the co-requisite; enrollment subject to departmental approval; may be repeated for credit. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: PHI 250, LOG 201 or 335 and one other (non PHI 250) PHI course. Co-requisite: One of PHI 298, 300, 301, 302, 310, 401 or 498
Typically offered in Fall, Spring, and Summer
PHI 496 Research and Writing in Contemporary Philosophy (1 credit hours)
A substantial paper in contemporary philosophy, assigned by the instructor of the corequisite; enrollment subject to departmental approval; may be repeated for credit. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.
Prerequisite: (PHI 250 or LOG 201 or LOG 335) and one other PHI course, Corequisite: One of PHI 298, 305, 320, 330, 331, 332, 333, 340, 347, 425, 440, 447 or 498
Typically offered in Fall, Spring, and Summer

PHI 497 Research and Writing in Logic, Representation and Reasoning (1 credit hours)
A substantial paper in logic, representation and reasoning, assigned by the instructor of the corequisite. enrollment subject to departmental approval; may be repeated for credit. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.
Prerequisite: LOG 201 or 335, and one other PHI course, not PHI 250, Corequisite: One of LOG/MA 335, LOG 430/530, 435/535, PHI 298, 330, 331, 332, 333, 347, 340, 425/525, 440/540 or 447/547
Typically offered in Fall, Spring, and Summer

PHI 498 Special Topics in Philosophy (1-6 credit hours)
Detailed investigation of selected topics in philosophy. Topics determined by faculty members in consultation with head of the department. Course may be used for individualized study.
Prerequisite: Six credits in PHI courses
Typically offered in Fall and Spring

PHI 501 Kant's Critique of Pure Reason (3 credit hours)
A text-based critical study of Kant's Critique of Pure Reason focusing on topics such as perception, judgment, knowledge, space, time, substance, causation, and reality. Students cannot receive credit for both PHI 401 and PHI 501.
Prerequisite: Graduate Standing. Credit is not allowed for both PHI 501 and PHI 401.

PHI 503 Continental Philosophy After 1900 (3 credit hours)
Key themes in continental European philosophy after 1900. Work studied will include selections from writings of authors in at least two major traditions, e.g., phenomenology, hermeneutics, structuralism, and critical theory. Students cannot receive credit for both PHI 403 and PHI 503. Junior standing is required for PHI 403. Graduate standing is required for PHI 503.
R: Graduate Standing
Typically offered in Spring only

PHI 520 Global Justice (3 credit hours)
The applications of the ideas of justice and right beyond and across the borders of individual nation states, attending to the facts of globalization and their consequences for political and economic justice and human rights. Topics: skepticism about global justice; transnational distributive justice, pollution, and poverty; national sovereignty, self-determination, and intervention; the ethics of war; international human rights; and global democracy. No one can receive credit for both PHI 420 and PHI 520.
Prerequisite: Graduate standing. Credit is not allowed for both PHI 520 and PHI 420.

PHI 525/PSY 525 Introduction To Cognitive Science (3 credit hours)
Philosophical foundations and empirical fundamentals of cognitive science, an interdisciplinary approach to human cognition. Topics include: the computational model of mind, mental representation, cognitive architecture, the acquisition and use of language. Students cannot receive credit for both PHI/PSY 425 and PHI/PSY 525.
Prerequisite: Graduate standing. Credit is not allowed for PHI 525 and PHI/PSY 425.
Typically offered in Spring only

PHI 540 The Scientific Method (3 credit hours)
Detailed examination of core issues in the philosophy of science: the confirmation of scientific theories, falsification, projectibility, the nature of scientific explanation, laws of nature, and causation. Students cannot receive credit for both PHI 440 and PHI 540.
Prerequisite: Graduate standing. Credit is not allowed for both PHI 540 and PHI 440.
Typically offered in Fall only

PHI 547 Philosophy, Evolution and Human Nature (3 credit hours)
This course covers philosophical issues in the evolutionary study of human cognition: the role of adaptationism; the values of psychological vs. behavioral approaches; the phenotypic gambit; the evolution of morality and altruism; the nature of culture and the possibility of cultural evolution; innateness, genetic determinism and development; and case studies of evolutionary explanation of human behavior or psychology. Students cannot receive credit for both PHI 447 and PHI 547.
Credit is not allowed for both PHI 547 and PHI 447. Graduate Standing Required.
Typically offered in Fall only

PHI 575 Ethical Theory (3 credit hours)
An introduction to some central themes and issues in ethical theory. Topics in normative and meta-ethics such as consequentialism, deontology, virtue ethics, constructivism, realism, relativism, subjectivism, and expressivism. Readings primarily from contemporary literature.
Prerequisite: Graduate Standing. Credit is not allowed for both PHI 575 and PHI 475.

PHI 598 Special Topics in Philosophy (3-6 credit hours)
Typically offered in Fall and Spring

PHI 696 Summer Thesis Res (1 credit hours)
PHI 816 Introduction to Research Ethics  (1 credit hours)
Institutional rules guiding the responsible conduct of research (RCR) and their philosophical justification. Rudiments of moral reasoning and their application to RCR. Topics: plagiarism, falsification and fabrication of data, and ethics versus custom, law, science, and religion.
Prerequisite: Graduate standing
Typically offered in Fall and Spring

PHI 896 Summer Dissert Res  (1 credit hours)

Physics (PY)

PY 123 Stellar and Galactic Astronomy  (3 credit hours)
Introductory, descriptive survey of stars, galaxies and cosmology, designed primarily for non-science majors. Exotic recent discoveries such as quasars, pulsars, and black holes will be included. Complements PY 124, Solar System Astronomy. Companion laboratory course PY 125.

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

PY 124 Solar System Astronomy  (3 credit hours)
Introductory, descriptive survey of the solar system designed primarily for non-science majors, including current results from space probes, history of astronomy, and the motions of the moon, stars, and planets in the night sky. Complementary course covering stars, galaxies and cosmology (PY 123). Companion laboratory course (PY 125).

GEP Natural Sciences
Typically offered in Fall and Spring

PY 125 Astronomy Laboratory  (1 credit hours)
Introduction to astronomical observing. Twelve exercises include astronomical instruments; the nature of light; Kepler’s and Newton’s laws of motion; the constellations, planets, binary stars, stellar clusters, and galaxies. Use of small telescopes to observe celestial objects.
Corequisite: PY 123 or 124
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

PY 131 Conceptual Physics  (4 credit hours)

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

PY 201 University Physics I  (4 credit hours)
First course of three semester sequence for students majoring in physical and mathematical sciences. Calculus used throughout. Principles of classical Newtonian mechanics covered in detail.
Corequisite: MA 141. Credit is not allowed for both PY 201 and PY 205 or PY 211.
Typically offered in Fall only

PY 202 University Physics II  (4 credit hours)
Second course of three semester sequence designed primarily for students majoring in physical and mathematical sciences. Calculus used throughout. Principles of electricity and magnetism covered in detail.
Prerequisite: PY 201, MA 141, Corequisite: MA 241. Credit is not allowed for both PY 202 and PY 208 or PY 211.
Typically offered in Spring only

PY 203 University Physics III  (4 credit hours)
Third course of three semester sequence designed primarily for students majoring in physical and mathematical sciences. Calculus is used throughout. Principles of wave optics and modern physics are covered in detail.
Prerequisite: PY 202, MA 241, Corequisite: MA 242
Typically offered in Fall only

PY 205 Physics for Engineers and Scientists I  (3 credit hours)
First semester of a two-semester sequence in introductory physics, with coordinated problem-solving experiences. A calculus-based study of mechanics, sound and heat. Credit not allowed for more than one of PY 205, PY 201, and PY 211.
Prerequisite: MA 141 with a grade of C- or better or MA 241 PL. Credit is not allowed for both PY 205 and PY 201 or PY 211. Co-requisite: PY 206. ADD BOTH PY 205 and PY 206 TO YOUR SHOPPING CART AND THEN ENROLL SIMULTANEOUSLY
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

PY 206 Physics for Engineers and Scientists I Laboratory  (1 credit hours)
Laboratory course to accompany the PY 205 lecture course. A calculus-based study of mechanics, sound and heat.
Prerequisite: MA 141 with a grade of C- or better or MA 241 Placement. Co-requisite: PY 205. ADD BOTH PY 205 and PY 206 TO YOUR SHOPPING CART AND THEN ENROLL SIMULTANEOUSLY
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

PY 208 Physics for Engineers and Scientists II  (3 credit hours)
Second semester of a two-semester sequence in introductory physics. A calculus-based study of electricity, magnetism, optics and modern physics. Credit not allowed for more than one of PY 208, PY 202, and PY 212.
Prerequisite: C- or better in PY 205 and C- or better in MA 241. Credit is not allowed for both PY 208 and PY 202 or PY 212. Co-requisite: PY 209. ADD BOTH PY 208 and PY 209 TO YOUR SHOPPING CART AND THEN ENROLL SIMULTANEOUSLY
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

PY 209 Physics for Engineers and Scientists II Laboratory  (1 credit hours)
Laboratory course to accompany the PY 208 lecture course. A calculus-based study of electricity, magnetism, optics and modern physics.
Pre-requisite: PY 205 with grade of C- or better, MA 241 with grade of C- or better, PY 206 with grade of C- or better. Co-requisite: PY 208. ADD BOTH PY 208 and PY 209 TO YOUR SHOPPING CART AND THEN ENROLL SIMULTANEOUSLY
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer
**PY 211 College Physics I** (4 credit hours)
First semester of a two-semester introductory sequence in non-calculus physics, with laboratory. Mechanics, heat, wave motion and sound. Credit not allowed for more than one of PY 211, PY 201 or PY 205
Prerequisite: MA 107 or 111 or 121 or 131 or 108 or 141 with a C- or better, or 480 on the SAT Subject Test in Mathematics Level 2 or the NCSU Math Skills Test, or 2 or better on an AP Calc exam. Credit is not allowed for both PY 211 & PY 201 or PY 205
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

**PY 212 College Physics II** (4 credit hours)
Second semester of a two-semester introductory sequence in non-calculus physics, with laboratory. Electricity, and magnetism, light, modern physics. Credit not allowed for more than one of PY 212, PY 202, and PY 208
Prerequisite: PY 211 or PY 205. Credit is not allowed for both PY 212 and PY 202 or PY 208.

Typically offered in Fall, Spring, and Summer

**PY 251 Introduction to Scientific Computing** (3 credit hours)
An introductory course in scientific computing for the physical and mathematical sciences using python and other open-source tools. Using a problem-oriented approach, students will learn the basic computing skills needed to conduct scientific research and to prepare for upper-level courses in science and engineering. Topics will include algorithm development, numerical methods, elements of programming, data analysis, and data visualization.
Prerequisite: MA 241; Corequisite: PY 202 or PY 208
Typically offered in Fall and Spring

**PY 252 Instrumental and Data Analysis for Physics** (2 credit hours)
Digital data acquisition and lab computers (e.g. using LabView or MatLab) are tools used in nearly all current physics research labs. By using both analysis and thorough lab experimental investigation the student will learn basic skills with electronic devices (osilloscope, power supplies, function generator, op-amps, high & low-pass filters, feedback circuits), electronic noise (measurement and analysis), and basic circuit construction methods (such as shielding/gounding, soldering).
Prerequisite: PY 202 or PY 208
Typically offered in Fall and Spring

**PY 299 Special Problems in Physics** (1-3 credit hours)
Study in experimental or analytical topics in classical and modern physics.
Typically offered in Fall, Spring, and Summer

**PY 301 Introduction to Quantum Mechanics** (3 credit hours)
An introduction to wave mechanics and quantum phenomena including the Schroedinger equation for simple systems, the Hamiltonian operator, the use of commutator relations, and the application of angular momentum operators. Emphasis on mathematical tools used in wave mechanics, including complex numbers, function operators, eigenvalues and eigenvectors.
Prerequisite: C- or better in PY 203 or PY 407
Typically offered in Fall only

**PY 328 Stellar and Galactic Astrophysics** (3 credit hours)
Introduction to the study of stars, galaxies, and the universe. Stars and stellar evolution; interstellar medium; galaxies and galaxy clusters; cosmology. Recent developments in the understanding of neutron stars, black holes, active galaxies, quasars and inflationary cosmologies.
Prerequisite: PY 202 or PY 208
Typically offered in Fall only

**PY 341 Relativity, Gravitation and Cosmology** (3 credit hours)
Introduction to relativity, gravitation and cosmology in accordance with Einstein's special and general theories of relativity. Flat spacetime: Minkowski metric, time dilation, length contraction, doppler effect, twin paradox, and space travel. Curved spacetime: Schwarzchild metric, black holes and event horizons, particle and light motion, Global positioning system, precession of planetary orbits. Cosmology: hubble law, expansion of the universe, Friedman-Robertson-Walker metric, big bang, cosmological redshift, dark matter and dark energy.
Prerequisite: C- or better in PY 203 or PY 407
Typically offered in Spring only

**PY 401 Quantum Physics I** (3 credit hours)
An introduction to the basic principles of quantum physics with an emphasis on selected applications to atoms, molecules, solids, nuclei and elementary particles.
Prerequisite: Grade of C- or better in PY 411 and grade of C- or better in PY 203.
Typically offered in Spring only

**PY 402 Quantum Physics II** (3 credit hours)
An introduction to the basic principles of quantum physics with an emphasis on selected applications to atoms, molecules, solids, nuclei and elementary particles.
Prerequisite: C- or better in PY 401
Typically offered in Spring only

**PY 407 Introduction to Modern Physics** (3 credit hours)
Major developments in modern physics: special relativity, origin of the quantum theory, atomic and molecular structure, radioactivity, properties of nuclei. Credit not allowed for both PY 203 and PY 407
Prerequisite: MA 242, PY 208
Typically offered in Spring only

**PY 411/PY 511 Mechanics I** (3 credit hours)
First semester of a two-semester sequence in particle and continuum mechanics at the intermediate level. Focuses on single-particle dynamics: Elementary Newtonian mechanics, harmonic oscillator, central force motion, conservation laws, motion in non-inertial frames, Coriolis and centrifugal forces, Lagrangian dynamics, Hamilton's equations.
"Co-requisite: MA 341"
Typically offered in Spring only

**PY 412/PY 512 Mechanics II** (3 credit hours)
Second semester of a two-semester sequence in particle and continuum mechanics at the intermediate level. Focuses on dynamics of systems of particles and continua: Center of mass, collisions, rigid bodies, inertia tensor, principal axes, stress and strain tensors, mechanical properties of fluids and solids; Waves in discrete and continuum systems, coupled oscillators, normal modes, elements of special relativity.
Prerequisite: C- or better in PY 411
Typically offered in Fall only
PY 413 Thermal Physics (3 credit hours)
An introduction to statistical mechanics and thermodynamics. The statistical study of physical systems emphasizing the connection between the statistical description of macroscopic systems and classical thermodynamics. Concepts of heat, internal energy, temperature and entropy. Classical and quantum statistical distributions.
Prerequisite: PY 203 or PY 407; Corequisite: MA 341
Typically offered in Spring only

PY 414/PY 514 Electromagnetism I (3 credit hours)
First semester of a two-semester sequence. An intermediate course in electromagnetic theory using the methods of vector calculus. Electrostatic field and potential, dielectrics, solution to Laplace’s and Poisson’s equations, magnetic fields of steady currents.
Prerequisite: C- or better in PY 203 or C- or better in PY 407, and MA 341
Typically offered in Fall only

PY 415/PY 515 Electromagnetism II (3 credit hours)
A continuation of PY 414. Electromagnetic induction, magnetic fields in matter, Maxwell’s equations, wave guides, radiation.
Prerequisite: C- or better in PY 414
Typically offered in Spring only

PY 452 Advanced Physics Laboratory (3 credit hours)
Introduction to laboratory electronics and instrumentation. Experiments in mechanics; electromagnetism; electronics; optics; and atomic, nuclear, plasma and solid state physics. Senior Physics students only
Prerequisite: Senior standing, Physics Majors
Typically offered in Fall and Spring

PY 489/PY 589/ECE 489/ECE 589/MSE 489/MSE 589 Solid State Solar and Thermal Energy Harvesting (3 credit hours)
This course studies the fundamental and recent advances of energy harvesting from two of the most abundant sources, namely solar and thermal energies. The first part of the course focuses on photovoltaic science and technology. The characteristics and design of common types of solar cells is discussed, and the known approaches to increasing solar cell efficiency will be introduced. After the review of the physics of solar cells, we will discuss advanced topics and recent progresses in solar cell technology. The second part of the course is focused on thermoelectric effect. The basic physical properties, Seebeck coefficient, electrical and thermal conductivities, are discussed and analyzed through the Boltzmann transport formalism. Advanced subject such as carrier scattering time approximations in relation to dimensionality and the density of states are studied. Different approaches for further increasing efficiencies are discussed including energy filtering, quantum confinement, size effects, band structure engineering, and phonon confinement.
P: ECE 302 or E 304 or MSE 355 or PY 407
Typically offered in Fall only

PY 495 Special Topics in Physics (1-4 credit hours)
Special Topics in theoretical, experimental, or computational physics at the advanced undergraduate level. Course offerings vary from semester to semester. Course may be repeated if course content varies.
Typically offered in Fall, Spring, and Summer

PY 499 Independent Research in Physics (1-6 credit hours)
Study and research in physics. Topics for experimental or theoretical investigation. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member
Typically offered in Fall, Spring, and Summer

PY 501 Quantum Physics I (3 credit hours)
Basic principles of quantum physics with emphasis on selected applications to atoms, molecules, solids, nuclei and elementary particles. PY 501 - first semester in two-semester sequence in quantum mechanics; PY 501 - second semester of sequence. Credit for both PY 401 and PY 501 is not allowed
Prerequisite: Graduate Level Status in Physics or Physics Departmental Approval
Typically offered in Spring only

PY 502 Quantum Physics II (3 credit hours)
Basic principles of quantum physics with emphasis on selected applications to atoms, molecules, solids, nuclei and elementary particles. PY 502 - second semester in two-semester sequence in quantum mechanics; PY 501, first semester of sequence. Credit for both PY 402 and PY 502 is not allowed.
Prerequisite: PY 501
Typically offered in Fall only

PY 506 Nuclear and Subatomic Physics (3 credit hours)
Introduction to nuclear and subatomic phenomena: properties of nuclear radiations and detectors, accelerators, nuclear forces and nuclear structure, elementary particles, fundamental symmetries and conservation laws.
Prerequisite: PY 203 or 407; PY 412
Typically offered in Fall only

PY 507 Elementary Particle Physics (3 credit hours)
Introduction to fundamental symmetries and dynamics of quarks and leptons. The Standard Model, Dirac equation, Feynman rules in QED and QCD, the Higgs mechanism and electroweak unification.
Prerequisite: PY 401 and PY 506
Typically offered in Spring only

PY 509 General Relativity (3 credit hours)
This course provides in-depth knowledge of general relativity covering: Einstein’s equation, Schwarzschild metric, Kerr metric, Friedmann-Robertson-Walker metric, Christoffel symbols, Killing vectors, Riemann curvature, and Ricci tensors. Theoretical computations are compared with experimental data including the precession rate of the perihelion for Mercury and the deflection in the solar eclipse, the geodetic effect and the frame dragging effect measured in Gravity Probe B experiment.
P: MA 401 and MA 405 and PY 412 and PY 415; R: Graduate Standing
Typically offered in Fall only

PY 511/PY 411 Mechanics I (3 credit hours)
First semester of a two-semester sequence in particle and continuum mechanics at the intermediate level. Focuses on single-particle dynamics: Elementary Newtonian mechanics, harmonic oscillator, central force motion, conservation laws, motion in non-inertial frames, Coriolis and centrifugal forces, Lagrangian dynamics, Hamilton's equations.
*Co-requisite: MA 341*
Typically offered in Spring only


**PY 512/PY 412 Mechanics II** (3 credit hours)
Second semester of a two-semester sequence in particle and continuum mechanics at the intermediate level. Focuses on dynamics of systems of particles and continua: Center of mass, collisions, rigid bodies, inertia tensor, principal axes, stress and strain tensors, mechanical properties of fluids and solids; Waves in discrete and continuum systems, coupled oscillators, normal modes, elements of special relativity.

Prerequisite: C- or better in PY 411
Typically offered in Fall only

**PY 514/PY 414 Electromagnetism I** (3 credit hours)
First semester of a two-semester sequence. An intermediate course in electromagnetic theory using the methods of vector calculus. Electrostatic field and potential, dielectrics, solution to Laplace’s and Poisson’s equations, magnetic fields of steady currents.

Prerequisite: C- or better in PY 203 or C- or better in PY 407, and MA 341
Typically offered in Fall only

**PY 515/PY 415 Electromagnetism II** (3 credit hours)
A continuation of PY 414. Electromagnetic induction, magnetic fields in matter, Maxwell’s equations, wave guides, radiation.

Prerequisite: C- or better in PY 414
Typically offered in Spring only

**PY 516 Physical Optics** (3 credit hours)
Physical optics with major emphasis on wave properties of light. Boundary conditions, interference and diffraction, optics of thin films, fiber optics and applications to absorption, scattering and laser operation. A background in Maxwell’s equations and vector analysis required.

Prerequisite: PY 415
Typically offered in Fall only

**PY 517 Atomic and Molecular Physics** (3 credit hours)
The quantum mechanical treatment of structure and spectra for atoms and molecules. The hydrogen atom, helium atom, multielectron atoms, selection rules, diatomic and simple polyatomic molecules and nuclear magnetic resonance spectroscopy.

Prerequisite: PY 401, 412
Typically offered in Spring only

**PY 519 Biological Physics** (3 credit hours)
This course presents the application of physics principles and methods to problems in biological systems. Important biological molecules, their structures and their processes are introduced for physical scientists. Functional mechanisms are analyzed with concepts from thermodynamics, statistical mechanics, fluid mechanics, and electrostatics. Modern experimental methods and computational approaches to molecular and cellular level biological phenomena are emphasized.

Prerequisite: PY 413 or Graduate Standing
Typically offered in Spring only

**PY 525 Computational Physics** (3 credit hours)
Computational approach to physics problem solving using standard software relevant for physicists. Electrostatic potentials, data analysis, Monte Carlo simulations, Fourier optics, particle orbits, Schrodinger’s equation. Examples and assignments for each topic chosen to complement other physics courses.

Prerequisite: CSC 112 or equivalent; Corequisite: of PY 401
Typically offered in Fall only

**PY 528/NE 528 Introduction to Plasma Physics and Fusion Energy** (3 credit hours)
Concepts in plasma physics, basics of thermonuclear reactions; charged particle collisions, single particle motions and drifts, radiation from plasmas and plasma waves, fluid theory of plasmas, formation and heating of plasmas, plasma confinement, fusion devices and other plasma applications.

Prerequisite: MA 401 and PY 208
Typically offered in Fall only

**PY 529/NE 529 Plasma Physics and Fusion Energy II** (3 credit hours)
This course expands on the treatment of plasmas as a system of coupled fluids and introduces the foundations of plasma kinetic theory. Derivation of the plasma kinetic equation and the Vlasov equation serve as the starting point to introduce the kinetic study of plasma systems. From this introduction of the governing equations for full kinetic treatment, methods for analyzing plasma response to electromagnetic and electrostatic perturbations using the linearized Vlasov model for uncorrelated plasmas are introduced. Kinetic stability of Vlasov plasmas is introduced and the Nyquist method is used to determine conditions for kinetic stability. The concept of correlated plasmas is then introduced through the introduction of reduced distribution functions and the BBGKY hierarchy. Finally, simple correlated systems and the Liouville model for two-system correlation is covered to look at the impact of particle correlation due to collisions and coulomb interaction.

Prerequisite: NE 528
Typically offered in Spring only

**PY 543 Astrophysics** (3 credit hours)
Basic physics necessary to investigate, from observational data, internal conditions and evolution of stars. The formation and structure of spectral lines, methods of energy generation and transport, stellar structure, degeneracy, white dwarfs and neutron stars.

Prerequisite: PY 203 or 407; PY 411
Typically offered in Spring only

**PY 552 Condensed Matter Physics I** (3 credit hours)
Basic considerations of crystalline solids, metals, conductors and semiconductors.

Prerequisite: C- or better in PY 401
Typically offered in Spring only

**PY 570/TE 570 Polymer Physics** (3 credit hours)
Polymer microstructures, polymer solutions, polymer physical states (including amorphous polymers, crystalline polymers, polymer melts, melting of polymers, glass-transition, and other transitions), polymer blends, polymer mechanical properties, polymer viscoelasticity and flow, multicomponent polymer systems, and modern polymer topics. The physics of polymer fibers. Graduate standing or permission of instructor.

Typically offered in Fall only
**PY 581 Matter & Interactions for Teachers I** (3 credit hours)
First semester (mechanics) of a two-semester sequence intended to broaden and deepen in high school physics teachers their knowledge of introductory-level physics from a contemporary point of view. Includes an introduction to computational physics.  
_Typically offered in Spring only_

**PY 582 Matter & Interactions for Teachers II** (3 credit hours)
Second semester (electricity and magnetism) of a two-semester sequence intended to broaden and deepen in high school physics teachers their knowledge of introductory-level physics from a contemporary point of view. Includes an introduction to computational physics.  
_Typically offered in Fall only_

**PY 589/ECE 489/ECE 589/MSE 489/MSE 589/PY 489 Solid State Solar and Thermal Energy Harvesting** (3 credit hours)
This course studies the fundamental and recent advances of energy harvesting from two of the most abundant sources, namely solar and thermal energies. The first part of the course focuses on photovoltaic science and technology. The characteristics and design of common types of solar cells is discussed, and the known approaches to increasing solar cell efficiency will be introduced. After the review of the physics of solar cells, we will discuss advanced topics and recent progresses in solar cell technology. The second part of the course is focused on thermoelectric effect. The basic physical properties, Seebeck coefficient, electrical and thermal conductivities, are discussed and analyzed through the Boltzmann transport formalism. Advanced subject such as carrier scattering time approximations in relation to dimensionality and the density of states are studied. Different approaches for further increasing efficiencies are discussed including energy filtering, quantum confinement, size effects, band structure engineering, and phonon confinement.

_P: ECE 302 or E 304 or MSE 355 or PY 407_
_Typically offered in Fall only_

**PY 590 Special Topics In Physics** (1-6 credit hours)
Investigations in physics under staff guidance. May consist of literature reviews, experimental or theoretical projects or special topics lectures.  
_Credits Arranged_

_Typically offered in Fall, Spring, and Summer_

**PY 599 Special Topics in Physics** (1-6 credit hours)
Investigations in physics under staff guidance. May consist of literature reviews, experimental or theoretical projects or special topics lectures.  
_Credits arranged_

_Typically offered in Fall, Spring, and Summer_

**PY 601 Seminar** (1 credit hours)
Reports on topics of current interest in physics. Several sections offered so that students with common research interests may be grouped together.  
_Typically offered in Fall and Spring_

**PY 610 Special Topics** (1-6 credit hours)
Investigations in physics under staff guidance. May consist of literature reviews, experimental or theoretical projects or special topics lectures.  
_Credits Arranged_

_Typically offered in Fall and Spring_

**PY 615 Advanced Special Topics In Physics** (1-6 credit hours)
Advanced study in astrophysics, atomic and molecular physics, condensed matter physics, nuclear physics or plasma physics. Emphasis on new and rapidly developing research areas.  
_Typically offered in Fall and Spring_

**PY 685 Master's Supervised Teaching** (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.  
_Prerequisite: Master's student_

_Typically offered in Fall, Spring, and Summer_

**PY 693 Master's Supervised Research** (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.  
_Prerequisite: Master's student_

_Typically offered in Spring only_

**PY 695 Master's Thesis Research** (1-9 credit hours)
The student carries out a thesis or report under the supervision of a member of the Graduate Faculty.  
_Prerequisite: Master's student_

_Typically offered in Fall, Spring, and Summer_

**PY 696 Summer Thesis Research** (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.  
_Prerequisite: Master's student_

_Typically offered in Summer only_

**PY 699 Master's Thesis Preparation** (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.  
_Credits Arranged_

**PY 711 Advanced Quantum Mechanics I** (3 credit hours)
Introduction to relativistic quantum theory of Dirac particles and the positron. Other topics including second quantization technique and its application to many-body problems, radiation theory and quantization of the electromagnetic field.  
_Prerequisite: MA 512, PY 782_

_Typically offered in Fall, Spring, and Summer_

**PY 712 Advanced Quantum Mechanics II** (3 credit hours)
A general propagator treatment of Dirac particles, photons and scalar and vector mesons. Applications of Feynman graphs and rules illustrating basic techniques employed in treatment of electromagnetic, weak and strong interactions. Renormalization theory, the effects of radiative corrections and aspects of the general Lorentz covariant theory of quantized fields.  
_Prerequisite: PY 711_

_Typically offered in Spring only_
**PY 721 Statistical Physics I** (3 credit hours)
Basic elements of kinetic theory and equilibrium statistical mechanics, both classical and quantum; applications of the techniques developed to various ideal models of noninteracting particles.
Prerequisite: PY 401, PY 413
*Typically offered in Spring only*

**PY 722 Statistical Physics II** (3 credit hours)
A continuation of PY 721, with emphasis on the static and dynamic properties of real (interacting) systems. Topics including equilibrium theory of fluids and linear response theory of time-dependent phenomena.
Prerequisite: PY 721
*Typically offered in Fall only*

**PY 753 Condensed Matter Physics II** (3 credit hours)
The properties of semiconductors, superconductors, magnets, ferroelectrics and crystalline defects and dislocations.
Prerequisite: PY 552
*Typically offered in Fall only*

**PY 755 Dielectric Films and their Interfaces** (3 credit hours)
This course addresses: i) local atomic structure of non-crystalline/amorphous dielectrics - experimental methods and theory; ii) classification of dielectric materials - by bond ionicity, bond density and bonding contraints/atom to discriminate between ideal covalent random networks, disrupted networks, and nano-crystallinity; iii) thermally-grown silicon dioxide and its interface with Si - the standard for alternative dielectrics; iv) electronic structure and bonding in transition metal/lathanide rare earth dielectrics; and v) intrinsic limitations on the performance and reliability of metal-oxide-semiconductor devices.
Prerequisite: PY 552
*Typically offered in Spring only*

**PY 781 Quantum Mechanics I** (3 credit hours)
Fundamental concepts and formulations, including interpretation and techniques, and the application of theory to simple physical systems, such as the free particle, the harmonic oscillator, the particle in a potential well and central force problems. Other topics including approximation methods, identical particles and spin, transformation theory, symmetries and invariance, and an introduction to quantum theory of scattering and angular momentum.
Prerequisite: MA 512; PY 411 or 414; Graduate standing
*Typically offered in Fall only*

**PY 782 Quantum Mechanics II** (3 credit hours)
Fundamental concepts and formulations, including interpretation and techniques, and the application of theory to simple physical systems, such as the free particle, the harmonic oscillator, the particle in a potential well and central force problems. Other topics including approximation methods, identical particles and spin, transformation theory, symmetries and invariance, and an introduction to quantum theory of scattering and angular momentum.
Prerequisite: MA 512; PY 411 or 414; Graduate standing
*Typically offered in Spring only*

**PY 783 Advanced Classical Mechanics I** (3 credit hours)
Introduction to theoretical physics in preparation for advanced study. Emphasis on classical mechanics, special relativity and the motion of charged particles. Topics including variational principles, Hamiltonian dynamics and canonical transformation theory, structure of the Lorentz group and elementary dynamics of unquantized fields.
Prerequisite: MA 512, PY 412, PY 414; Graduate standing
*Typically offered in Fall only*

**PY 785 Advanced Electricity and Magnetism I** (3 credit hours)
Topics including techniques for solution of potential problems, development of Maxwell's equations; wave equations, energy, force and momentum relations of an electromagnetic field; covariant formulation of electrodynamics; radiation from accelerated charges.
Prerequisite: PY 415; Graduate standing
*Typically offered in Fall only*

**PY 786 Advanced Electricity and Magnetism II** (3 credit hours)
Topics including techniques for solution of potential problems, development of Maxwell's equations; wave equations, energy, force and momentum relations of an electromagnetic field; covariant formulation of electrodynamics; radiation from accelerated charges.
Prerequisite: PY 415; Graduate standing
*Typically offered in Spring only*

**PY 790 Special Topics in Physics** (1-99 credit hours)
Reports on topics of current interest in physics. Several sections offered so that students with common research interests may be grouped together.
Typically offered in Fall and Spring

**PY 801 Seminar** (1 credit hour)
Investigations in physics under staff guidance. May consist of literature reviews, experimental or theoretical projects or special topics lectures.
Credits Arranged
Typically offered in Fall and Spring

**PY 885 Doctoral Supervised Teaching** (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Spring only

**PY 890 Doctoral Preliminary Examination** (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

**PY 893 Doctoral Supervised Research** (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Spring only
Typically offered in Spring only
level physics and chemistry
P: BCH451 and BCH553 (or equivalents) and one year each of college-
address cardiovascular, respiratory, and renal physiology in humans.
In this course, we will
and be able to integrate knowledge and concepts from various organ
function of cells, tissues, organs, and organ systems of the human body
Students will learn the fundamental mechanisms underlying normal
molecular to organismal level. As such, this course will build on your
knowledge of anatomy, biochemistry, and cell biology and also presumes
a working knowledge of the basics of college level physics and chemistry.
Students will learn the fundamental mechanisms underlying normal
function of cells, tissues, organs, and organ systems of the human body
and be able to integrate knowledge and concepts from various organ
systems to explain function in the human body. In this course, we will
address cellular, neural, muscular, and gastrointestinal physiology in humans.
P: BCH451 and BCH553 (or equivalents) and one year each of college-
level physics and chemistry
Typically offered in Fall only

Comparative Reproductive Physiology and Biotechnology (3 credit hours)
Comparative approach to examining aspects of reproductive physiology in selected vertebrate species. Detailed examination of current reproductive biotechnologies and ethical issues associated with the application of reproductive biotechnologies. Credit

Prerequisite: ANS 220
Typically offered in Fall only

General Physiology I (3 credit hours)
Physiology is the study of the how living systems function from the molecular to organismal level. As such, this course will build on your knowledge of anatomy, biochemistry, and cell biology and also presumes a working knowledge of the basics of college level physics and chemistry. Students will learn the fundamental mechanisms underlying normal function of cells, tissues, organs, and organ systems of the human body and be able to integrate knowledge and concepts from various organ systems to explain function in the human body. In this course, we will address cellular, neural, muscular, and gastrointestinal physiology in humans.
P: BCH451 and BCH553 (or equivalents) and one year each of college-
level physics and chemistry
Typically offered in Fall only

General Physiology II (3 credit hours)
Physiology is the study of the how living systems function from the molecular to organismal level. As such, this course will build on your knowledge of anatomy, biochemistry, and cell biology and also presumes a working knowledge of the basics of college level physics and chemistry. Students will learn the fundamental mechanisms underlying normal function of cells, tissues, organs, and organ systems of the human body and be able to integrate knowledge and concepts from various organ systems to explain function in the human body. In this course, we will address cardiovascular, respiratory, and renal physiology in humans.
P: BCH451 and BCH553 (or equivalents) and one year each of college-
level physics and chemistry
Typically offered in Spring only

Comparative Reproductive Physiology and Biotechnology (3 credit hours)
Comparative approach to examining aspects of reproductive physiology in selected vertebrate species. Detailed examination of current reproductive biotechnologies and ethical issues associated with the application of reproductive biotechnologies. Credit

Prerequisite: Doctoral student
Typically offered in Summer only

Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student

Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Doctoral Dissertation Research (1 credit hours)

Special Topics in Physiology (1-6 credit hours)
The study of special problems and selected topics of current interest in physiology and related fields.
Typically offered in Spring only

Graduate Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

Special Problems In Physiology (1-6 credit hours)
Credits Arranged
Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

Special Topics In Physiology (1-6 credit hours)

Master’s Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

Master’s Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.
Prerequisite: Master's student
Typically offered in Summer only

Master’s Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer
PHY 695  Master's Thesis Research  (1-9 credit hours)  
Thesis Research  
Prerequisite: Master's student  
Typically offered in Fall, Spring, and Summer

PHY 696  Summer Thesis Research  (1 credit hours)  
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.  
Prerequisite: Master's student  
Typically offered in Summer only

PHY 699  Master's Thesis Preparation  (1-9 credit hours)  
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.  
Prerequisite: Master's student  
Typically offered in Fall, Spring, and Summer

PHY 702/ANS 702  Reproductive Physiology of Mammals  (3 credit hours)  
Survey of reproductive strategies among vertebrates; in-depth coverage of mammalian reproductive physiology; gametogenesis, fertilization, embryonic and fetal development, parturition, puberty, neuroendocrine control mechanisms in male and female mammals.  
Prerequisite: ZO 421  
Typically offered in Fall and Spring

PHY 764/CBS 764/NTR 764  Advances in Gastrointestinal Pathophysiology  (3 credit hours)  
This course will focus on advanced gastrointestinal physiology and the pathophysiology of diseases of relevance to scientists involved in animal-related research. In particular, the course will cover the pathophysiology of ulceration, infectious diarrhea, ischemia, motility disorders, and inflammatory diseases of the gut. An in-depth review paper will be required based on recent literature regarding a specific gastrointestinal disease.  
Prerequisite: PHY 503, PHY 504  
Typically offered in Fall only

PHY 780/ANS 780  Mammalian Endocrinology  (3 credit hours)  
Mammalian endocrine system with emphasis on ontogeny and anatomy of key organs; synthesis and action of hormones. Role of hormones in regulation of physiological processes such as metabolism, exocrine function, digestion, ion balance, behavior, lactation, growth and reproduction.  
Prerequisite: BCH 451, ZO 421

PHY 795  Special Topics in Physiology  (1-9 credit hours)  
The study of special problems and selected topics of current interest in physiology and related fields.  
Typically offered in Fall and Spring

PHY 801  Physiology Seminar  (1 credit hours)  
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.  
Prerequisite: Graduate standing  
Typically offered in Spring only

PHY 810  Special Topics In Physiology  (1-4 credit hours)  
The study of special problems and selected topics of current interest in physiology and related fields.  
Prerequisite: Graduate standing  
Typically offered in Fall and Spring

PHY 820  Special Problems In Physiology  (1-6 credit hours)  
Credits Arranged  
Prerequisite: Graduate standing  
Typically offered in Fall and Spring

PHY 855  Doctoral Supervised Teaching  (1-3 credit hours)  
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.  
Prerequisite: Doctoral student  
Typically offered in Summer only

PHY 890  Doctoral Preliminary Examination  (1-9 credit hours)  
For students who are preparing for and taking written and/or oral preliminary exams.  
Prerequisite: Doctoral student  
Typically offered in Fall, Spring, and Summer

PHY 893  Doctoral Supervised Research  (1-9 credit hours)  
Instruction in research and research under the mentorship of a member of the Graduate Faculty.  
Prerequisite: Doctoral student  
Typically offered in Fall, Spring, and Summer

PHY 895  Doctoral Dissertation Research  (1-9 credit hours)  
Dissertation Research  
Prerequisite: Doctoral student  
Typically offered in Fall, Spring, and Summer

PHY 896  Summer Dissertation Research  (1 credit hours)  
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.  
Prerequisite: Doctoral student  
Typically offered in Fall only

PHY 899  Doctoral Dissertation Preparation  (1-9 credit hours)  
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.  
Prerequisite: Doctoral student  
Typically offered in Fall, Spring, and Summer

Plant Biology (PB)

PB 103  Perspectives on Botany  (1 credit hours)  
Orientation to modern botany, including discussions of historical background, relation to other sciences, the nature of modern subdisciplines, professionalism and ethics, local resources of personnel and facilities, educational opportunities, and career possibilities.  
Typically offered in Fall only
PB 200  Plant Life  (4 credit hours)
An introduction to the structure, processes, and reproduction of higher plants, including the diversity of the plant kingdom and principles of inheritance, ecology, and evolution. Students cannot receive credit for both PB 200 and PB 250.

GEP Natural Sciences
Typically offered in Fall and Spring

PB 205  Our Green World  (3 credit hours)
Awareness and understanding of plants in the world for the non-science student. Essential fundamental concepts of plant structure, growth, processes, uses, biotechnology, evolution, environmental issues and ecology. Short field trips will be held that may require students to provide their own transportation. Credit cannot be received for both PB 205 and PB 200 (or PB 250).

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

PB 208/AEE 208/ANS 208  Agricultural Biotechnology: Issues and Implications  (3 credit hours)
Trends and issues of agricultural biotechnology in today's society are addressed while covering the basic biological science behind the technology. Applications of and policy issues associated with plant, animal, and environmental biotechnology used in the agricultural industry are examined from an interdisciplinary approach.

Prerequisite: (BIO 105 or BIO 115 or BIO 181 or BIO 183)
GEP Interdisciplinary Perspectives
Typically offered in Spring only

PB 213  Plants and Civilization  (3 credit hours)
This course covers plant use in ancient civilizations, including the economic, social, political, religious, culinary and medical roles of plants and plant products. Plant use in ancient cultures, including but not limited to, Amazonian, Celtic, Chinese, Egyptian, Greek, Inca, Indian, Maya, Mesopotamian, Nubian, Persian, and Roman will be discussed. Topics include foods, beverages, medicines, fibers, construction materials, psychoactive drugs, and religious symbols.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

PB 215  Medicinal Plants  (3 credit hours)
Plants and their derived pharmaceuticals in Western medicine and in herbal medicine.

Prerequisite: CH 101 and any one of the following courses: BIO 125, BIO 181, PB 200, ZO 150, ZO 160
Typically offered in Fall only

PB 219  Plants in Folklore, Myth, and Religion  (3 credit hours)
The structural and functional biology of plants and cultural inclusions in folklore, myth, and religion. The myth/religion-plant-human culture nexus. Mythical and religious themes covered, but not limited to, are: the world tree and cosmic order; plants and the creation of Earth; the unity of plants and divine entities; the tree of life; life-giving waters and human immortality; human descent from plants; origin of food plants from humans; plants of witchcraft and magic; psychoactive plants and access to deities; solidarity between humans and plants; death and resurrection of plants and humans.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Summer

PB 220  Local Flora  (3 credit hours)
Structural terminology of vascular plants, field identification of plant species by sight and using taxonomic keys, description of natural community types, including their soil and topographic features. Two Saturday field trips required.

Prerequisite: BIO 105 or BIO 181 or PB 200
GEP Natural Sciences
Typically offered in Fall only

PB 250  Plant Biology  (4 credit hours)
An introduction for Life Science majors to the ecology, structure, function, processes, reproduction and evolution of higher plants. Students may not receive credit for both PB 200 and PB 250.

Prerequisite: BIO 181 and BIO 183
Typically offered in Fall only

PB 277  Space Biology  (3 credit hours)
Overview of the biology of plants, animals, and humans in the space environment, including gravitational biology, aerospace medicine, astrobiology, search for extraterrestrial life, terraforming, and life support.

Prerequisite: BIO 105 or BIO 181 or BIO 183 or PB 200
GEP Natural Sciences
Typically offered in Fall only

PB 295  Special Topics in Botany  (1-4 credit hours)
Trial offerings of new or experimental courses in Botany at the early undergraduate level.

Typically offered in Fall, Spring, and Summer

PB 321  Introduction to Whole Plant Physiology  (3 credit hours)
Physiology of higher plants with emphasis on whole plant aspects including structure-function relationships, water and solute movement, energy sources and needs, plant growth and development, and the impact of plant physiology findings on agriculture. Students cannot receive credit for both PB 321 and PB 421.

Prerequisite: (BIO 183 or PB 200 or PB 250) and CH 101/102
Typically offered in Spring only

PB 325  Culinary Botany  (3 credit hours)
This course explores the ethnobotany, taxonomic diversity, and unique physical and chemical characteristics of important food and beverage plants used by peoples in different regions of the world. After an introduction to plant domestication and agricultural origins, most course weeks are spent examining the culturally significant edible flora of a different geographic region, combining short lectures on the botany of selected species, discussions about the uses of plant biocultural diversity, and, when feasible, hands-on activities where course participants can sample plant-based foods from each region. One Saturday field trip required.

Prerequisite: CS 213 or HS 201 or PB 200 or PB 250
Typically offered in Fall only
PB 345 Economic Botany (3 credit hours)
This course covers plants of economic importance that have been valued by societies regionally, nationally and globally from the modern era to the present day. Topics include, but are not limited to, plant species used as food, spices, beverages, oils, fibers, paper, dyes, perfumes, body care, construction materials, fuels and ornamentals. Aspects related to the botany and ethnobotany of economically important plant species will be discussed including taxonomy, anatomy, physiology, ecology, conservation, human uses, social and environmental issues, and roles in the economy.
Prerequisite: BIO 181 or PB 200 or PB 250
Typically offered in Spring only

PB 346 Economic Botany Lab (1 credit hours)
This lab course explores plants and plant products of economic importance through hands-on activities. Aspects related to the botany and ethnobotany of economically important plant species will be covered including taxonomy, anatomy, physiology, ecology, conservation, human uses, social and environmental issues, and roles in the economy.
"Co-requisite: PB 345"
Typically offered in Spring only

PB 360/AEC 360 Ecology (4 credit hours)
The science of ecology, including factors which control distribution and population dynamics of organisms, structure and function of biological communities, and energy flow and nutrient cycling in ecosystems; contrasts among the major biomes; and principles governing ecological responses to global climatic and other environmental changes.
Prerequisite: C- or better in BIO 181
Typically offered in Fall only

PB 400 Plant Diversity and Evolution (4 credit hours)
Diversity, morphology, taxonomy, and evolutionary history of living and fossil plants including fungi, algae, bryophytes, pteridophytes, gymnosperms, and angiosperms. Two one-day weekend field trips required.
Prerequisite: BIO 181 or PB 200 or PB 250
Typically offered in Spring only

PB 403/PB 503 Systematic Botany (4 credit hours)
The course introduces basic and contemporary systematic principles and methods as applied to vascular plants, with emphasis on flowering plants. It covers classification, identification, phylogenetics, and molecular approaches, and surveys important and common plant families representing major groups of vascular plants.
Prerequisite: PB 200, PB 250, BIO 183, Junior standing
Typically offered in Spring only

PB 407/PB 507 Medical Ethnobotany (3 credit hours)
This course covers traditional medical systems from a diversity of ancient and modern cultures, with an emphasis on the medicinal plants utilized within these healing traditions. Humans, as well as a number of other species, have utilized plants and other products from nature to treat their physical and spiritual ailments since prehistoric times. In addition to covering medicinal plant species and their known bioactivity, other topics will include traditional diagnostic techniques, complementary healing modalities, beliefs regarding health and illness, treatment and causes of spiritual diseases, food and spices as medicine, and ethical considerations in ethnobotanical research.
Typically offered in Spring only

PB 413/PB 513 Plant Anatomy (2 credit hours)
Organelles, cells, tissues and organs of flowering plants and selected gymnosperms. Emphasis placed on developmental patterns and structural adaptations for survival. Laboratory focuses on dissection, histochemistry, and imaging of plant cells and tissues. Students cannot reserve credit for both PB 413 and PB 513.
Prerequisite: PB 200 or PB 250 or PB 321 or PB 421
Typically offered in Spring only

PB 421 Plant Physiology (3 credit hours)
Physiology of higher plants with emphasis on biochemical, cell biological and molecular aspects of how plants function. Unique aspects of regulation of plant metabolism including photosynthesis, respiration, nitrogen fixation, cell wall biosynthesis, growth and stress responses will be emphasized. The course is intended for students interested in postgraduate studies in plant biology. Students cannot receive credit for both PB 321 and PB 421.
Prerequisite: BIO 183 or ZO 160, or PB 200 and CH 220 or CH 221 or CH 225
Typically offered in Fall only

PB 445/PB 545 Paleobotany (4 credit hours)
Morphologic, taxonomic, geologic and evolutionary relationships of fossil plants; emphasis on vascular plants; discussions of taphonomy, biogeography and palynology. Requires weekend field trips at student expense. Credit will not be allowed for both BO 445 and BO 545.
Prerequisite: BIO 181 or MEA 102

PB 450/PB 550 Plant Ecology (3 credit hours)
This course introduces students to the principles and methods of plant ecology. Topics include how individual plants extract resources from their environments; population dynamics and plant life histories; species interactions in communities; and global change ecology. The course emphasizes distinctive ways that plant natural history affects their ecology while also illustrating how plants can be ideal systems for studying general ecological problems. Undergraduate students gain hands-on ecological experience by gathering real data through field activities, and all students design independent research proposals.
Typically offered in Spring only

PB 464/PB 564 Rare Plants of North Carolina (3 credit hours)
This course provides a taxonomic survey of the rare plants of North Carolina, focusing primarily on federally- and secondarily on state-listed species. Particular attention will be placed on: (1) the identification of rare species, their congeners, and morphologically similar species, (2) the biogeography of rare species, (3) optimum survey windows, and (4) the conservation biology of select taxa. Two Saturday field trips required. Junior level or higher. Students cannot receive credit for both PB 464 and PB 564.
Prerequisite: One of the following: PB 200, PB 220, PB 403, or PB 405
Typically offered in Fall only
PB 480/PB 580  Introduction to Plant Biotechnology  (3 credit hours)
Introduction to gene cloning, plant tissue culture and transformation, and the development of agriculturally important transgenic traits. Critical thinking, case studies, and discussions are used to examine global approaches to the regulation and risks of genetically-modified organisms, plant and gene patents, and the consequences of these factors on food sovereignty and trade. Students cannot receive credit for both PB 480 and PB 580.
Prerequisite: BCH 454 or BIT 410 or CS 211 or GN 311 or PB/BIO 414 or PB 421.
Typically offered in Fall only

PB 481/BIT 481  Plant Tissue Culture and Transformation  (2 credit hours)
Basic techniques in plant tissue culture and transformation. Empirical approaches to techniques in plant tissue culture, designing transgenes for expression in specific plant cell organelles and tissues, use of reporter genes to optimize transformation, and troubleshooting transformation. Laboratory sessions provide hands-on experience with plant tissue culture and transformation. Use of reporter genes, fluorescence microscopy and digital imaging. Half semester course, first part.
Typically offered in Spring only

PB 488/ECE 488/PB 588/ECE 588  Systems Biology Modeling of Plant Regulation  (3 credit hours)
This course provides an introduction to the field of systems biology with a focus on mathematical modeling, gene regulatory network and metabolic pathway reconstruction in plants. Students will learn how to integrate biological data with mathematical, statistical, and computational approaches to gain new insights into structure and behavior of complex cellular systems. Students are expected to have a minimal background in calculus and basic biology. The course will build on these basic concepts and provide all students, regardless of background or home department, with the fundamental biology, mathematics, and computing knowledge needed to address systems biology problems.
Prerequisite: MA 131 or MA 141
Typically offered in Fall only

PB 492  External Learning Experience  (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.
Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

PB 493  SP Problems in BO  (1-6 credit hours)
A learning experience within an academic framework that utilizes campus facilities and resources. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.
Typically offered in Fall, Spring, and Summer

PB 495  Special Topics in Botany  (1-6 credit hours)
Offered as needed to present material not normally available in regular course offerings or for offering of new courses on a trial basis.
Typically offered in Fall, Spring, and Summer

PB 501/MB 501/PP 501  Biology of Plant Pathogens  (3 credit hours)
Biology of microbes that cause plant diseases. The ecology, genetics, physiology, taxonomy, and mechanisms of parasitism, pathogenicity and virulence of bacteria (and other prokaryotes), fungi (and oomycetes), nematodes, and viruses that cause plant diseases. Prepares graduate students for advanced courses in plant pathology, host-parasite interactions, and provides a knowledge base for students in other disciplines involved with plant pathogens or who seek to broaden their knowledge of microbes.
Prerequisite: PP 315, or PP 318, or an introductory course in microbiology
Typically offered in Fall only

PB 503/PB 403  Systematic Botany  (4 credit hours)
The course introduces basic and contemporary systematic principles and methods as applied to vascular plants, with emphasis on flowering plants. It covers classification, identification, phylogenetics, and molecular approaches, and surveys important and common plant families representing major groups of vascular plants.
Prerequisite: PB 200, PB 250, BIO 183, Junior standing
Typically offered in Spring only

PB 507/PB 407  Medical Ethnobotany  (3 credit hours)
This course covers traditional medical systems from a diversity of ancient and modern cultures, with an emphasis on the medicinal plants utilized within these healing traditions. Humans, as well as a number of other species, have utilized plants and other products from nature to treat their physical and spiritual ailments since prehistoric times. In addition to covering medicinal plant species and their known bioactivity, other topics will include traditional diagnostic techniques, complementary healing modalities, beliefs regarding health and illness, treatment and causes of spiritual diseases, food and spices as medicine, and ethical considerations in ethnobotanical research.
Typically offered in Spring only

PB 513/PB 413  Plant Anatomy  (2 credit hours)
Organelles, cells, tissues and organs of flowering plants and selected gymnosperms. Emphasis placed on developmental patterns and structural adaptations for survival. Laboratory focuses on dissection, histochemistry, and imaging of plant cells and tissues. Students cannot reserve credit for both PB 413 and PB 513.
Prerequisite: PB 200 or PB 250 or PB 321 or PB 421
Typically offered in Spring only

PB 545/PP 445  Paleobotany  (4 credit hours)
Morphologic, taxonomic, geologic and evolutionary relationships of fossil plants; emphasis on vascular plants; discussions of taphonomy, biogeography and palynology. Requires weekend field trips at student expense. Credit will not be allowed for both BO 445 and BO 545.
Prerequisite: BIO 181 or MEA 102
Typically offered in Spring only
PB 550/PB 450  Plant Ecology  (3 credit hours)
This course introduces students to the principles and methods of plant ecology. Topics include how individual plants extract resources from their environments; population dynamics and plant life histories; species interactions in communities; and global change ecology. The course emphasizes distinctive ways that plant natural history affects their ecology while also illustrating how plants can be ideal systems for studying general ecological problems. Undergraduate students gain hands-on ecological experience by gathering real data through field activities, and all students design independent research proposals.

Typically offered in Spring only

PB 559  Plant Water Relations  (2 credit hours)
Physical and biological mechanisms that govern water uptake, water transport, transpiration, and plant responses to drought; constraints and tradeoffs that limit evolution and artificial selection of drought tolerance; methods for studying water relations. Weekly lecture and paper discussions will draw upon examples from both crop and wild plants.

Typically offered in Spring only

PB 564/PB 464  Rare Plants of North Carolina  (3 credit hours)
This course provides a taxonomic survey of the rare plants of North Carolina, focusing primarily on federally- and secondarily on state-listed species. Particular attention will be placed on: (1) the identification of rare species, their congeners, and morphologically similar species, (2) the biogeography of rare species, (3) optimum survey windows, and (4) the conservation biology of select taxa. Two Saturday field trips required. Junior level or higher. Students cannot receive credit for both PB 464 and PB 564.

Prerequisite: One of the following: (PB 200, PB220, PB 403, or PB 405)
Typically offered in Fall only

PB 570  Plant Functional Ecology  (3 credit hours)
Mechanisms by which plants interact with their environment, with an emphasis on the role of physiological, morphological, and life history traits, and the evolution of these traits.

Prerequisite: PB/BIO 360
Typically offered in Fall only

PB 575/MB 575/PP 575  Introduction to Mycology  (4 credit hours)

Prerequisite: BS 125 or BS 181 and 183 or BO 200 or PP 315 or PP 318
Typically offered in Fall only

PB 580/PB 480  Introduction to Plant Biotechnology  (3 credit hours)
Introduction to gene cloning, plant tissue culture and transformation, and the development of agriculturally important transgenic traits. Critical thinking, case studies, and discussions are used to examine global approaches to the regulation and risks of genetically-modified organisms, plant and gene patents, and the consequences of these factors on food sovereignty and trade. Students cannot receive credit for both PB 480 and PB 580.

Prerequisite: BCH 454 or BIT 410 or CS 211 or GN 311 or PB/BIO 414 or PB 421.
Typically offered in Fall only

PB 588/ECE 588/PB 488/ECE 488  Systems Biology Modeling of Plant Regulation  (3 credit hours)
This course provides an introduction to the field of systems biology with a focus on mathematical modeling, gene regulatory network and metabolic pathway reconstruction in plants. Students will learn how to integrate biological data with mathematical, statistical, and computational approaches to gain new insights into structure and behavior of complex cellular systems. Students are expected to have a minimal background in calculus and basic biology. The course will build on these basic concepts and provide all students, regardless of background or home department, with the fundamental biology, mathematics, and computing knowledge needed to address systems biology problems.

Prerequisite: MA 131 or MA 141
Typically offered in Fall only

PB 595  Special Topics Botany  (1-6 credit hours)
The study of special problems and selected topics of current interest in botany and related fields.

PB 601  Botany Seminar  (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

PB 620  Special Problems in Botany  (1-6 credit hours)
Directed research in some phase of botany other than a thesis problem, but designed to provide experience and training in research. Credits Arranged.

Typically offered in Fall, Spring, and Summer

PB 624  Topical Problems  (1-4 credit hours)
Discussions and readings on problems of current interest in fields of ecology, anatomy and morphology, taxonomy, plant physiology and cell biology. May be repeated with a change in topic for a maximum of six credits.

Typically offered in Fall and Spring

PB 685  Master's Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PB 688  Non-Thesis Masters Continuous Registration - Half Time Registration  (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's Student
Typically offered in Fall, Spring, and Summer
**PB 689 Non-Thesis Master Continuous Registration - Full Time Registration** (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's Student
Typically offered in Fall, Spring, and Summer

**PB 690 Master's Examination** (1-9 credit hours)
For students in non-thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's Student
Typically offered in Fall, Spring, and Summer

**PB 693 Master's Supervised Research** (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's Student
Typically offered in Fall, Spring, and Summer

**PB 695 Master's Thesis Research** (1-9 credit hours)
Thesis Research.

Prerequisite: Master's Student
Typically offered in Fall, Spring, and Summer

**PB 699 Master's Thesis Preparation** (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's Student
Typically offered in Fall, Spring, and Summer

**PB 704 Plant Nomenclature** (1 credit hours)
A practical foundation in plant nomenclature and nomenclatural references. Emphasis on the evolution of international rules for naming plant taxa and their application in both wild and cultivated plants. Nomenclature applications used in patents, cultivar releases and journal articles. Taught mid-semester. Taught five weeks of semester.

Typically offered in Spring only

**PB 730/GN 730/MB 730/PP 730 Fungal Genetics and Physiology** (3 credit hours)
Basic concepts of genetics and physiology of fungi, with emphasis on saprophytic and plant pathogenic mycelial fungi. Current literature on evolution, cell structure, growth and development, gene expression, metabolism, sexual and asexual reproduction and incompatibility systems. Laboratory exercises on mutant isolation, sexual and parasexual analysis, genetic transformation, and RFLP and isozyme analysis.

Prerequisite: BCH 451, BO 775, GN 311 or PP 501
Typically offered in Spring only

**PB 733 Plant Growth and Development** (3 credit hours)
Advanced course in plant physiology covering plant growth, development, differentiation, senescence and biological control mechanisms.

Prerequisite: PB(ZO) 414 or PB 421, organic chemistry
Typically offered in Spring only

**PB 751 Advanced Plant Physiology I** (3 credit hours)
Cellular mechanisms and regulatory features related to plant respiration, photosynthesis, sulfur metabolism, nitrogen fixation and metabolism, and signal transduction. One of two courses covering field of plant physiology.

Prerequisite: PB 421
Typically offered in Fall only

**PB 761/BCH 761/GN 761 Advanced Molecular Biology Of the Cell** (3 credit hours)
An advanced graduate class involving integrated approaches to complex biological questions at the molecular level, encompassing biochemistry, cell biology and molecular genetics. The course will focus on an important, current area of research in eukaryotic biology using the primary scientific literature, and will involve class discussions, oral presentations, and a written research proposal.

Typically offered in Spring only

**PB 774/MB 774 Phycology** (3 credit hours)
Introduction to taxonomy, morphology, reproduction and ecological importance of organisms which may be included in the algae. Attention to local freshwater flow and physiology of selected species in relation to algal blooms, water quality and nutrient loading in aquatic habitats.

Typically offered in Spring only

**PB 780 Plant Molecular Biology** (3 credit hours)
Molecular analysis of plant growth and development. Molecular techniques and their application to understanding control of gene expression in plants.

Prerequisite: BCH 451, GN 411
Typically offered in Fall only

**PB 795 Special Topics Botany** (1-6 credit hours)
The study of special problems and selected topics of current interest in botany and related fields.

Typically offered in Fall and Spring

**PB 801 Seminar** (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring
PB 820 Special Problems (1-6 credit hours)
Directed research in some phase of botany other than a thesis problem, but designed to provide experience and training in research. Credits Arranged.
Typically offered in Fall, Spring, and Summer

PB 824 Topical Problems (1-4 credit hours)
Discussions and readings on problems of current interest in fields of ecology, anatomy and morphology, taxonomy, plant physiology and cell biology. May be repeated with a change in topic for a maximum of six credits.
Typically offered in Fall and Spring

PB 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral Student
Typically offered in Fall, Spring, and Summer

PB 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral Student
Typically offered in Fall, Spring, and Summer

PB 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PB 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PB 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral Student
Typically offered in Summer only

PB 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral Student
Typically offered in Fall, Spring, and Summer

Plant Pathology (PP)

PP 144/HS 144 Weeds & Diseases of Ornamentals (3 credit hours)
The objective of this course is to give students a fundamental and practical understanding of weed, disease, and pesticide management in the ornamental industries in North Carolina. Agricultural Institute students only.
Requisite: Agricultural Institute Only
Typically offered in Fall only

PP 150 Introduction to Plant Molecular Biology (3 credit hours)
Hands-on introduction to modern molecular biology techniques. Isolation of SNA from tobacco leaves, isolating a plant gene through polymerase chain reaction (PCR), cloning DNA fragments in plasmid vectors, bacterial transformation and plasmid DNA purification, restriction digestion and gel electrophoresis, gene transfer and expression of reporter genes in plant cell lines through a biolistic gene gun. Field trips, poster assignment and poster presentation are mandatory. This course is part of the Summer College in Biotechnology and Life Sciences (SCIBLS) and other pre-college, transitional and early-college programs. Students must have no more than 30 credit hours. Department approval required.
Typically offered in Summer only

PP 154/CS 154 Turf Weed and Disease Management (3 credit hours)
General principles in turfgrass weed and disease development and management programs. Different weeds, their life cycles, management techniques, and factors affecting herbicide application performance will be covered. Students will learn the causes, development, identification and management of turfgrass diseases. Laboratory includes weed identification and herbicide application methods. Certain laboratory exercises will require personal transportation to Lake Wheeler Road Turf Field Lab unless otherwise specified by the lab instructors. The course is restricted to AGI students only.
Requisite: Agricultural Institute Only
Typically offered in Fall only

PP 155 Diseases of Ornamentals and Turfgrasses (3 credit hours)
Causes, development, identification and management of diseases of greenhouses and landscape ornamentals and turfgrasses. WARFIELD
Requisite: Agricultural Institute Only
Typically offered in Fall only

PP 222 Kingdom of Fungi (3 credit hours)
Influence and impact of fungi in our world. The role of fungi in history, ecology, medicine, human and plant diseases, industry, food and politics. Mushrooms, molds, mildews and symbiosis.
Prerequisite: Any 100-level course in Biology or 200-level course in Plant Biology
GEP Natural Sciences
Typically offered in Spring only
PP 232  Big Data in Your Pocket: Call it a Smartphone  (3 credit hours)
Data have been, are, and will be collected in every scientific discipline. Data provide a foundation to evaluate hypotheses and advance knowledge. For centuries scientists have collected data and built models separately with methods and principles defined in their disciplines. Modern technological advances have resulted in a data revolution. Data now come fast in all forms and in high volumes, presenting both new challenges and opportunities in many disciplines. In this course we will discuss how data is collected and visually summarized and how modern technology has allowed for the collection of big data, resulting in a revolution in the way we live, work, and think.

GEP Interdisciplinary Perspectives
Typically offered in Fall only

PP 241  The Worm’s Tale: Parasites In Our Midst  (3 credit hours)
This is a 3 credit hour survey course on the impact of parasites on society, including development and exploration, wars and expansion, agriculture, health and medicine, economic impacts, political impacts, and attempts at control/management. From the fiery serpent to the scourge of malaria, parasitic organisms have played a significant, and sometimes pivotal role in the development and progress of human society. This course presents an overview that provides students the necessary information and resources to understand this ubiquitous and critically important group of organisms. Parasites represent a significant hurdle to overcome as global society continue to move forward.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

PP 315  Principles of Plant Pathology  (4 credit hours)
Fundamental principles of plant pathology with emphasis on disease etiology, nature of pathogenesis, ecology of host/parasite interaction, epidemiology of plant diseases, current strategies and practices for integrated disease control.

Typically offered in Fall and Spring

PP 318/FOR 318  Forest Pathology  (3 credit hours)
Major diseases of forest trees and deterioration of wood products emphasizing principles of plant pathology; diagnosis; nature, physiology, ecology, and dissemination of disease-causing agents; mechanisms of pathogenesis; epidemiology and environmental influences; principles and practices of control.
Prerequisite: PB 200
Typically offered in Fall and Spring

PP 470/CS 470/ENT 470  Advanced Turfgrass Pest Management  (2 credit hours)
Characteristics and ecology of turfgrass weed, insect, and disease pests; identification and diagnosis of turfgrass pests, strategies for managing pests including cultural, mechanical, biological, and chemical methods; development of integrated pest management programs, characteristics and modes of action for herbicides, insecticides, fungicides, and plant growth regulators; behavior and fate of pesticides in soil; and the development and management of pesticide resistant pest populations.
Prerequisite: C- or better in CS 200
Typically offered in Spring only

PP 492  External Learning Experience  (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.
Prerequisite: Sophomore standing
Typically offered in Fall and Spring

PP 493  Special Problems in Plant Pathology  (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes campus facilities and resources. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.
Prerequisite: Sophomore standing
Typically offered in Fall and Spring

PP 495  Special Topics in Plant Pathology  (1-3 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.
Typically offered in Fall, Spring, and Summer

PP 501/PB 501/MB 501  Biology of Plant Pathogens  (3 credit hours)
Biology of microbes that cause plant diseases. The ecology, genetics, physiology, taxonomy, and mechanisms of parasitism, pathogenicity and virulence of bacteria (and other prokaryotes), fungi (and oomycetes), nematodes, and viruses that cause plant diseases. Prepares graduate students for advanced courses in plant pathology, host-parasite interactions, and provides a knowledge base for students in other disciplines involved with plant pathogens or who seek to broaden their knowledge of microbes.
Prerequisite: PP 315, or PP 318, or an introductory course in microbiology
Typically offered in Fall only

PP 502/CS 502/HS 502  Plant Disease: Methods & Diagnosis  (2 credit hours)
Introduction to the basic principles of disease causality in plants and the methodology for the study and diagnosis of plant diseases caused by fungi. Identification of plant-pathogenic fungi. Research project, disease profiles and field trips are required.
Prerequisite: PP 315
Typically offered in Fall only

PP 506  Epidemiology and Plant Disease Control  (3 credit hours)
Consideration of fundamental concepts and principles of epidemiology as applied to modern strategies of plant disease control. Special consideration given to evaluation of current techniques for control of fungal, bacterial, viral and nematode pathogens in an integrated crop protection system.
Prerequisite: PP 315 or PP 318
Typically offered in Spring only
PP 530 Agriculture, Ethics and the Environment (3 credit hours)
Case studies in ethical theory and moral issues in agriculture and life sciences research including ethical theories, populations, food, ozone depletion, soil quality, sustainable and organic agriculture, plant biotechnology and biodiversity, animal rights and welfare, water quality, pesticides, risk assessment, biologically-based pest management, environmental policy and research ethics. Students are active participants and use role playing to present a forum.

Typically offered in Fall only

PP 540 Tropical Plant Pathology (2 credit hours)
Class introduces students to agriculture in the tropics and disease on tropical crops including cacao, banana, potato, root vegetables and coffee will be given. Trade issues relevant to US and Central American farmers are discussed. A week long trip Costa Rica in the summer and tours of coffee, banana, pineapple, tropical fruit, cacao and vegetable farms in the country is required. Learn about the diseases, social and political issues facing farmers in the developing world.

Typically offered in Spring only

PP 575/PB 575/MB 575 Introduction to Mycology (4 credit hours)
Prerequisite: BS 125 or BS 181 and 183 or BO 200 or PP 315 or PP 318
Typically offered in Fall only

PP 590 Special Topics (1-3 credit hours)
The study of special problems and selected topics of current interest in plant pathology and related fields.

Typically offered in Fall, Spring, and Summer

PP 601 Seminar (1 credit hours)
Discussion of assigned phytopathological topics.

Typically offered in Fall and Spring

PP 610 Special Topics (1-6 credit hours)
The study of special problems and selected topics of current interest in plant pathology and related fields.

Typically offered in Fall, Spring, and Summer

PP 615 Advanced Special Topics in Plant Pathology (1-6 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.
Prerequisite: PP 501, 502, Co-requisite: ST 511
Typically offered in Fall only

PP 620 Special Problems (1-6 credit hours)
Investigation of special problems in plant pathology not related to thesis problem. Investigations may consist of original research and/or literature survey.

Typically offered in Fall and Spring

PP 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall and Spring

PP 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.
Prerequisite: Master's student
Typically offered in Spring only

PP 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall and Spring

PP 695 Master's Thesis Research (1-9 credit hours)
Thesis research.
Prerequisite: Master's student
Typically offered in Fall and Spring

PP 696 Summer Thesis Res (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Typically offered in Summer only

PP 699 Master's Thesis Preparation (1-9 credit hours)
Original research in plant pathology.
Prerequisite: Graduate standing
Typically offered in Spring only

PP 707 Plant Microbe Interactions (3 credit hours)
Fundamental concepts and current status of research on the physiology, biochemistry and molecular biology of host-pathogen interactions during plant disease. Topics include recognition, penetration and colonization, pathogenicity and virulence determinants, resistance mechanisms, sign transduction, programmed cell death, and other current topics. Information presented in context of viral-, bacterial-, fungal-and nematode-plan interactions.Credit cannot be received for both PP 507 and PP 707
Prerequisite: PP 501
Typically offered in Spring only

PP 715/MB 715 Applied Evolutionary Analysis of Population Genetic Data (3 credit hours)
This course will introduce nonparametric and model-based methods for making inferences on population processes (mutation, migration, drift, recombination, and selection). The goal is to provide a conceptual overview of these methods and hands-on training on how to implement and interpret the results. Sample data sets in computer laboratories will integrate summary statistic, cladistic, coalescent, and bayesian approaches to examine population processes in different pathosystems with specific emphasis on eukaryotic microbes, viruses and bacteria.
PP 727/ENT 727 Ecology of Soil Ecosystems (3 credit hours)
This course will focus on the interactions between soil organisms and their environment, and the ecological consequences of these diverse complex interactions. In particular, it will explore the scientific evidence that illustrates links between soil organisms, ecosystem functioning and the quality of air and water systems, and examine why and how the related research was conducted. This course will bring together theory and research trends from distinct subject areas: soil microbiology, entomology and ecosystem ecology.

Prerequisite: One course in: (SSC 332, SSC 511, SSC 521, or SSC 532), or ecology (BO 360 or CS 430), or microbiology (MB 351), or consent of instructor.

Typically offered in Spring only

PP 728 Soilborne Plant Pathogens (3 credit hours)
In-depth study of ecology of soilborne fungal and bacterial pathogens inducing root and wilt diseases in plants. Concepts and principles including but not limited to the rhizosphere, inoculum potential, soil fungistasis, survival, root disease models and biological control.

Prerequisite: PP 501, 502

Typically offered in Fall only

PP 730/GB 730/MB 730 Fungal Genetics and Physiology (3 credit hours)
Basic concepts of genetics and physiology of fungi, with emphasis on saprophytic and plant pathogenic mycelial fungi. Current literature on evolution, cell structure, growth and development, gene expression, metabolism, sexual and asexual reproduction and incompatibility systems. Laboratory exercises on mutant isolation, sexual and parasexual analysis, genetic transformation, and RFLP and isozyme analysis.

Prerequisite: BCH 451, BO 775, GN 311 or PP 501

Typically offered in Spring only

PP 755 Plant Disease Resistance: Mechanisms and Applications (3 credit hours)
This class deals with the major concepts in plant disease resistance: Its molecular and biochemical bases, its effectiveness and methods of deployment and conventional and transgenic breeding methods used to incorporate improved disease resistance into crop species.

P: Basic Undergraduate Level Genetics Class

Typically offered in Spring only

PP 790 Special Topics (1-6 credit hours)
The study of special problems and selected topics of current interest in plant pathology and related fields.

PP 795 Advanced Special Topics (1 credit hours)
Critical study of special problems and selected topics of current interest in plant pathology and related fields.

PP 801 Seminar In Plant Pathology (1 credit hours)
Discussion of assigned phytopathological topics.

Typically offered in Fall and Spring

PP 810 Special Topics (1-6 credit hours)
The study of special problems and selected topics of current interest in plant pathology and related fields.

Typically offered in Fall, Spring, and Summer

PP 815 Advanced Special Topics (1-6 credit hours)
Critical study of special problems and selected topics of current interest in plant pathology and related fields.

Typically offered in Fall and Spring

PP 820 Special Problems In Plant Pathology (1-6 credit hours)
Investigation of special problems in plant pathology not related to thesis problem. Investigations may consist of original research and/or literature survey.

Typically offered in Fall and Spring

PP 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student

Typically offered in Fall and Spring

PP 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student

Typically offered in Fall only

PP 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student

Typically offered in Fall and Spring

PP 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student

Typically offered in Fall and Spring

PP 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student

Typically offered in Summer only

PP 899 Doctoral Dissertation Preparation (1-9 credit hours)

For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree and are writing and defending their dissertations.

Prerequisite: Doctoral student

Typically offered in Summer only

Political Science (PS)

PS 101 Internet Research (1 credit hours)
Tools and techniques for conducting Internet research and electronic literature reviews. Documentation and ethics of using and citing information sources. Individualized/Independent Study and Research courses require a Course Agreement for Students Enr

Typically offered in Fall, Spring, and Summer
PS 102 Data Analysis (1 credit hours)
Statistical analysis of governmental and survey data. Introduction to data sets and collecting, computerizing and analyzing political and social data.

Typically offered in Fall, Spring, and Summer

PS 103 Designing Political Web Pages (1 credit hours)
Principles of effective internet communication in political professions, for constituency contact and grassroots mobilization, and use of web documents by politicians and political organizations. Design of web page documents and creation of internet directories.

Typically offered in Fall, Spring, and Summer

PS 201 American Politics and Government (3 credit hours)
Analysis of American political institutions and processes, including the constitution, political culture, campaigns and elections, political parties, interest groups, the media, the president, congress, the federal courts, and public policy. Discussion of contemporary and controversial issues in American politics. Emphasis on placing current issues in comparative and historical perspective where relevant.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PS 202 State and Local Government (3 credit hours)
State and local governments within the context of the American federal system. Special emphasis on federalism, the constitutional/legal relationships between state and local governments, and the institutions, organizational forms, and political processes in American state and local government.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PS 203 Introduction to Nonprofits (3 credit hours)
Development of nonprofit organizations and the contributions of nonprofits in the U.S., other countries, and the international community; political, social, and economic roles of nonprofits; nonprofit governance; partnerships with government and other nonprofits; types of organizations in the nonprofit sector; contemporary policy issues. Service project with minor transportation costs.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PS 204 Problems of American Democracy (3 credit hours)
Political problems in America from the perspective of political theory. Democracy, economics and politics, racial and sexual equality, civil disobedience, and individual freedom.

Typically offered in Spring only

PS 231 Introduction to International Relations (3 credit hours)
Evolution of relations among nations and of the roles of the United Nations and other international institutions, including changes in the world political system since the end of the cold war.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PS 236 Issues in Global Politics (3 credit hours)
Selected problems facing the world community, related political issues, and international responses to them, including international trade, economic development, wars, arms control, terrorism, ethnic conflict, human rights, status of women, population growth, food security, and environmental degradation.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PS 241 Introduction to Comparative Politics (3 credit hours)
Introductory comparative analysis of a selected variety of political systems always including some developed democracies, some communist states and some developing countries. A minimum familiarity with the American political system is assumed.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Spring only

PS 288 Special Topics in Political Science (1-6 credit hours)
Experimental course at the freshman and sophomore levels.

PS 301 The Presidency and Congress (3 credit hours)
Historical development, selection, and internal organization of the presidency and congress. Discussion of the relations between the branches and the influence of public opinion, interest groups and parties on the federal government. Analysis of the legislative process.

Prerequisite: PS 201
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PS 302 Campaigns and Elections in the US Political System (3 credit hours)
Campaigns and elections in the United States with emphasis on presidential and congressional primary and general elections. Development of theoretical propositions concerning how and why people vote, how and why candidates campaign, and behavioral reasons underlying candidates’ successes and failures. Special emphasis on the role of the mass media in the electoral process.

Prerequisite: PS 201
GEP Social Sciences
Typically offered in Fall only

PS 303 Race in U.S. Politics (3 credit hours)
Race in American politics with emphasis on the African-American political experience: civil rights legislation, voting rights, political representation, campaigns and party politics, survey attitudes, and public policies including affirmative action.

Requisite: Sophomore Standing or Above
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Summer
PS 305 The Justice System in the American Political Process (3 credit hours)
Criminal justice process and civil justice system in the American judiciary, including court organization and legal professionals such as police, attorneys and judges; formulation and implementation of policies by law enforcement and the courts; impact of political system upon police, attorneys and judges; interaction between public and legal professionals in judicial decision making. Students who have successfully completed PS 306 or PS 311 may not receive credit for PS 305.

GEP Social Sciences
Typically offered in Fall only

PS 306/WGS 306 Gender and Politics in the United States (3 credit hours)
This course explores the role of gender in contemporary American politics. The course examines the historical course of gender politics to see how we have arrived at the present state. It investigates the activities that women and men play in modern politics-voting, running for office, serving in office, etc., and how women and men perform these activities in different ways. The course also focuses on major areas of public policy that affect women and men in different ways.

Prerequisite: PS 201
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall only

PS 307 Introduction to Criminal Law in the United States (3 credit hours)
Principles underlying the criminal law in the United States and classification of crimes, criminal act, factors affecting criminal responsibility and various types of offenses. Observation of state and federal court sessions.

Typically offered in Fall and Spring

PS 308 Supreme Court and Public Policy (3 credit hours)
The role of the Supreme Court in American politics, with emphasis on the use of litigation as a form of political activity. Readings include relevant court cases as well as descriptions of the Supreme Court in action.

Typically offered in Fall and Spring

PS 309 Equality and Justice in United States Law (3 credit hours)
Equality and justice in American law; federal and state court interpretation of constitutional and statutory law. Topics include racial justice; prisoners' rights and just punishments; nontraditional families and reproductive technologies; gay rights;

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall only

PS 310 Public Policy (3 credit hours)
Introduction to public policy formulation and analysis, including agenda-setting strategies, problems of legitimation, the appropriations process, implementation, evaluation, resolution, and termination.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PS 312 Introduction to Public Administration (3 credit hours)
Administration in city, state and national governments: effectiveness and responsiveness, involvement in policy areas, and issues of ethics and responsibilities.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PS 313 Criminal Justice Policy (3 credit hours)
This course covers the basic policies and controversies in criminal justice in the United States. The course will explore how criminal justice policies get made, why they get made, how well or poorly they work, and what we can do better. The course will examine primarily longstanding areas of policy debate, e.g., illegal drugs, prisons, capital punishments, etc., but we will also pay attention to policy debates in the news. The course will also pay special attention to the intersection of race and social class with our modern criminal justice policies.

Prerequisite: PS 201
GEP U.S. Diversity
Typically offered in Fall only

PS 314 Science, Technology and Public Policy (3 credit hours)
Technological innovation and scientific discovery since World War II have led to profound social, political, and economic change. This course explores some of the opportunities and challenges these advances have created and the ways in which society and government seek to limit their negative effects while maximizing gains and promoting further innovation.

GEP Social Sciences
Typically offered in Fall only

PS 320 U.S. Environmental Law and Politics (3 credit hours)
Emergence of the environment as an issue in United States politics. Law and policy pertaining to air and water pollution, land-use, water, energy, toxic substances, and wilderness. Roles of national and state governments, scientists, corporations, and citizens groups in addressing environmental problems

GEP Social Sciences
Typically offered in Fall and Spring

PS 331 U.S. Foreign Policy (3 credit hours)
The content, formulation, and execution of U.S. foreign policy during the postwar period, with concentration on major issues and trends, the instruments for implementing foreign policy, and analysis of the policymaking process.

GEP Social Sciences
Typically offered in Fall and Summer

PS 335 International Law (3 credit hours)
Usefulness and limitations of international law, including obligations and immunities of sovereign states, non-state actors, peaceful settlement of disputes, human rights, laws of war, and recent international war crimes tribunals. Emphasis on individual case decisions in U.S. and international courts.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall and Spring

PS 336 Global Environmental Politics (3 credit hours)
International politics, laws, and policies pertaining to global environmental problems in the realms of population, pollution, climate change, biological diversity, forests oceans, and fisheries.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall and Spring
PS 339 Politics of the World Economy (3 credit hours)
Politics of international trade and payments, including barriers to trade, dispute settlement, multinational corporations, financial crises, international economic institutions and the problems of economic underdevelopment.

GEP Global Knowledge
Typically offered in Fall only

PS 341 European Politics (3 credit hours)
Comparative analysis of the interests, institutions and processes that determine political stability and economic security in Europe, including the political and economic development of Europe, the role of parties and party politics, the institutions and politics of the European Union.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall only

PS 342 Politics of China and Japan (3 credit hours)
Politics, public policy, and foreign affairs of China and Japan.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall and Spring

PS 343 Government and Politics in South Asia (3 credit hours)
Survey of government structures, politics, foreign policies and economic policies of India, Pakistan, Bangladesh and Sri Lanka. Democratization; religious, ethnic and sectarian conflicts; nuclear proliferation; Kashmir conflict; and economic development.

Typically offered in Fall only

PS 345 Governments and Politics in the Middle East (3 credit hours)
Historical, geographic, religious, and political-economic factors of the Middle East. Particular attention is given to the internal politics of selected countries, as well as issues of international concern.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Spring only

PS 353 Issues in Latin American and Caribbean Politics (3 credit hours)
Introduction to the major issues affecting political and economic development and stability in Latin America and the Caribbean.

GEP Social Sciences
Typically offered in Spring and Summer

PS 361 Introduction to Political Theory (3 credit hours)
Nature and purpose of politics, as treated by such writers as Plato, Aristotle, St. Augustine, Machiavelli, Locke, Rousseau, Mill, Marx, and Nietzsche.

GEP Humanities
Typically offered in Fall and Spring

PS 362 American Political Thought (3 credit hours)
American ideas and institutions as viewed from the perspective of great American political thinkers, such as Frederick Douglass, Thomas Jefferson, James Madison, Alexander Hamilton, Henry David Thoreau, Abraham Lincoln, Franklin Roosevelt, and Malcolm X.

GEP Humanities
Typically offered in Fall, Spring, and Summer

PS 371 Research Methodology of Political Science (3 credit hours)
Research methods in social science and quantitative analysis in political science and public policy including research design, data collection, statistical analysis and computer applications.

Prerequisite: ST 311 or (ST301 and ST302)
Typically offered in Fall, Spring, and Summer

PS 391 Internship in Political Science (1-6 credit hours)
Internship in a governmental agency, interest group, or like organization involves seminar or formal report. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

PS 398 Special Topics in Political Science (3 credit hours)
For topics not part of regular course offerings, or offering of new courses on a trial basis. May be taken up to three times provided the topics are different.

Typically offered in Fall, Spring, and Summer

PS 401 American Political Parties (3 credit hours)
Political Parties are the central linkage mechanism of American Government. They serve to connect the desires and viewpoints of ordinary Americans to actual governing in Washington and statehouses. The course will explore the structure of the party system in America, how it compares to other countries, and the struggle of third parties in America. The course will also explore political parties as organizations working towards electoral victory. The course will examine parties as changing coalitions of voters and place our current partisan polarization in context. The course will conclude by examining how all these aspects of contemporary political parties come together to shape modern American politics and policy.

Prerequisite: PS 201
Typically offered in Spring only

PS 409/AFS 409 Black Political Participation in America (3 credit hours)
African American political participation in the United States; political culture, socialization, and mobilization, with a focus on the interaction between African Americans and actors, institutions, processes, and policies of the American political system.

Typically offered in Fall only

PS 411 Public Opinion and the Media in American Politics (3 credit hours)
Nature, content, origins, and effects of public opinion in the American political system; role of the mass media in articulating and shaping public opinion; issues concerning measurement of public opinion.

Prerequisite: PS 201
Typically offered in Fall only

PS 415 Administration of Justice (3 credit hours)
Politics and administration in the American system of justice. Credit will not be given for both PS 415 and PA 515

Junior standing or above
Typically offered in Fall only
PS 418/WGS 418  Gender Law and Policies  (3 credit hours)
Law and policy pertaining to contemporary gender issues. Examination of agenda setting, policy formation, implementation, judicial interpretation and evaluation of selected issues, such as reproductive policies, equal employment and sexual abuse.

Prerequisite: 3 hours of Political Science
GEP U.S. Diversity
Typically offered in Spring only

PS 431  The United Nations and Global Order  (3 credit hours)
United Nations in contemporary world politics. Functions and operation of central organs, commissions, and specialized agencies. Role in addressing global issues including peacekeeping, arms control, human rights, economic and social development, and environment.

Prerequisite: PS 231 or PS 236 or PS 335
GEP Global Knowledge
Typically offered in Fall and Spring

PS 432/SOC 432  Violence, Terrorism, and Public Policy  (3 credit hours)
The course examines interpersonal and group violence in contemporary societies and the causes for its occurrences. Specific forms of violence that will be examined include domestic violence, gangs, homicide, and terrorism, domestically and internationally. Throughout the course students will use data to critically evaluate policies and practices to prevent and control violence and will examine potential solutions to the problems of violence.

Prerequisite: SOC 300 or PS 371
Typically offered in Fall and Spring

PS 433  Global Problems and Policies  (3 credit hours)
Critical analysis of issues and events in world politics, including terrorism, drug trafficking and money laundering, transmission of infectious diseases, democratization, globalization and economic development.

Prerequisite: PS 231 or PS 236 or PS 241
GEP Global Knowledge
Typically offered in Fall only

PS 437  U.S. National Security Policy  (3 credit hours)
Formulation and implementation of United States national security policy, including its military, political and economic dimensions. Historical evolution of US policy primarily from the end of World War II through the end of the Cold War and to its contemporary context.

Prerequisite: PS 331

PS 443/PS 543  Seminar in Latin American & Caribbean Politics  (3 credit hours)
Comparative political development in Latin America and the Caribbean. Emphasis on democratization and implications for US foreign policy. Credit cannot be given for both PS 443 and PS 543

Prerequisite: Six hours of Political Science including PS 231
Typically offered in Spring only

PS 445/PS 545  Comparative Systems of Law and Justice  (3 credit hours)
Legal culture and administration of justice in various countries and in the U.S. Emphasis on the impact of legal ideology on crime, political justice, police administration, corrections and judicial process. Credit will not be given for both PS 445 and PS 545

Junior standing or above
Typically offered in Spring only

PS 462  Seminar in Political Theory  (3 credit hours)
A special area in political theory through selected texts, independent research, and seminar reports. Topics vary from year to year, such as ancient and modern political thought, democratic theory, and political theory in literature.

Prerequisite: PS 361 or Consent of Instructor
Typically offered in Spring only

PS 463  Public Choice and Political Institutions  (3 credit hours)
Examination of public choice approach to political science. Analysis of political institutions and how they modify human behavior and influence political and policy outcomes. Fulfills department's undergraduate senior seminar requirement.

Prerequisite: Junior standing or Senior standing, Political Science Majors, 12 hours of Political Science Courses
Typically offered in Spring only

PS 464  The Classical Liberal Tradition  (3 credit hours)
Analysis of the genesis and development in Europe and North America of liberal ideas such as natural rights, individual liberty, democracy, economic liberalism, religious pluralism, and the rule of law with a particular emphasis on important documents, thinkers, events, and leaders.

Prerequisites: PS 201 or PS 361 or PS 362
Typically offered in Fall only

PS 471  Public Opinion Research Methodology  (3 credit hours)
Survey research methodology in public opinion polling, campaign management, media and market research, needs assessment and program evaluation. Topics include questionnaire design, survey sampling, computer applications, and data analysis. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall and Spring

PS 490  Readings and Research in Political Science  (1-6 credit hours)
Extensive readings or research in political science under direct faculty supervision. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member

Typically offered in Fall and Spring

PS 492  Honors Readings and Thesis in Political Science  (1-6 credit hours)
Independent reading and preparation of an honors thesis in political science. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member

Prerequisite: Admission to Honors Program
Typically offered in Fall, Spring, and Summer

PS 498  Special Topics in Political Science  (1-6 credit hours)
Detailed investigation of a topic. Topic and mode of study determined by the student and a faculty member.

Prerequisite: Six hours of Political Science
Typically offered in Fall and Spring
PS 502 The Legislative Process  (3 credit hours)
The formulation of public policy from institutional and behavioral viewpoints. Important current legislative problems at congressional and state legislative levels selected and serve as basis for analyzing legislative process.

Prerequisite: Advanced Undergraduate standing including 12 hrs. of PS, Graduate standing or PBS status
Typically offered in Fall only

PS 506 United States Constitutional Law  (3 credit hours)
Basic constitutional doctrines, including federalism, state, and local government, individual rights and political privileges and national and state power. Special attention given to application of these doctrines to regulation of business, agriculture and labor and to rights safeguarded by First, Fifth and Fourteenth Amendments to the Constitution.

Prerequisite: 12 hours of PS or Graduate standing or PBS status
Typically offered in Fall only

PS 507 Civil Liberties In the United States  (3 credit hours)
Leading constitutional cases in civil liberties and individual rights along with writings of leading commentators.

Prerequisite: 12 hours of PS or Graduate standing or PBS status
Typically offered in Fall only

PS 530 Seminar In International Relations  (3 credit hours)
May be taken for up to six hours credit. In-depth examination of a topic within larger field of international politics to be selected by instructor for each semester from subjects pertaining to interstate relations, international law and organization, regional politics, foreign and security policy or global issues. Students undertake substantial independent research project.

Typically offered in Fall only

PS 531 International Law  (3 credit hours)
Sources and subjects of international law, domestic and international jurisdictions, judicial settlement, legal and illegal uses of force and substance of law in selected policy areas.

Prerequisite: Graduate standing or Advanced Undergraduate standing
Typically offered in Fall and Spring

PS 532 Seminar in Global Governance  (3 credit hours)
The politics of global governance, with emphasis on the role of intergovernmental organizations, non-governmental organizations, international regimes, and supranational institutions, and the comparative analysis of different governance structures. Includes study of the mechanisms of international cooperation between states and their citizens in a variety of issue areas, such as trade, money, development, humanitarianism, the environment, human rights, and security. Graduate standing.

Typically offered in Fall only

PS 533 Global Problems and Policy  (3 credit hours)
International policy processes and policy responses to problems of global scope including role of international law. Consideration given to economic development, human rights and other policy problems selected for specific semesters. Independent research on a global policy problem of student's choice.

Prerequisite: Advanced Undergraduate standing including 12 hours of PS program, Graduate standing or PBS status
Typically offered in Spring only

PS 534 The Politics of Human Rights Policies  (3 credit hours)
Human rights policies and politics within the modern global society; the interplay of international organizations, governments and non-governmental actors in promoting and undermining international human rights; examines how domestic politics, sovereignty, cultural norms, religion, geo-political competition, past colonialism, and economic considerations affect efforts to address human rights violations in different countries; human rights issues such as genocide, humanitarian intervention, women and gender issues, refugees, transitional justice or reconciliation, ethnic/racial divisions, human trafficking, etc. Graduate standing.

Typically offered in Fall only

PS 536 Global Environmental Law and Policy  (3 credit hours)
International organizations, laws and policies addressing global environmental problems including: population growth, atmospheric pollution, climate change, use of oceans, forests and biodiversity. Relationship between environment and Third World economic development.

Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

PS 539 International Political Economy  (3 credit hours)
Politics of international trade and payments, with special emphasis on international and domestic determinants of protectionism, international and national political institutions, multinational corporations, debt crises, and dilemmas of economic underdevelopment.

Prerequisite: Advanced Undergraduate standing, Graduate standing or PBS status
Typically offered in Fall only

PS 540 Seminar In Comparative Politics  (3 credit hours)
This seminar opens with a survey of the problems and methods of comparative political analysis, after which students assigned a specific, limited subject to be examined within framework of a systematic, analytical scheme appropriate to topic. Specific topics drawn from subjects of political ideologies, political groups, political elites and decision-making institutions and processes.

Prerequisite: One course in comparative politics and one course in PS methodology
Typically offered in Fall and Spring

PS 541 Political Islam  (3 credit hours)
Explores the diversity of movements, organizations, and political parties that fall within political Islam, from the extremist, violent fringe to democratically functioning groups. Begins with an overview of the interaction of religion and politics before defining political Islam and exploring major groups practicing it. The course provides a comparative perspective on Islam's interactions with the political realm, as well as a study of the role it plays in promoting or hindering democratic development.

Prerequisite: Graduate standing
Typically offered in Spring only
PS 542 European Politics (3 credit hours)
Analysis of political institutions and processes in selected European states and the European community and major social, economic and political issues confronting European societies.
Prerequisite: Nine hours of PS program, Graduate standing or PBS status
Typically offered in Spring only

PS 543/PS 443 Seminar in Latin American & Caribbean Politics (3 credit hours)
Comparative political development in Latin America and the Caribbean. Emphasis on democratization and implications for US foreign policy. Credit cannot be given for both PS 443 and PS 543
Prerequisite: Six hours of Political Science including PS 231
Typically offered in Spring only

PS 544 Contemporary African Politics (3 credit hours)
A survey of key themes, trajectories, and trends in contemporary African politics. It analyzes political and economic development on the continent since the dawn of independence in the late 1950s. Although largely focused on Sub-Saharan Africa, the course will nevertheless touch upon linkages and connections with North Africa as well as diasporic influences and inspirations especially in the pan-African struggles for independence and the forging of new sovereign nation-states.
Prerequisite: Graduate standing
Typically offered in Fall only

PS 545/PS 445 Comparative Systems of Law and Justice (3 credit hours)
Legal culture and administration of justice in various countries and in the U.S. Emphasis on the impact of legal ideology on crime, political justice, police administration, corrections and judicial process. Credit will not be given for both PS 445 and PS 545
Junior standing or above
Typically offered in Fall and Spring

PS 546 The Politics of East Asia (3 credit hours)
This course examines the history and key theoretical and policy debates on the politics of East Asia, which in this course includes China, Japan, two Koreas, and Taiwan. Yet, other countries in and beyond the region (the United States, Russia, Southeast Asian nations) and their relations with the five states are an integral part of the course. The class comprises three parts. Part I introduces the modern history of East Asia. Part II examines the contemporary governments of East Asia, including their political systems and the main debates surrounding their politics. Part III focuses on interstate relations of East Asia and Pacific, comprising a series of topics that are both timely and heatedly debated among intellectuals and policymakers. While these topics are mostly country/ countries-specific, they together are important in understanding the regional dynamics of East Asia.
Typically offered in Fall only

PS 547 Russian Politics (3 credit hours)
The course investigates the principal political and societal actors in today's Russia, as well as the key trends in Russia's domestic and foreign policy.
Typically offered in Spring only

PS 548 Nuclear Nonproliferation Policy & Process (3 credit hours)
Policy and processes associated with global nuclear nonproliferation efforts. Special emphasis on the history of the development of the global nonproliferation regime, current challenges, and future threats.
Typically offered in Fall and Spring

PS 551 Nuclear Strategy and Nonproliferation (3 credit hours)
No understanding of world politics is complete without an accounting of the role of nuclear weapons. Observers have credited the nuclear revolution with everything from responsibility for the longest period without a great-power war in modern history to bringing humanity to the precipice of annihilation. This course gives students an understanding of the role that nuclear weapons have played in world politics over the past seven decades. The course explores the ways these weapons have been incorporated into military force structures; the roles they have played in military strategy; and the effort to control their spread, limit deployments and stockpiles, avoid nuclear war, and prevent nuclear terrorism. This course will be of use to graduate students with an interest in international relations, foreign policy, and national security. No prior background in international security or nuclear policy is required.
Typically offered in Fall only

PS 552 Research Methods and Analysis (3 credit hours)
A survey of methods used in behavioral research as applied to field of political science: elements of empirical theory, research design, measurement of variables, sampling procedures, data courses, techniques of data collection, statistical analysis, qualitative methodologies and presentation of research findings.
Prerequisite: Advanced Undergraduate standing including 12 hours of PS program, Graduate standing or PBS status
Typically offered in Fall only

PS 553 Constitutional and Legal Principles for Police Supervisors (3 credit hours)
Intensive look at the constitutional underpinnings and restrictions on laws and government agency policies impacting police agencies. Specific constitutional protections relating to interrogation and search of employees, freedom of speech, freedom of religion and drug testing. Legal risks and liabilities facing police managers and how to reduce these risks.
Typically offered in Fall, Spring, and Summer

PS 554 Special Topics (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

PS 555 Special Topics In Political Science (1-6 credit hours)
Detailed investigation of a topic. Topic and mode of study determined by student and a faculty member.
Prerequisite: Six hours of PS program
Typically offered in Fall and Spring

PS 556 Special Topics (1-6 credit hours)
Typically offered in Fall and Spring
Polymer and Color Chemistry (PCC)

PCC 101 Introduction to Polymer and Color Chemistry (2 credit hours)
Introduction of topics related to Polymer and Color Chemistry, e.g. fiber and fiber forming polymers, polymerization methods, into to color assessment methods, various chemistry disciplines, molecular interactions, periodic table, acids, bases, solutions, into to and examples of textile coloration and textile finishing techniques.

Corequisite: PCC 104
Typically offered in Fall only

PCC 104 Introduction to Polymer and Color Chemistry Lab (1 credit hours)
An introduction to hands-on laboratory work for the study of basic polymer principles, dye synthesis, forensic analysis and coloration of fibers.

Corequisite: PCC 101
Typically offered in Fall only

PCC 106 Polymer Chemistry and Environmental Sustainability (3 credit hours)
Polymer are prevalent in almost every part of our lives. Many polymers are petroleum based and their raw material supply is limited. Using a theme of environmental impact, this course will review the origin and preparation of key industrial raw materials and how they are used in polymer synthesis. Properties of synthetic polymers will be introduces and concepts for establishing sustainable polymers will be discussed.

Prerequisite: CH 101 or CH 103; Corequisite: CH 221 or CH 225
Typically offered in Fall only

PCC 201 Impact of Industry on the Environment and Society (3 credit hours)
Relationship of society to safety and environmental aspects of manufactured products. Quantifying manufacturing risks. Protective methods, e.g. administrative, engineering, personal, treatment, pollution prevention. Social factors, e.g. political, regulatory, legal, consumer attitudes, public policy, perceptions. Understanding complex social issues, especially situations with conflicting goals. Critical comparison of options for risk reduction, and selecting reasonable (hopefully optimal) courses of action in complex and uncertain situations. Unsolved problems of industry and society (e.g. greenhouse effect). Relationships of ethics, laws and regulations to manufacturing.

GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

PCC 274 Introduction to Forensic Science (3 credit hours)
The field of forensic science is the application of science to the law. The primary purpose of this course is to introduce students to the "real world" of forensics. It will serve as a basis for more advanced forensic courses. Solving crimes are often complex and costly affairs, involving myriad science and engineering disciplines, ethics, legal issues, and strong communication skills. These key areas will be introduced via regular course lectures, guest lectures from faculty members within NC State and other institutions, and guest lectures from current or former field agents and professional forensic scientists.

GEP Interdisciplinary Perspectives
Typically offered in Fall only

PCC 301 Technology of Dyeing and Finishing (3 credit hours)
Basic principles and procedures for the preparation, dyeing, printing, and finishing of natural and man-made fibers. The chemical nature of dyes and fastness properties and the chemical nature of finishes used to impart specific end-use properties.

Prerequisite: PCC 106 or PCC 203 or TE 200 and Corequisite: PCC 304
Typically offered in Fall and Spring

PCC 302 Technology of Textile Wet Processing (4 credit hours)
Introduction to the science and technology used in textile wet processing. Topics include preparation, dyeing, printing and finishing of textiles, basics of color generation and measurement. Emphasis mainly on cotton, wool, nylon and polyester. Laboratory includes experiments in wet processing and a project on statistical analysis of fabric defects.

Prerequisite: (TT 105 or MT 105 or PCC 101) and TMS 211 and CH 101 and (PY 211 or PY 205).
Typically offered in Fall, Spring, and Summer

PCC 304 Technology of Dyeing & Finishing Laboratory (1 credit hours)
Laboratory experience involving the preparation, dyeing, printing, and finishing of natural and man-made fibers.

Prerequisite: PCC 106 or PCC 203 or TE 200 and Corequisite: PCC 301
Typically offered in Fall and Spring

PCC 350 Introduction to Color Science and Its Applications (2 credit hours)
Basic principles and applications of color science. Physical, physiological and psychophysical aspects of color, color perception, color specification, color measurement and color control.

Prerequisite: PCC 301 and either PY 208 or PY 212; Corequisite: PCC 354
Typically offered in Spring only

PCC 354 Intro to Color Science Laboratory (1 credit hours)
An introduction to hands-on laboratory work for the color measurement and perception of colored materials.

Prerequisite: PCC 301 and either PY 208 or PY 212; Corequisite: PCC 350
Typically offered in Spring only

PCC 404 Introduction to the Theory and Practice of Fiber Formation (3 credit hours)
Flow behavior of polymeric materials as related to the formation of fibers by melt, dry and wet extrusion. Elementary theories of drawing and heat setting. Application of fiber-forming theories to synthetic and cellulosic fibers. Offered in Fall only.

Prerequisite: TE 200 and (CH 201 or CH 203) and ((PY 208 and PY 209) or PY 212) and (MA 231 or MA 241)
Typically offered in Fall and Spring

PCC 410 Textile Preparation and Finishing Chemistry (3 credit hours)
Topics in textile wet processing. Chemical mechanisms and unit operations in fabric preparation and finishing.

Prerequisite: PCC 301
Typically offered in Fall only
PCC 412 Textile Chemical Analysis (2 credit hours)
Application of analytical techniques for analysis to fibers, textile chemicals and textile processes; atomic absorption, ultraviolet, visible, near-infrared and infrared spectrophotometry; chromatography; interfacial tension; calorimetric, gravimetric and complexometric analyses. Emphasis on interpretation of data and solving problems of analysis for quantitate and characterization purposes.
Prerequisite: PCC 301 and (CH 331 or CH 433 or TE 303); Corequisite: PCC 414
Typically offered in Spring only

PCC 414 Textile Chemistry Analysis Lab (1 credit hours)
Laboratory course in the application of analytical techniques for analysis of fibers, textile chemicals and textile processes; atomic absorption, ultraviolet, visible, near-infrared and infrared spectrophotometry; chromatography; interfacial tension; calorimetric, gravimetric and complexometric analyses. Emphasis on interpretation of data solving problems of analysis for quantitave and characterization purposes.
Prerequisite: PCC 301 and (CH 331 or CH 433 or TE 303); Corequisite: PCC 412
Typically offered in Spring only

PCC 420 Textile Dyeing and Printing (3 credit hours)
Topics in coloration of textile fibers; chemical and physical mechanisms in textile dyeing and printing.
Prerequisite: PCC 301
Typically offered in Spring only

PCC 442 Theory of Physico-Chemical Processes in Textiles II (3 credit hours)
Second semester of a two-semester sequence. Ideal and non-ideal solutions, colligative properties. Electro chemistry, dyeing isotherms, chemical kinetics, surface chemistry, theory of repellency and other special topics.
Prerequisite: TE 303 or CH 331 or CH 433
Typically offered in Fall only

PCC 461 Chemistry of Polymeric Materials (3 credit hours)
Polymers are a critical component of most products used by society today. Knowledge of their formation and properties is key to development of the materials of the future. The formation and properties of the major polymers are the primary focus areas of this course, including Step-growth and Chain-growth polymerization, formation techniques for preparation of synthetic fibers and the fundamental relationships between chemical structure and physical properties of natural and synthetic polymers.
Prerequisite: (CH 220 and TE 200) or CH 223 or CH 227; Corequisite: PCC 464
Typically offered in Fall only

PCC 462 Characterization and Physical Properties of Polymers (3 credit hours)
Properties unique to polymers are related to their high molecular weight, long and flexible chains, or polymers physics. The detailed molecular structures of polymer, pr polymer chemistry, are characterized and utilized to establish structure-property relations. An inside/outside approach connects their microstructures to their local conformational flexibilities, which impact their global responses, such as sizes and shapes and conformational entropies, to both their environments and the stresses placed upon them.
Prerequisite: PCC 461
Typically offered in Fall and Spring

PCC 464 Chemistry of Polymeric Materials Laboratory (1 credit hours)
Polymers are a critical component of most products used by society today. Understanding their formation and properties is key to development of the materials of tomorrow. This laboratory course is focused on preparation of the major synthetic polymers u
Prerequisite: (CH 220 and TE 200) or CH 223 or CH 227; Corequisite: PCC 461
Typically offered in Fall only

PCC 466 Polymer Chemistry Laboratory (3 credit hours)
Synthesis and characterization of polymers; thermodynamics of rubber elasticity and gelation; spectroscopic, thermal and scattering techniques for polymer analysis. The processing of polymers into fibers and films.
Prerequisite: (CH 331 or TE 303 or CH 433) and Senior Standing
Typically offered in Spring only

PCC 471/MT 471 The Chemistry of Synthetic and Natural Bipolymers (3 credit hours)
Introduction to natural and synthetic biopolymers used for biomedical applications. Goals and challenges of biomaterials selection for biomedical engineering. Polymer concepts of polymerization and characterization. Sources/synthesis, chemical and physical properties and degradation mechanisms are described. Polymer classes include: polysaccharides, proteins, polyesters, polyurethanes, polyanhydrides and polyethers.
Prerequisite: CH 220 or 221 or 225
Typically offered in Spring only

PCC 474 Forensic Chemistry Laboratory (3 credit hours)
Forensic chemistry is the application of chemistry to the law. It is a key part of crime scene investigations. In this course, students work in teams and discover standard methods of crime scene processing, latent evidence processing and analysis of materials and chemicals germane to forensic trace evidence. Advanced analytical chemistry techniques will be learned and applied to solve a ‘crime’ with suspects. Students will attempt to solve the crime and will present their analytical evidence in a courtroom setting with cross-examination.
Prerequisite: (CH 220 or CH 223 or CH 227) and TMS 211
Typically offered in Fall only
PCC 490  Undergraduate Research in Polymer and Color Chemistry  (1-6 credit hours)
Faculty-supervised individual research for undergraduates in PCC. Students must find an advisor from within the department with whom to work on a regular basis. Intended for PCC majors. Individualized Independent Study and Research courses require a Co
Prerequisite: PCC 301 and PCC 461/CH 461 and (TE 303 or CH 331 or CH 433).
Typically offered in Fall and Spring

PCC 491 Seminar in Polymer and Color Chemistry  (1 credit hours)
Familiarizes student with the principal sources of polymer and color chemistry literature and emphasizes importance of keeping abreast of developments in the field. Emphasizes fundamentals of technical writing. Arranged. Intended for PCC majors3
Prerequisite: Senior standing
Typically offered in Fall, Spring, and Summer

PCC 492 Special Topics in Polymer and Color Chemistry  (3 credit hours)
Presentation of material not normally available in regular course offerings or offering of new courses on a trial basis. Credits and content determined by faculty member in consultation with the Department Head.
Typically offered in Fall, Spring, and Summer

Poultry Science (PO)

PO 111 Poultry Production  (3 credit hours)
Introduction to poultry science and production. Domestication of key poultry species, embryology and hatchery management, anatomy and physiology, poultry rations, housing refinements, and diseases relative to the production of poultry meats and eggs. STAFF
Requisite: Agricultural Institute Only
Typically offered in Fall only

PO 150 Poultry Management  (3 credit hours)
Principles and practices of commercial market turkey, broiler, and roaster management. Includes breeding, nutrition, housing, related production parameters, and an examination of contracts and grower-company relationships.
Requisite: Agricultural Institute Only
Typically offered in Spring only

PO 162/VMP 162 Livestock and Poultry Disease Management  (3 credit hours)
Basic principles of disease and disease management in livestock and poultry. Disease prevention through sanitation and vaccination. Diseases of horses, pigs, ruminants, poultry, and disease prevention programs for each species.
Requisite: Agricultural Institute Only
Typically offered in Spring only

PO 201A/PO 201 Poultry Science and Production  (3 credit hours)
Fundamental principles of broiler, turkey and egg production including poultry physiology, breeding, incubation, housing, nutrition, disease control, management and marketing.
Co-requisite: PO 202
GEP Natural Sciences
Typically offered in Fall and Spring

PO 202A/PO 202A Poultry Science and Production Laboratory  (1 credit hours)
This laboratory course will cover the fundamental principles of broiler, turkey and egg production including poultry physiology, breeding, incubation, housing, nutrition, disease control, management and marketing. This course includes field trips for which transportation will be provided.
Corequisite: PO 201
GEP Natural Sciences
Typically offered in Fall and Spring

PO 202A/PO 202 Poultry Science and Production Laboratory  (1 credit hours)
This laboratory course will cover the fundamental principles of broiler, turkey and egg production including poultry physiology, breeding, incubation, housing, nutrition, disease control, management and marketing. This course includes field trips for which transportation will be provided.
Corequisite: PO 201
GEP Natural Sciences
Typically offered in Fall and Spring

PO 212 Poultry and People: Why did the chicken cross the world?  (3 credit hours)
Poultry species play a vital role in modern society. This course engages students to develop research skills including information literacy, data collection, and developing arguments based on evidence. Specific course topics are developed by students during each course offering. General course content will include, but is not limited by the following topics: History of Domestication, Religious Symbolism, Social and Culinary Practice, and Modern Poultry Production (post-1950) commercial and hobby. Delivery of this course will be inquiry based and focus on utilizing research techniques to gather information, develop a hypothesis, collect information, interpret the results, and report findings in multiple formats.
GEP Interdisciplinary Perspectives
Typically offered in Fall only

PO 215 Applied Avian and Aquaculture Nutrition  (3 credit hours)
Comparison of poultry and aquaculture digestive systems, nutrient requirements, formulation and nutritional management, influence of growth and production curves, consumption patterns, and feeding management in commercial poultry and aquaculture industries. Feed manufacturing and government regulations.
Prerequisite: CH 101 and CH 102
Typically offered in Spring only
PO 290  Poultry Seminar  (1 credit hours)
Exploration of topics related with current and future potential to influence the poultry industry. Guest lectures from industry representatives will include: vertically integrated poultry production, primary breeders, marketing, animal health, veterinary medicine as it relates to poultry, allied equipment manufacturers, and management of poultry companies. Special emphasis on summer internships and career services.
Prerequisite: Sophomore standing
Typically offered in Fall only

PO 322/ANS 322/FS 322  Muscle Foods and Eggs  (3 credit hours)
Processing and preserving fresh poultry, red meats, seafood, and eggs. Ante- and post-mortem events as they affect quality, yield, and compositional characteristics of muscle foods. Principles and procedures involved in the production of processed meat items.
Prerequisite: ZO 160, BIO 181 or BIO 183
Typically offered in Fall only

PO 340  Live Poultry and Poultry Product Evaluation, Grading, and Inspection  (3 credit hours)
To provide students with experience handling live poultry as well as working with an learning about USDA grades and evaluation of poultry meat, meat products, and eggs. Develop an understanding of product specifications.
Prerequisite: PO 201
Typically offered in Fall only

PO 404/PO 504  Avian Anatomy and Physiology  (4 credit hours)
Principles of avian physiology integrating physiological functions and anatomical structures of organs and organ systems. Practical problems associated with poultry production. The importance of maximizing growth and productivity via exploitation of env
Prerequisite: PO 201
Typically offered in Fall only

PO 406/PO 506  Physiological Aspects of Poultry Management  (3 credit hours)
Application of physiological principles to modern poultry management and research. Poultry physiology will be related to practical and research management topics including nutrition, housing, ventilation, disease, heat stress, and lighting programs. Students cannot receive credit for both PO 406 and PO 506.
Prerequisite: PO 201, Corequisite: PO 407
Typically offered in Fall only

PO 407  Physiological Aspects of Poultry Management Laboratory  (1 credit hours)
Practical experience with poultry husbandry, animal environment management, and feeding in a research environment Laboratory exercises include feeding and nutrition programs, weighing birds, lighting management and infrastructure, biosecurity and sanitation, vaccinations, hatching egg management, brooding, ventilation programs and infrastructure, housing design and infrastructure, SOP development, human safety and health training, and animal care training. Laboratory exercises will prepare students for both commercial poultry industry and animal research management careers. Co-requisite with PO 406. Personal transportation to Chicken Educational Unit required.
Prerequisite: PO 201, Corequisite: PO 406
Typically offered in Fall only

PO 410  Production and Management of Game Birds in Confinement  (3 credit hours)
Management principles associated with the successful propagation and rearing of game birds, ornamental birds and waterfowl in confinement. Housing and pen requirements, nutrition, disease control and regulatory issues included.

PO 411  Agrosecurity  (3 credit hours)
This course is designed to increase the awareness of the issues and vulnerabilities of the IS agricultural system, the importance of agriculture in the US economy, and the importance of protecting it from disease and/or attack. This course is organized to integrate and assimilate knowledge across multiple disciplines including agriculture, animal health, human health, infectious diseases, business, economics, and public policy. Students will identify and analyze the interactions between these disciplines in light of increasing population and concentrated agriculture's increased vulnerability to major disruptions in food production. Students will also analyze where potential links in the food chain are susceptible to disruptions by individuals (or natural disasters), the consequences of these disruptions, and how to minimize the associated risks by developing case studies and strategies for defending against specific threats. Students must have junior standing.
Junior standing or above
GEP Interdisciplinary Perspectives
Typically offered in Spring only

PO 412  Emerging Topics in Poultry Science  (3 credit hours)
This course is designed to allow students to merge science taught in previous Poultry Science courses with topics considered of interest or emerging in the poultry industry. Students will utilize science and critical thinking skills to solve real world
Typically offered in Spring only

PO 415/PO 515/NTR 515/ANS 515/ANS 415/NTR 415  Comparative Nutrition  (3 credit hours)
Principles of nutrition, including the classification of nutrients and the nutrient requirements of and metabolism by different species for health, growth, maintenance and productive functions.
Prerequisite: ANS 225 or ANS 230 or CH 220 or CH 223 or CH 227
Typically offered in Fall, Spring, and Summer

PO 421  Commercial Egg Production  (3 credit hours)
Principles and current practices of commercial egg production. The Commercial Egg Industry as it is currently evolving and operating in the US. We will examine the development of the industry as it has progressed through integration, consolidation, and expansion. We will also look at the outside influences on the industry such as federal government, European Economic Community (EEC) perspective, animal welfare and consumer desire for naturally raised poultry and poultry products.
Prerequisite: PO 201
Typically offered in Spring only

PO 424  Poultry Meat Production  (3 credit hours)
Principles and current practices of vertically integrated broiler and turkey production; encompassing management, nutrition, poultry health, environmental, and related areas.
Prerequisite: PO 201
Typically offered in Spring only
PO 425 Feed Manufacturing Technology (3 credit hours)
Feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture.

Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225
Typically offered in Fall and Spring

PO 426/FM 426 Feed Manufacturing Technology Laboratory (1 credit hour)
Laboratory associated with feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture. PO/ANS/FM 425 is a required course for the Poultry Science Technology Concentration (TPS); the Feed Milling Minor (FEM); and the Feed Mill Certificate.

Corequisite: PO 425 or ANS 425 or FM 425 and FEM minor or 11PLTRYBS
Typically offered in Spring only

PO 433/PO 533 Poultry Processing and Products (3 credit hours)
Poultry processing, further processing, and resulting products as affected by basic muscle composition and function during the conversation of muscle to meat. Microbiology of spoilage and pathogenic organisms, and the regulatory and HACCP programs designed to minimize problems. Overall business functions of poultry processing to understand profit/loss factors, and skills necessary for communication and management. Various sections on sanitary design/construction, pest control, wastewater treatment, and further processed egg products. Credit for both PO 533 and PO 433 is not allowed. Transportation to field trips will be provided. Non-scheduled class time for field trips or out-of-class activities may be required for this class. Transportation to scheduled labs at Lake Wheeler CEU/Poultry Processing Lab will be provided by students.

Prerequisite: PO 201
Typically offered in Fall only

PO 435 Poultry Incubation & Breeding (4 credit hours)
Principles and current practices of modern poultry incubation and breeding production systems. Students will be able to describe basic elements of breeding management and production practices, to apply these elements to specific scenarios, and to strengthen their ability to interpret and make critical judgements relative to the breeding of poultry, production of hatching eggs, and the subsequent incubation and hatching process.

Prerequisite: PO 201
Typically offered in Spring only

PO 466/BIT 466/BIT 566/PO 566 Animal Cell Culture Techniques (2 credit hours)
Introduction to animal cell culture techniques. Aseptic technique for vertebrate cell culture, media formulation, primary cell culture, long-term maintenance of cell lines, application of molecular techniques to in vitro situations. Half semester course, first part.

Prerequisite: BIT 410 or BIT 510 or BCH 454
Typically offered in Spring only

PO 492 External Learning Experience (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

PO 493 Special Problems in Poultry Science (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes campus facilities and resources. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

PO 495 Special Topics in Poultry Science (1-3 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

PO 504/PO 404 Avian Anatomy and Physiology (4 credit hours)
Principles of avian physiology integrating physiological functions and anatomical structures of organs and organ systems. Practical problems associated with poultry production. The importance of maximizing growth and productivity via exploitation of env

Prerequisite: PO 201
Typically offered in Fall only

PO 506/PO 406 Physiological Aspects of Poultry Management (3 credit hours)
Application of physiological principles to modern poultry management and research. Poultry physiology will be related to practical and research management topics including nutrition, housing, ventilation, disease, heat stress, and lighting programs. Students cannot receive credit for both PO 406 and PO 506.

Prerequisite: PO 201, Corequisite: PO 407
Typically offered in Fall only

PO 510 Poultry Product Safety: An On-Farm Model (3 credit hours)
Typically offered in Spring only

PO 515/NTR 515/ANS 515/ANS 415/NTR 415/PO 415 Comparative Nutrition (3 credit hours)
Principles of nutrition, including the classification of nutrients and the nutrient requirements of and metabolism by different species for health, growth, maintenance and productive functions.

Prerequisite: ANS 225 or ANS 230 or CH 220 or CH 223 or CH 227
Typically offered in Fall, Spring, and Summer

PO 524/ZO 524/PHY 524 Comparative Endocrinology (3 credit hours)
Basic concepts of endocrinology, including functions of major endocrine glands involved in processes of growth, metabolism and reproduction.

Prerequisite: BIO 421 or PO 405
Typically offered in Spring only
PO 525/NTR 425/ANS 425/FM 425/PO 425/NTR 525/FM 525/ANS 525  **Feed Manufacturing Technology**  (3 credit hours)
Feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture.
Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225
Typically offered in Fall, Spring, and Summer

PO 533/PO 433  **Poultry Processing and Products**  (3 credit hours)
Poultry processing, further processing, and resulting products as affected by basic muscle composition and function during the conversation of muscle to meat. Microbiology of spoilage and pathogenic organisms, and the regulatory and HACCP programs designed to minimize problems. Overall business functions of poultry processing to understand profit/loss factors, and skills necessary for communication and management. Various sections on sanitary design/construction, pest control, wastewater treatment, and further processed egg products. Credit for both PO 533 and PO 433 is not allowed. Transportation to field trips will be provided. Non-scheduled class time for field trips or out-of-class activities may be required for this class. Transportation to scheduled labs at Lake Wheeler CEU/Poultry Processing Lab will be provided by students.
Prerequisite: PO 201
Typically offered in Fall only

PO 566/PO 466/BIT 466/BIT 566  **Animal Cell Culture Techniques**  (2 credit hours)
Introduction to animal cell culture techniques. Aseptic technique for vertebrate cell culture, media formulation, primary cell culture, long-term maintenance of cell lines, application of molecular techniques to in vitro situations. Half semester course, first part.
Prerequisite: BIT 410 or BIT 510 or BCH 454
Typically offered in Spring only

PO 580/FM 580  **Feed and Ingredient Quality Assurance**  (3 credit hours)
The course will teach students the principles of feed and ingredient quality assurance and how to develop a comprehensive quality assurance program. The course will include the development of an approved supplier list, ingredient specifications, feed manufacturing quality assurance procedures, and risk based feed safety programs.
Prerequisite: NTR(FM) 525
Typically offered in Fall only

PO 590  **Special Problems in Poultry Science**  (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

PO 601  **Seminar**  (1 credit hours)
Preparation for research, research perspectives, rising concerns in poultry production, orientation for graduate studies in poultry science. Required of all graduate students in the Department of Poultry Science.
Typically offered in Spring only

PO 620  **Special Problems**  (1-6 credit hours)
Specific problems of study assigned in various phases of poultry science.
Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

PO 685  **Master's Supervised Teaching**  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PO 688  **Non-Thesis Masters Continuous Registration - Half Time Registration**  (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.
Prerequisite: Master's student
Typically offered in Spring only

PO 689  **Non-Thesis Master Continuous Registration - Full Time Registration**  (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.
Prerequisite: Master's student
Typically offered in Spring and Summer

PO 690  **Master's Examination**  (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.
Prerequisite: Master's student
Typically offered in Spring and Summer

PO 693  **Master's Supervised Research**  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall and Spring

PO 695  **Master's Thesis Research**  (1-9 credit hours)
Thesis Research
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PO 696  **Summer Thesis Research**  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master's student
Typically offered in Summer only

PO 699  **Master's Thesis Preparation**  (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer
PO 757/IMM 757 Comparative Immunology (3 credit hours)
Compare and contrast the immune system structure and function of animal species of agricultural and veterinary significance with that of humans and traditional biomedical model organisms. Discuss key evolutionary differences, how different species use different mechanisms to achieve the same outcomes, and the clinical implications for these differences.
Prerequisite: MB 751 or MB 441 or BIO 414
Typically offered in Spring only

PO 775/NTR 775 Mineral Metabolism (3 credit hours)
Requirements, function, distribution, absorption, excretion and toxicity of minerals in humans and domestic animals. Interactions between minerals and other factors affecting mineral metabolism or availability. Emphasis on mechanisms associated with mineral functions and the metabolic bases for the development of signs of deficiency.
Prerequisite: ANS(NTR,PO) 415, BCH 451 and ZO 421
Typically offered in Fall only

PO 801 Graduate Seminar in Poultry Science (1 credit hour)
Preparation for research, research perspectives, rising concerns in poultry production, orientation for graduate studies in poultry science. Required of all graduate students in the Department of Poultry Science.
Typically offered in Spring only

PO 820 Special Problems in Poultry Science (1-6 credit hours)
Specific problems of study assigned in various phases of poultry science.
Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

PO 865 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

PO 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Spring only

PO 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PO 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PO 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Summer only

PO 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Professional Writing (WRT)

WRT 111 Expository Writing (3 credit hours)
Emphasis on writing process including audience analysis, topic selection, thesis support and development, editing and revision. Upon completion, students should be able to prepare unified, coherent, well-developed essays using standard written English. AGI majors only. C-Wall course; prerequisite for WRT 114, Professional Writing, Research and Reporting.
Requisite: Agricultural Institute Only
Typically offered in Fall and Spring

WRT 114 Professional Writing, Research and Reporting (3 credit hours)
Emphasis placed on research, listening, critical thinking, analysis, interpretation and design used in oral and written presentations. Upon completion, students should be able to work individually and collaboratively to produce well-designed and professionally written and oral presentations. Restricted to AGI majors; C-Wall course.
Prerequisite: WRT 111
Typically offered in Fall and Spring

Psychology (PSY)

PSY 200 Introduction to Psychology (3 credit hours)
Survey of basic principles for the understanding of behavior and experience including development, learning, cognition, biological foundations, perception, motivation, personality, behavior abnormalities, measurement of individual differences, and social processes. The value of scientific observation and experimentation to the development of psychological understanding is emphasized.
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PSY 208 Psychobiology of Success (3 credit hours)
Exploration of what happens within your body when you experience stress, techniques to alter your body’s response, ways to manage your thoughts and emotions to enhance your performance. Development of an understanding of why your physiology and your background do not have to determine your future. Across all topics, students will critically examine biological, psychological, and medical evidence regarding stress responses, stress management and optimizing functioning.
GEP Interdisciplinary Perspectives, GEP Social Sciences
Typically offered in Summer only
PSY 230 **Introduction to Psychological Research** (3 credit hours)
This course is an introduction to the principles of scientific research. Students will develop and test research hypotheses in accordance with methods approved by the American Psychological Association. Methods of analyzing data and the interpretation of research findings will be stressed. Students will work in teams to collect, analyze, report, and provide a professional presentation of a group research project. Psychology majors and minors must take the course under the graded option.

Prerequisite: PSY 200
Typically offered in Fall, Spring, and Summer

PSY 240 **Introduction to Behavioral Research I** (3 credit hours)
Introduction to quantitative methods in psychology, including measurement, experimental control, validity, and fundamentals of research design. Discussion of distributions and statistical inference. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: PSY or HRD Majors, PSY 200, Corequisite: PSY (ST) 241
Typically offered in Fall and Spring

PSY 241 **Introduction to Behavioral Research I Lab** (1 credit hours)
Students design, analyze and report a variety of simple experiments. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: PSY or HRD Majors, PSY 200, Corequisite: PSY (ST) 240
Typically offered in Fall and Spring

PSY 242 **Introduction to Behavioral Research II** (3 credit hours)
Continuation of PSY (ST) 240. Ethics of Research in Psychology. Techniques for the development of research proposals. Statistical techniques for data analysis including non-parametrics, one-way and two-way ANOVA and introduction to correlation and regression. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: PSY or HRD Majors, PSY (ST) 240, Corequisite: PSY (ST) 243
Typically offered in Fall and Spring

PSY 243 **Introduction to Behavioral Research II Lab** (2 credit hours)
Design and analysis of a major research project. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: PSY or HRD Majors, PSY (ST) 240, Corequisite: PSY (ST) 242
Typically offered in Fall and Spring

PSY 307 **Industrial and Organizational Psychology** (3 credit hours)
Surveys the application of psychological theories and methods to problems involving people in working settings. Topics include: organizational and management theory; work motivation and job satisfaction; job and organizational analysis; performance evaluation; personnel recruitment, selection, and placement; and personnel training and development.

Prerequisite: PSY 200 or PSY 201
Typically offered in Fall, Spring, and Summer

PSY 311 **Social Psychology** (3 credit hours)
Theory and research on how individuals respond and are responded to in social situations. Topics include attitude formation and change, affiliation, attraction, self and interpersonal perception, interpersonal relationships, aggression, helping behavior, intergroup behavior, and group dynamics.

Prerequisite: PSY 200 or PSY 201
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PSY 312 **Applied Psychology** (3 credit hours)
Covers diverse areas of psychological practice, related methods and ethical issues. Includes illustrative cases of psychological practice in health, education, work settings, law, sports, consumer markets, and cross-cultural settings. Explores professional roles and contributions in the contexts of social, organizational and technological change.

Prerequisite: PSY 200 or PSY 201
Typically offered in Fall and Spring

PSY 313 **Positive Psychology** (3 credit hours)
Positive psychology is the scientific study of positive experience, positive individual traits, and the institutions and practices that facilitate their development. This course reviews the history of positive psychology and the contributions this new field has made to several traditional research areas in psychology. Among other issues, the course will address the questions such as: What is happiness and how should we measure it? What determines subjective well-being? Can (and should) we deliberately increase happiness? (Restricted to psychology majors)

Prerequisite: PSY 200
Typically offered in Fall only

PSY 340 **Ergonomics** (3 credit hours)
Concepts from ergonomics, environmental psychology, and cognitive psychology related through design examples to problems of everyday living. Criteria of efficiency, comfort and safety evaluated relative to the design of activity, products, and the environment. Topics include: visual and auditory perception, information processing, physical activity, noise and lighting, work space design, workload, and product design.

Prerequisite: PSY 200 or PSY 201
Typically offered in Fall and Spring
PSY 345/AFS 345 Psychology and the African American Experience (3 credit hours)
Historical and cultural examination of the psychological experiences of African American experience from pre-American times to the present. Focus on mental health, personality, identity development, racism, oppression, psychological empowerment and an African-centered world view. Discussion of contemporary issues within the African American community.
Prerequisite: PSY 200 or PSY 201
GEP U.S. Diversity
Typically offered in Fall and Spring

PSY 360 Community Psychology Principles and Practice (3 credit hours)
This course provides an introduction to the field of community psychology. The aim of this course is to help empower students to contribute to effective social change in their communities. Community psychology focuses upon person-environment interactions and the ways individuals navigate between different social contexts (e.g., schools, neighborhood, community, and society). Community psychologists employ a variety of methodological approaches to understand the social issues facing communities today such as juvenile violence, homelessness, HIV-AIDS, and domestic violence.
Prerequisite: PSY 200
Typically offered in Fall and Spring

PSY 370 Personality (3 credit hours)
Major personality theories. Definition of personality associated with each theory as well as the assumptions and principles used in accounting for human behavior. Theories evaluated considering recent research.
Prerequisite: PSY 200
Typically offered in Fall and Spring

PSY 376 Developmental Psychology (3 credit hours)
Behavioral development during the life span, including study of current theories and project work with persons at various stages of the life cycle.
Prerequisite: PSY 200 or EDP 304
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PSY 400 Perception (3 credit hours)
Anatomy and physiology of the major sensory systems, their relationship to central structures of the brain, important and/or common pathological conditions. Basic issues and techniques of psychophysics. Perceptual phenomena and theory, with an emphasis on topics in two- and three-dimensional spatial perception, including the perceptions of size, depth and motion. Consideration of perceptual phenomena in practical settings.
Prerequisite: PSY 200 or PSY 201, Junior/Senior
Typically offered in Fall and Spring

PSY 406/WGS 406 Psychology of Gender (3 credit hours)
Current theory and research on perceived and actual biological, social, cognitive, personality and emotional similarities and differences of men and women throughout the lifespan. The construction and consequences of gender in our society and others. Credit will not be given for both PSY/WGS 406 and PSY/WGS 506.
Prerequisite: PSY 200 or WGS 200
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

PSY 410 Learning and Motivation (3 credit hours)
Introduction to the primary laboratory research areas in learning and motivation: classical conditioning, operant conditioning, verbal learning, drive theory, and the role of motives. Emphasis upon research on conditioning and its motivational processes as the foundations for techniques in behavior modification. Examination of both the uses and limitations of current information on learning and motivation.
Prerequisite: PSY 200, Junior standing
Typically offered in Fall and Spring

PSY 411 The Psychology of Interdependence and Race (3 credit hours)
The Psychology of Interdependence and Race is designed to explore how interpersonal relationships are structured and how two-person interactions within those structures are influenced by race. Drawing on the major social psychological theory of interper
Prerequisite:PSY 311
Typically offered in Fall and Spring

PSY 416 Psychology of Emotion (3 credit hours)
Introduction to the classic and contemporary theories of emotion, with strong emphasis on how data provide evidence to test theory. Biological, cognitive, social, and cultural foundations are explored.
Prerequisite: PSY 200
Typically offered in Fall and Spring

PSY 420 Cognitive Processes (3 credit hours)
Introduction to research and theory in cognition, including such topics as memory, acquisition and use of language, reading, problem-solving, reasoning, and concepts.
Prerequisite: PSY 200, Junior standing
Typically offered in Fall, Spring, and Summer

PSY 425/PHI 425 Introduction to Cognitive Science (3 credit hours)
Philosophical foundations and empirical fundamentals of cognitive science, an interdisciplinary approach to human cognition. Topics include: the computational model of mind, mental representation, cognitive architecture, the acquisition and use of language. Students cannot receive credit for both PHI/PSY 425 and PHI/PSY 525.
Prerequisite: One upper-level PHI, PSY, CSC or Linguistics course.
Credit is not allowed for PHI 425 and PHI/PSY 525.
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

PSY 430 Biological Psychology (3 credit hours)
Biological mechanisms of behavior, including elementary neuroanatomy and neurophysiology, sensory and motor processes, and their application to motivation, learning, and psychological processes.
Prerequisite: PSY 200 and (BIO 105/106 or BIO 181)
Typically offered in Fall and Spring
PSY 431 Health Psychology (3 credit hours)
Introduction to health psychology. This course provides an overview of the field of health psychology, which is concerned with how behavior and psychological states influence physical health (i.e., how people stay healthy, why people become ill, and how people respond to illness). Application of psychological theory and research methods to such topics as: pain, stress and coping, helplessness and control, reactivity to stress, the effectiveness of behavioral interventions in health, illness prevention, health maintenance, recovery from injury and chronic pain, adjustment to chronic illness, treatment compliance.
Prerequisite: PSY 200 and (PSY 230 or PSY 240/242 OR equivalent research methods course).
Typically offered in Fall and Spring

PSY 436 Introduction to Psychological Measurement (3 credit hours)
The basic principles of psychological measurement, including elementary statistical concepts, reliability, and validity. Emphasizes measurement in the science of psychology. Application of measurement principles to a wide variety of measurement problems.
Prerequisite: PSY 240-241
Typically offered in Spring only

PSY 465 Advanced Methods in Psychology (3 credit hours)
Provides students with practical experience in psychological research. Emphasis will be on hands-on training in analyzing data to develop practical problem-solving skills important in psychology research as well as in other related careers working with
Prerequisite: PSY 230 and ST 311
Typically offered in Fall, Spring, and Summer

PSY 470 Abnormal Psychology (3 credit hours)
Prerequisite: PSY 200 or 304 or EDP 304
Typically offered in Fall, Spring, and Summer

PSY 475 Child Psychology (3 credit hours)
Theories, methods, and phenomena of child psychology and application of this information to the enhancement of child development. Multiple aspects of development, including physical, cognitive/intellectual, and social/emotional development, from conception to adolescence. Emphasis on recent research findings in developmental psychology.
Prerequisite: PSY 200 or 304 or EDP 304; PSY 376
Typically offered in Fall and Spring

PSY 476/EDP 476 Psychology of Adolescent Development (3 credit hours)
Theories, principles, and issues of human psychological development emphasizing adolescence. Cognitive, social, and physical changes; their interaction. Implications for teaching and parenting adolescents.
Prerequisite: PSY 200 or EDP 304
Typically offered in Fall, Spring, and Summer

PSY 491/PSY 590 Special Topics in Psychology (3 credit hours)
Exploration in depth of advanced areas and topics of current interest in psychology.
Prerequisite: PSY 200
Typically offered in Fall and Spring

PSY 495 Community-Based Applied Psychology (4 credit hours)
Service learning course that covers one or more areas of psychological practice, including relevant research methods, community engagement principles and practices, and ethical issues. Includes learning about psychological practice in at least one of the following settings: health, education, work settings, law, sports, community-based setting, consumer markets, and/or cross-cultural settings. Explores professional roles and contributions in the contexts of social, education, organizational and/or technological change. An internship liability insurance fee is required.
Prerequisite: PSY 200 and PSY 230
Typically offered in Fall and Spring

PSY 498 Psychology Honors Seminar (3 credit hours)
Seminar and independent study under faculty direction. Provides the undergraduate psychology honors students with an opportunity to practice skills in designing, conducting, and evaluating research. The student, working closely with a faculty advisor, designs a research approach to a particular body of literature, accumulates appropriate data, and analyzes and evaluates the data. Must take two semesters
Prerequisite: HRD and PSY honors students
Typically offered in Fall and Spring

PSY 499 Individual Study in Psychology (1-6 credit hours)
Individual research project (literature review, experiment, survey, field study) open to any undergraduate, under the direction of a Psychology Department faculty member.
Corequisite: PSY 495 for HRD majors during their work semester
Typically offered in Fall, Spring, and Summer

PSY 500 Visual Perception (3 credit hours)
Detailed consideration of anatomy and physiology of visual system (both peripheral and central components). Modern quantitative approaches to psychophysical problems of detection, discrimination, scaling. Examination of chief determinants of visual perception, including both stimulus variables and such organismic variables as learning, motivation and attention. Discussion of perceptual theory and processes emphasizes several topics in two- and three-dimensional spatial perception.
Prerequisite: Graduate standing
Typically offered in Fall only

PSY 502 Physiological Psychology (3 credit hours)
Physiological foundations of behavior, basic vertebrate neuroanatomy and neurophysiology.
Prerequisite: Twelve hours of PSY including PSY 200, 400,410
Typically offered in Spring only

PSY 504 Evolutionary Psychology (3 credit hours)
Emphasis upon use of evolutionary theory to understand the interaction of genetic and environmental influences on human behavior and thought. Topics include human mating, kinship, parenting, cooperation, aggression, cognition, and morality.
Typically offered in Fall and Spring
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSY 508</td>
<td>Cognitive Processes</td>
<td>(3 credit hours)</td>
<td>Emphasis upon the results from research on a number of complex processes (e.g., remembering, concept learning, problem solving, acquisition and use of language) and the theories that have been proposed to explain these results. Prerequisite: Graduate standing or PBS status Typically offered in Fall and Spring</td>
</tr>
<tr>
<td>PSY 510</td>
<td>Advanced Problems In Psychology</td>
<td>(1-3 credit hours)</td>
<td>Offers opportunities to explore various areas of psychology. Sections: Section D, developmental psychology; Section X, experimental psychology; Section I, industrial-organizational and vocational psychology; Section S, social psychology. Prerequisite: Graduate standing Typically offered in Fall and Spring</td>
</tr>
<tr>
<td>PSY 511</td>
<td>Advanced Social Psychology</td>
<td>(3 credit hours)</td>
<td>A survey of theory and research in social psychology through reading and discussion of primary source materials. In addition, the course deals with issues of methodology, ethical questions in social psychological research and application of research findings to the world at large. Prerequisite: Graduate standing or PBS status Typically offered in Fall only</td>
</tr>
<tr>
<td>PSY 525/PHI 525</td>
<td>Introduction To Cognitive Science</td>
<td>(3 credit hours)</td>
<td>Philosophical foundations and empirical fundamentals of cognitive science, an interdisciplinary approach to human cognition. Topics include: the computational model of mind, mental representation, cognitive architecture, the acquisition and use of language. Students cannot receive credit for both PHI/PSY 425 and PHI/PSY 525. Prerequisite: Graduate standing, Credit is not allowed for PHI 525 and PHI/PSY 425. Typically offered in Spring only</td>
</tr>
<tr>
<td>PSY 535</td>
<td>Tests and Measurements</td>
<td>(3 credit hours)</td>
<td>A study of the principles of psychological testing including norms and units of measurement, elementary statistical concepts, reliability and validity. In addition, some attention devoted to the major types of available tests such as general intellectual development, tests of separate abilities, achievement tests, measures of personality and interest inventories. Prerequisite: Six hours of PSY program Typically offered in Fall and Spring</td>
</tr>
<tr>
<td>PSY 540/ISE 540</td>
<td>Human Factors In Systems Design</td>
<td>(3 credit hours)</td>
<td>Introduction to problems of the systems development cycle, including human-machine function allocation, military specifications, display-control compatibility, the personnel sub-system concept and maintainability design. Detailed treatment given to people as information processing mechanisms. Prerequisite: IE 452 or PSY 340, Corequisite: ST 507 or 515 Typically offered in Spring only</td>
</tr>
<tr>
<td>PSY 541</td>
<td>Overview of Human Factors Psychology</td>
<td>(3 credit hours)</td>
<td>An overview of Human Factors Psychology covering a large number of tools, topics, and exercises important for the field of human factors. Includes topics fundamental to human factors research, such as attention, decision making, and motor control, as well as specific domains within human factors, such as information technology, healthcare, aging, and transportation, with particular emphasis on the methods used for study of these areas. A group project will give students experience with the usability evaluation process. Typically offered in Fall only</td>
</tr>
<tr>
<td>PSY 558</td>
<td>Psychology and the African Experience</td>
<td>(3 credit hours)</td>
<td>An ethnographic approach to the psychology of peoples of African descent through examination of the influence of historical and cultural phenomena. Specific attention to understanding the Africentric world view and issues of mental health, personality and identity development, racism, oppression and empowerment. Prerequisite: Six hours PSY program Typically offered in Spring only</td>
</tr>
<tr>
<td>PSY 582/EDP 582</td>
<td>Adolescent Development</td>
<td>(3 credit hours)</td>
<td>Current theories and research on development during adolescence. Topics include: physical growth, cognitive changes, relationships with peers, parents and teachers, quest for identity and independence, morality and sexuality. Prerequisite: Six hours PSY, including PSY 376, PSY 475 or PSY 476 Typically offered in Spring and Summer</td>
</tr>
<tr>
<td>PSY 584</td>
<td>Advanced Developmental Psychology</td>
<td>(3 credit hours)</td>
<td>A survey of the role of growth and development in human behavior, particularly during the child and adolescent periods. This course pays particular attention to basic principles and theories in the area of developmental psychology. Prerequisite: Nine hrs. of PSY, including PSY 376, PSY 475 or PSY 476 Typically offered in Fall only</td>
</tr>
<tr>
<td>PSY 590/PSY 491</td>
<td>Special Topics in Psychology</td>
<td>(3 credit hours)</td>
<td>Exploration in depth of advanced areas and topics of current interest in psychology. Prerequisite: PSY 200 Typically offered in Fall and Spring</td>
</tr>
<tr>
<td>PSY 591</td>
<td>History and Systems Of Psychology</td>
<td>(1-3 credit hours)</td>
<td>Aim of this course is to acquaint students with the history of psychology and psychological systems and to give students some practice in taking different approaches to a particular problem area. Prerequisite: PSY 200,400,410,420, Consent of Instructor or Graduate standing Typically offered in Spring only</td>
</tr>
<tr>
<td>PSY 641</td>
<td>Psychological Clinic Practicum</td>
<td>(1-12 credit hours)</td>
<td>Clinical participation in interviewing, counseling, psycho-therapy and administration of psychological tests. Practicum to be concerned with adults and children. Prerequisite: Twelve hrs. in grad. PSY, which must include clinical skill courses PSY 722 and PSY 723. Typically offered in Fall and Spring</td>
</tr>
</tbody>
</table>
PSY 651 Internship In Psychology (1-6 credit hours)
Supervised work experience in an appropriate setting with professional supervision in the field from a doctoral level psychologist with credentials and/or experience in the appropriate specialty in psychology. Experience consists of full time for one se
Prerequisite: Approval of advisory committee
Typically offered in Fall and Spring

PSY 680 Directed Study Psychology (1-6 credit hours)
Research project for graduate students supervised by members of the graduate faculty. Research to be elected on basis of interest of student and not to be part of thesis or dissertation research. Credits Arranged
Typically offered in Fall, Spring, and Summer

PSY 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PSY 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PSY 695 Master's Thesis Research (1-9 credit hours)
Thesis Research
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PSY 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Master's student
Typically offered in Summer only

PSY 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis. Credits arranged
Prerequisite: Master's student
Typically offered in Fall and Spring

PSY 704 Learning and Motivation (3 credit hours)
A systematic analysis of some of the major classes of variables determining behavioral change. Learning variables analyzed within their primary experimental setting, and emphasis upon the diversity of the functions governing behavior change rather than upon the development of some comprehensive theory. Examination of both learning and motivational variables as they contribute to changes in performance within the experimental setting.
Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

PSY 705 Affect and Cognition (3 credit hours)
Critical examination of research and theory dealing with the intersection of affect and cognition. Topics will include the impact of emotion, mood and other aspects of affective experience on memory, decision making, judgment, and reasoning. Developmental and individual difference will be explored, as will the neuropsychological underpinnings of observed relationships.
Prerequisite: Six Hours of Graduate Level PSY
Typically offered in Spring only

PSY 706/WGS 706 Psychology of Gender (3 credit hours)
Current theory and research on perceived and actual biological, social, cognitive, personality, and emotional similarities and differences of men and women throughout lifespan. Construction and consequences of gender in our society and others.
Typically offered in Fall and Spring

PSY 710 Special Topics In Psychology (1-3 credit hours)
Course provides opportunity for exploration in depth of advanced topical areas which, because of their degree of specialization, are not generally involved in other courses; for example, multivariate methodology in psychology, computer simulation, mathematical model building. Some new 700-level courses will first be offered under this title during developmental phase and as such may involve lectures and/or laboratories.
Prerequisite: Graduate standing
Typically offered in Fall and Spring

PSY 714 Social Psychology: Small Groups Research (3 credit hours)
Surveys the literature and research pertaining to social psychological processes in and between groups. Course content includes basic principles of group formation, role differentiation, communication, influence, norms, social exchange, equity, cooperation/conflict, decision making and pro-social behavior. Environmental factors affecting group behavior also considered. In conjunction with each substantive topic, suitable methodologies for research considered.
Prerequisite: PSY 511
Typically offered in Spring only

PSY 721 Area Seminar In School Psychology (1-6 credit hours)
The following topics dealt with: (1) the development of school psychology as a professional area, (2) methods of inquiry, (3) scientific and theoretical bases, (4) contemporary issues, (5) ethical questions, (6) relationship to other areas within psychology.
Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

PSY 722 Individual Intelligence Measurement (4 credit hours)
Theoretical approaches to and individual assessment of intellectual functioning, child development, adaptive behavior, and visual motor functioning. Administration, scoring, and interpretation of current standardized instruments and nonstandardized assessment. Written communication of findings.
Prerequisite: PSY 535 and consent of school psychology coordinator
Typically offered in Fall only
PSY 723 Personality Measurement (3 credit hours)
Theory and practicum in individual personality testing of children and adults with emphasis on projective techniques, other personality measures, report writing and case studies.
Prerequisite: PSY 722
Typically offered in Spring only

PSY 724 Psychological Intervention I (3 credit hours)
Designed to examine theories, research, techniques, ethics and professional responsibilities related to approaches to psychological intervention. Types of psychological intervention include behavior modification, milieu approaches, crisis intervention techniques and group process methods, in addition to more intensive relationship approaches. A close integration of experiences, content and supervision emphasized in a variety of professional settings with a wide range of personal problems and age groups.
Prerequisite: PSY 723
Typically offered in Fall only

PSY 725 Psychological Intervention II (3 credit hours)
The primary purpose of this course is to provide students opportunities to acquire information, conceptual frameworks, interpersonal skills and a sense of ethical responsibility, all basic to their further development as practicing psychologists. A major effort in the course made to help the student increase his/her interpersonal skills as a means of promoting the psychological growth and effective-ness of others.
Prerequisite: PSY 724
Typically offered in Spring only

PSY 727 Psychological Consultation (3 credit hours)
Introduction to psychological consultation with emphasis on school setting. Presentation of various consultation models and theoretical bases. Development of skills in practice of consultation.
Prerequisite: Nine hrs. grad. PSY or ED
Typically offered in Spring only

PSY 740/ISE 740 Engineering Psychology of Human-computer Interaction (3 credit hours)
Exploration of usability of computer technology. Theory and practice of user-centered design for HCI applications. Course focuses on current usability paradigms and principles, psychology of users, iterative and participatory design processes, system requirements specification, prototyping, user support systems, usability evaluation and engineering, interface design guidelines and standards. Application domains include, universal design, virtual reality, and scientific data visualization.
Prerequisite: IE(PSY) 540 or CSC 554
Typically offered in Spring only

PSY 743/ISE 743 Ergonomic Performance Assessment (3 credit hours)
Fundamentals of ergonomic performance measurement used to assess the effects of environment and system design on human performance. Treatment of topics such as workload measurement, measurement of complex performance, simulator studies, measurement of change, task taxonomies, criterion task sets and statistical methods of task analysis. Problems of laboratory and field research, measurement of change and generalizability of findings.
Prerequisite: PSY 200, ST 507 and 508
Typically offered in Fall only

PSY 745/ISE 745 Human Performance Modeling (3 credit hours)
Prerequisite: ST 507 or 515 or equivalent; IE (PSY) 540, CSC 554 or IE (PSY) 744

PSY 750 The Psychology of Inequality (3 credit hours)
The following topics dealt with: (1) inequality and social justice as key areas of inquiry for Applied Social and Community Psychology, (2) methods of inquiry for social change, (3) contemporary issues, (4) ethical questions, (5) relationship to other areas within psychology.
Typically offered in Fall only

PSY 751 Intervention Planning & Evaluation (3 credit hours)
Review of the literature, methods and research issues in the field of program intervention, planning and evaluation. Goal-setting, needs assessment, information systems, subjective probability, human resource accounting, decision processes, incentive programs, human productivity and related subjects. Focus on planning and evaluation methods for communities and organizations.
Prerequisite: Graduate standing or PBS status, Corequisite: ST 507
Typically offered in Spring only

PSY 752 Action Research In Psychology (3 credit hours)
Action research models in psychology and their relationships to research methods. Research in field settings and implications for ethics and social responsibility, internal and external validity, experimenter and volunteer effects and problems of measurement.
Prerequisite: ST 511, Corequisite: ST 508
Typically offered in Spring only

PSY 753 Principles and Practice Of Ecological/Community Psychology (3 credit hours)
Introduction to community psychology and its attempt to redefine social problems according to an ecological frame-of-reference with emphasis on humanitarian values, cultural diversity, the promotion of a psychological sense of community among individuals and groups, and the need for psychologists to engage in systematic community research and action.
Typically offered in Fall only

PSY 757 Innovation and Technology (3 credit hours)
Social science theory and research on innovation process and consequences of deploying and implementing technologies. Interactions between social and technical systems: R&D management; social/administrative technology; adoption and dissemination; public policy; computer-mediated communications; implementation; and intended and unintended outcomes for individuals, organizations and society.
Prerequisite: 3 hrs. grad. ST or research methods
Typically offered in Fall only
PSY 758 Special Topics in Applied Social and Community Psychology (3 credit hours)
Exploration of advanced specialized topics in Applied Social and Community Psychology to enhance in-depth graduate training in specific applied theories and methods. Seminar content will rotate, with attention to the development and evaluation of interventions to address important problems in individuals’ well-being in society, particularly those faced by underrepresented groups. Graduate standing is required.
Prerequisite: 6 credit hours in GRAD PSY
Typically offered in Fall and Spring

PSY 760 Psychometrics (3 credit hours)
Theoretical and statistical approaches to understanding psychological measurement. Topics include detailed coverage of reliability, validity, and factor analysis.
Prerequisite: Six hours of graduate statistics, including linear regression
Typically offered in Fall only

PSY 761 Advanced Psychometrics: Item Response Theory (3 credit hours)
Item Response Theory approaches to advanced test construction and scoring; the investigation of test bias via item response theory methods.
Prerequisite: PSY 760

PSY 762 Quasi-Experimental Evaluation Design (3 credit hours)
An introduction to quasi-experimental design as applied to HRD program evaluation: (1) Methods of assessing informational needs, (2) recognition of internal and external validity threats, (3) design of quasi-experiments to minimize threats and (4) use of results by program decision makers.
Prerequisite: ST 507
Typically offered in Spring only

PSY 764 Industrial Psychology (3 credit hours)
Issues in psychology literature surrounding the person, organization, and job. Work analysis and design, recruitment, selection, training, and performance appraisal of employees. Emphasis on scientist-practitioner model throughout the course. Graduate standing required or PBS status.
Typically offered in Fall only

PSY 766 Personnel Selection Research (3 credit hours)
A survey of theoretical, methodological, and research literature on personnel selection. Topics include organization, task and person analyses, validation strategies, utility and equal opportunity issues and selection strategies. Emphasis on research.
Prerequisite: Six hrs. of grad. ST, PSY 760
Typically offered in Fall only

PSY 767 Training Research (3 credit hours)
A survey of conceptual and research literature on training. Topics include needs assessments, learning, transfer, maintenance, criterion and evaluation issues, as well as a review of research on specific training techniques. Emphasis on research methods and findings, not skill development in specific training techniques.
Prerequisite: Six hrs. of grad. PSY and six hrs. of grad. ST
Typically offered in Fall only

PSY 768 Organizational Psychology I (3 credit hours)
A survey of the application of behavioral science, particularly psychology and social psychology literature and research to organizational and management problems. Topics include work motivation and attitudes, job design, employee organizational commitment and work engagement.
P: ST 511 and 512
Typically offered in Spring only

PSY 769 Work Motivation (3 credit hours)
Theory and research in work motivation. An in-depth examination of motivation theory as it pertains to the study of individual behavior in work settings.
Prerequisite: PSY 768
Typically offered in Spring only

PSY 770 Organization Development and Change (3 credit hours)
A survey of theory and research in organization development. Attention directed to: (1) methods of diagnosing need for organizational change, (2) techniques currently used to implement and evaluate organizational change, (3) professional ethics and other issues dealing with client-consultant relationship. Emphasis on developmental approaches originating from psychology and allied fields.
Prerequisite: PSY 768
Typically offered in Spring only

PSY 777 Organization Development and Change (3 credit hours)
A survey of theory and research in organization development. Attention directed to: (1) methods of diagnosing need for organizational change, (2) techniques currently used to implement and evaluate organizational change, (3) professional ethics and other issues dealing with client-consultant relationship. Emphasis on developmental approaches originating from psychology and allied fields.
Prerequisite: PSY 768
Typically offered in Spring only

PSY 778 Organizational Psychology II (3 credit hours)
A survey of the applications of behavioral science, particularly psychology and social psychology literature and research to organizational and management problems. Topics will pertain to the role of leadership in individual, team, and organizational performance.
Typically offered in Fall only

PSY 785 Methodological Issues In Developmental Psychology (3 credit hours)
Methodological issues, research designs and statistical techniques in developmental psychology. Role and meaning of age as a research variable. Interpretation of research reports. Ethical issues.
Prerequisite: PSY 584 and 3 hrs. of grad. statistics
Typically offered in Spring only

PSY 786 Cognitive Development (3 credit hours)
Examination of research and theory in cognitive development. Primary focus on childhood, but implications for the entire life span addressed. Application of cognitive developmental principles in creating interventions and educational programs also discussed.
Prerequisite: PSY 584
Typically offered in Spring only

PSY 787 Social Development (3 credit hours)
Survey of current theory and research on the development of social behavior systems, including attachment, aggression, gender-role behavior, prosocial behavior. Attention to the role of social class, race and culture, and to contemporary phenomena such as day care, single-parent and dual-career families, child abuse.
R: Psychology Graduate Status or Permission of Instructor
Typically offered in Spring only
PSY 788  Adulthood and Aging: Cognitive and Intellectual Change  (3 credit hours)
Critical examination of theory and research associated with the study of cognitive and intellectual change in adulthood and aging. Memory and learning, information processing, language, intelligence, social cognition and expertise.
Prerequisite: PSY 584 or PSY 508
Typically offered in Fall only

PSY 789  Socio-Emotional Processes In Adulthood and Aging  (3 credit hours)
Current theory and research on social, emotional and personality development during adulthood and aging. Generally including self-concept and identity, interpersonal relations (friendship, marriage, parenting, work), control, coping and life satisfaction. Attention to gender, culture and contemporary issues in adult development and aging.
Prerequisite: PSY 584
Typically offered in Fall only

PSY 792  Psychology Of Families and Parenting  (3 credit hours)
Special topics in the area, including family influences on cognitive development, effects of parental divorce on children, single-parenting, step-families, child abuse and ethnic/cultural differences in family functioning. A critical examination of traditional and contemporary parenting approaches and an introduction to family therapy.
Prerequisite: Nine hrs. grad. PSY or ED
Typically offered in Fall only

PSY 795  Stress and Coping  (3 credit hours)
Discussion of current research findings and theories in area of psycho-social stress. Topics include: biology of the stress response, methodology, physical, behavioral and psychological reactions to stress, and relationships between personality and social support to the development of stress-related disorders.
Prerequisite: Two grad. PSY courses
Typically offered in Fall only

PSY 809  Psychology Colloquium  (1 credit hours)
Typically offered in Fall only

PSY 820  Special Topics In Psychology  (1-6 credit hours)
Course provides opportunity for exploration in depth of advanced areas and topics of current interest.
Prerequisite: 6 hrs. of PSY. Corequisite: 3 hrs. of ST
Typically offered in Fall and Spring

PSY 841  School Psychology Practicum  (1-6 credit hours)
Clinical participation in interviewing, counseling, psycho-therapy and administration of psychological tests. Practicum to be concerned with adults and children.
Prerequisite: Twelve hrs. in grad. PSY, which must include clinical skill courses PSY 722 and PSY 723
Typically offered in Fall and Spring

PSY 846  Practicum in Industrial/Organizational Psychology  (3 credit hours)
Procedures and techniques used by Industrial and Organizational Psychologists in the field. Students write work proposals, conduct interventions in field, and document results. Review one or more I/O procedure step-by-step.
Prerequisite: PSY 764
Typically offered in Fall and Spring

PSY 851  Internship In Psychology  (1-6 credit hours)
Supervised work experience in an appropriate setting with professional supervision in the field from a doctoral level psychologist with credentials and/or experience in the appropriate specialty in psychology. Experience consists of full time for one se
Prerequisite: Master's degree in PSY and approval of advisory committee
Typically offered in Fall, Spring, and Summer

PSY 880  Directed Study In Psychology  (1-6 credit hours)
Research project for graduate students supervised by members of the graduate faculty. Research to be elected on basis of interest of student and not to be part of thesis or dissertation research. Credits Arranged
Typically offered in Fall and Spring

PSY 885  Doctoral Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PSY 890  Doctoral Preliminary Exam  (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PSY 893  Doctoral Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PSY 895  Doctoral Dissertation Research  (1-9 credit hours)
Dissertation Research
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PSY 896  Summer Dissertation Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Summer only
PSY 899  Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Public Administration (PA)

PA 311  Public Policy Analysis and Evaluation (3 credit hours)
This course will be an introductory course for the study of policy analysis, i.e. the systematic study of political-issue problems and alternative policy choices. An individual semester-long project will be completed by each student that identifies a policy issue of interest to the student and various alternatives to implement or improve the policy. Students will measure outcomes of their alternative choices and choose a course of action based on anticipated outcomes.

Typically offered in Fall and Spring

PA 332  Human Resource Management in Public Sector (3 credit hours)
PA 332 is a fundamental, comprehensive course designed to provide a view of the major influence human resources management has in a productive public sector organization. Specifically, it examines the challenges of managing complex work systems in the political and institutional environments. Emphasis is given to the challenges facing the public sector in attracting and developing human assets in an environment of conflicting goals, stakeholder obligations and a highly aware electorate. With theoretical concepts established, the focus will shift to practical implementation tools to include recruitment, retention, compensation, and evaluation techniques.

Typically offered in Spring only

PA 410  Public Administration for Police Supervisors (3 credit hours)
Introduces law enforcement supervisors to the subject of Public Administration as a field of intellectual inquiry and as a field of professional activity. Students will learn how important founding principles such as federalism, separation of powers, equity, and democratic accountability impact police organizations today. The more practical concerns of police administrators including budgeting and financial management, labor-management relations, and personnel law are also considered. Available only to distance education students enrolled in the AOMP.

Typically offered in Fall, Spring, and Summer

PA 411  Managing Police Organizational Behavior (3 credit hours)
This course is designed to prepare police managers to develop more efficient and effective organizations. Particular attention is given to improving leadership and interpersonal communication skills through self assessment. Students will also study group dynamics, team building, and the importance of employee empowerment within a law enforcement context. Problem-solving tools and assessments utilized by police agencies to facilitate organizational change are also considered. Available only to distance education students enrolled in the AOMP.

Typically offered in Fall, Spring, and Summer

PA 412  Management Skills & Practices for Police Supervision (3 credit hours)
The purpose of this course is to introduce law enforcement supervisors to management skills that can enhance their individual and organizational effectiveness. Students will learn collaborative leadership, conflict resolution, staff development, group problem solving, delegation and coaching. The skills taught in this class are considered theoretically (through reading assignments and lectures), experientially (through role plays, assessment center exercises, and management inventories), and analytically (through written analyses and class discussions). Available only to distance education students enrolled in the AOMP.

Typically offered in Fall, Spring, and Summer

PA 498  Special Topics in Public Administration (3 credit hours)
Offered as needed to engage professional literature not normally available in regular course offerings or for new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

PA 507  The Public Policy Process (3 credit hours)
Application of current theories of the public policy process to current issues in public policy and management. Emphasis on the dominant theories of the process, including policy streams, advocacy coalitions, punctuated equilibrium, institutional and rational choice models. Graduate standing or seniors with instructor's permission.

Typically offered in Spring only

PA 509  Applied Political Economy (3 credit hours)
Principles governing the interaction of politics and markets, and their application to public policy and public administration. Economic and political market failure, dilemmas of public choice and effects of political institutions. Case studies of public policy-making.

Prerequisite: EC/ARE 401
Typically offered in Fall only

PA 510  Public Administration Institutions and Values (3 credit hours)
Exploration of the critical roles public administration plays in the American constitutional system of government with emphasis on public institutions, policy making and implementation, intergovernmental and intersectoral relations, public service values, administrative discretion, and ethical responsibilities and decision-making.

Typically offered in Fall and Spring
PA 511 Public Policy Analysis (3 credit hours)
Methods and techniques of analyzing, developing and evaluating public policies and programs. Emphasis given to benefit-cost and cost-effectiveness analysis and concepts of economic efficiency, equity and distribution. Methods include problem solving, decision making and case studies. Examples used in human resource, environmental and regulatory policy.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Spring

PA 512 The Budgetary Process (3 credit hours)
Examination of generalized budgetary process used at all levels of government in the U. S. Understanding of the process based upon comprehension of institutions involved, roles of politicians and professionals and the objectives of budgetary systems. Focus also upon budgetary reforms and on Planning-Programming-Budgetary and Zero-Based Budgeting as management tools.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Summer

PA 513 Public Organization Behavior (3 credit hours)
Major conceptual frameworks developed to understand organization behavior. Motivation, leadership, group dynamics, communication, socio-technical systems, work design and organizational learning. Application of theories and concepts to public sector organizations.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Summer

PA 514 Management Systems (3 credit hours)
Use of management systems by public and nonprofit organizations to monitor and manage their programs. Results-based management approaches, including strategic planning, goal setting, and output/outcome measurement. Ways of increasing managerial effectiveness through the use of structural changes, process improvements, project planning tools, performance-based budget systems, and individual and group rewards.
Prerequisite: Six hours of graduate PA course work
Typically offered in Fall and Spring

PA 515 Research Methods and Analysis (3 credit hours)
A focus on behavioral approach to study of political and administrative behavior. Topics including philosophy of social science; experimental, quasi and non-experimental research design; data collection techniques; basic statistical analysis with computer applications.
Prerequisite: ST 311
Typically offered in Fall and Spring

PA 516 Effective Communications for Public Administrators (3 credit hours)
Focus on professional written and oral skills and the applications needed by public and nonprofit administrators. This includes drafting, editing, and presenting factual and persuasive materials. Use of visual aids, handling question and answer sessions, dealing with media, and holding effective meetings. Composing memos, position papers, and press releases. The course develops competency to communicate and interact productively with a diverse and changing workforce and citizenry.
Typically offered in Fall and Spring

PA 517 MPA Capstone (3 credit hours)
Students will demonstrate their achievement of core competencies developed through their MPA course of study. The course will include three key components: (1) Academic Portfolio; (2) Capstone Project; and (3) Reflection Essay. Students will develop a professional academic portfolio in which they identify activities and assignments from their course of study that demonstrate their attainment of the program's expected learning outcomes. Students will complete a hands-on, supervised course project focusing on a major public service problem or issue and that demonstrates practical application of core competencies. Students will prepare a reflection essay of what they learned in the MPA program during their preparation for a public service career.
P: PA 510, PA 511, PA 512, PA 513, PA 514, PA 515 and PA 516.
Typically offered in Fall, Spring, and Summer

PA 520 Seminar in Urban Management (3 credit hours)
A seminar focusing on analytical techniques and managerial principles required for policy formation and implementation in a complex urban governmental environment. Specific topics including urban planning and community development, housing, intergovernmental relations, organizational roles and decision making, budgeting and selected urban services (for example: police, transportation).
Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

PA 521 Government and Planning (3 credit hours)
The planning function at all levels of government in the U. S., with particular attention to problems posed for planning by rapid growth of metropolitan areas. Overview of community development, urban spatial structure, housing economics and land use planning.
Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

PA 522 Intergovernmental Relations in the United States (3 credit hours)
Examination of distinctive features of intergovernmental relations in the U. S. Topics stressed including historical adaptations of federalism, emerging role of the administrator, contemporary trends in intergovernmental relations and assessment of contemporary trends from federal, state and local perspectives.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

PA 523 Municipal Law (3 credit hours)
A focus on the legal nature of cities as municipal corporations and the legal context in which local governments operate. Specific topics covered including incorporation, ethics, public access to meetings and records, annexation, land use, development, planning, liability, financing, contracting, and personnel actions.
Prerequisite: Graduate standing
Typically offered in Fall only

PA 525 Organizational Development and Change Management (3 credit hours)
This course provides an introduction to the applied skills and knowledge necessary for helping public and nonprofit organizations and agencies effectively manage change. Students will gain knowledge and skills in organizational assessment, action research, systems change, and the stages of change management. Graduate standing only.
Typically offered in Spring only
PA 530 Financial Management in the Public Sector (3 credit hours)

Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

PA 531 Human Resource Management in Public and Nonprofit Organizations (3 credit hours)
Analysis of major Human Resource practices used by public and nonprofit organizations. Techniques examined include organization (strategy, job analysis, job evaluation, and compensation), staffing (recruitment, retention, testing, and hiring), performance management (appraisal and training & development), and employee relations (grievance & discipline mediation & negotiation, and labor relations).

Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Spring

PA 532 Contract Negotiation and Mediation in the Public and Nonprofit Sectors (3 credit hours)
Three inter-related leadership skills - negotiation, contracting, and mediation-essential for achieving organizational success. Skills for negotiating with partners, for facilitating among colleagues, for crafting and monitoring contracts for equipment, services, or performance, and for using alternate dispute resolution techniques, primarily mediation.

Prerequisite: Graduate standing or Management Development Certificate Program and 6 hours of 500-level course work
Typically offered in Spring only

PA 535 Problem Solving for Public and Nonprofit Managers (3 credit hours)
The course introduces a problem solving model specific to public and nonprofit organizations. The model is based on meeting three criteria: effectiveness, efficiency, and equity. Students learn to apply the model in interpersonal and group interactions. The course relies heavily on self-assessment to enable the students to recognize their problem solving propensities and the strengths and limitations of those tendencies.

Prerequisite: PA 513
Typically offered in Fall only

PA 536 Management of Nonprofit Organizations (3 credit hours)
Strategies for developing board leadership, staffing, and managing volunteers, working in multi-cultural environments, developing partnerships with other organizations, conducting government relations. Legal requirements and constraints on nonprofits: incorporation, lobbying, and tax policies.

Restriction: PBS status for Graduate Standing
Typically offered in Fall and Summer

PA 538 Nonprofit Budgeting and Financial Management (3 credit hours)
Nonprofit budgeting and financial management practices, including budgeting, financial analysis, cash flow forecasting, internally controlling financial transactions, borrowing, external auditing, investing, managing risk, purchasing and inventory control.

Typically offered in Spring only

PA 539/COM 539 Fund Development (3 credit hours)
Identifies and assesses techniques and best practices of fund development, annual giving, capital campaigns, endowments. Topics include setting achievable goals, organizing and staffing a fund development campaign, and identifying donors. Discusses links between fund development and organization mission and governance, ethical issues, and government regulations. PBS status or Graduate standing.

Typically offered in Fall only

PA 540 Grant Writing for Public Administrators (3 credit hours)
Survey of funding environment; how to identify foundations, corporation and government funding sources, write proposals, and evaluate proposals.

Typically offered in Fall only

PA 541 Geographic Information Systems for Public Administration (3 credit hours)
Introduction to management of spatial data in relation to public administration databases, including preparation of maps, tables, and data graphics related to geographic information systems in the public sector. Use of ArcView and a variety of other GIS computer applications.

Prerequisite: Graduate standing, PBS status, Advanced Undergraduate standing with 12 hours in PS program
Typically offered in Spring only

PA 545 Administrative Law (3 credit hours)
Case law of exercise of administrative power, judicial and legislative control of administrative action, legal rights of public employers and legal procedures of administrative tribunals.

Prerequisite: Graduate standing or PBS status

PA 546 Seminar in Program Evaluation (3 credit hours)
Combination of seminar and field research techniques to study evaluation of public programs. Focus on political and administrative problems associated with program evaluation. Examination of availability and appropriateness of various quantitative methods.

Prerequisite: Graduate standing and 6 hours of 500-level courses
Typically offered in Spring only

PA 550 Environmental Policy (3 credit hours)
Focus on formation and impact of environmental policy in the U. S. Examination on decision-making processes at all levels of government. Comparisons between political, economic, social and technological policy alternatives. Emphasis upon application of policy analysis in environmental assessment and consideration on theoretical perspectives on nature of the environmental crisis.

Prerequisite: Advanced Undergraduate standing including 12 hours of PS program, Graduate standing or PBS status
Typically offered in Fall only

PA 552 Science and Technology Policy (3 credit hours)
This course explores multiple methodologies and disciplinary perspectives to examine the public policies involving or affected by science and technology (S&T). Course themes include the history and evolution of S&T policy, current national and international S&T policy systems and the interactions and conflicts within and surrounding them, and responsible governance of S&T.

Prerequisite: Graduate Standing or PBS Status
Typically offered in Spring only
PA 553 Disaster, Crisis and Emergency Management and Policy (3 credit hours)
Study of the policies designed to prepare for, respond to, mitigate, and recover from natural and technological hazards, disasters, accidents, or terrorist attacks. Surveys government, nonprofit, and private sector activities in hazards, disasters, emergency and crisis management and policy.

Prerequisite: PS 311 or Graduate standing
Typically offered in Fall and Spring

PA 555 Administration of Criminal Justice (3 credit hours)
Politics and administration in American criminal justice system. Emphasis upon interrelationships between ideology, organization and policy outputs in analysis of major problems confronting the system today. Topics including intergovernmental relations, discretionary justice, impact of judicial decisions on criminal justice administration and management trends in criminal justice bureaucracies. Credit for both PS 555 and PA 555 is not allowed.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

PA 580 Independent Study (1-3 credit hours)
Independent research or readings by graduate students under direct supervision of individual faculty members. Students' work evaluated, based on reports, papers and exams.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

PA 598 Special Topics in Public Administration (1-6 credit hours)
Detailed investigation of contemporary topics in fields of public administration. Topic and mode of study determined by program faculty.

Prerequisite: Advanced Undergraduate standing including 12 hours in PS program, Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

PA 635 Readings and Research (1-3 credit hours)
To enable graduate students to pursue a subject of particular interest to them by doing extensive readings or research in that subject under direct, individual faculty supervision.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

PA 650 Internship in Public Affairs (1-6 credit hours)
Exposure of the student to environment and value systems of the public organization through a supervised work experience. Involving application of substantive knowledge and analytical skills to organizational problems. Credit will vary with nature of the experience.

Prerequisite: Minimum 9 hours graduate work
Typically offered in Fall, Spring, and Summer

PA 651 Advanced Practical Training (1-3 credit hours)
Substantive knowledge and analytical skills applied to projects under agency supervision. Participation in monthly on-campus meetings. Credit will not be given for placements in current or previous work unit. Credit will not be given for both PA 650 and PA 651. Credit will vary with number of work hours. Must have MPA, current or previous professional work experience.

Prerequisite: 12 graduate credit hours
Typically offered in Fall, Spring, and Summer

PA 655 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PA 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hour)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Spring and Summer

PA 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Spring and Summer

PA 696 Summer Thesis Research (1 credit hour)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

PA 714 Public Administration Research Methods and Traditions (3 credit hours)
This course explores a variety of topics, ranging from the philosophy of social science to tailoring a literature review. The goal of this course is to approach the public administration research craft from a variety of perspectives, though their underlying epistemic assumptions are often not made explicit. The course also incorporates material on the responsible conduct of research.

Typically offered in Fall only

PA 715 Quantitative Policy Analysis (3 credit hours)
Application of quantitative tools to conduct public policy and administrative research. Course identifies and uses secondary data, including U.S. Census Data, to empirically assess social and economic policies. Emphasis is on the correct selection, use and interpretation of data to answer public policy questions and to understand the strengths and limitations of quantitative analysis.

Prerequisite: ST 407, ST 511, ST 513
Typically offered in Fall only
PA 761 Foundation of Public Administration (3 credit hours)
Intellectual foundation of public administration and its development as a discipline. Boundaries between public administration and large political process, external political control, factors producing administrative influence and the bases of administrative ethics.

Prerequisite: Graduate standing
Typically offered in Fall only

PA 762 Public Organization Theory (3 credit hours)
Examination of fundamental questions guiding organization research in public administration with emphasis on reconciling democracy and organization. Analysis of classical bureaucratic systems, rational choice, cognitive and organizational economic, and nonlinear and chaos theories.

Prerequisite: Graduate standing
Typically offered in Spring only

PA 763 Public Policy Process (3 credit hours)
Examination of public policy process at federal level in the United States. Analysis of constitutional foundations of this process and the role of governmental institutions, political culture, parties, interest groups, and public opinion in policy making. Case studies of policy making and implementation in selected policy areas.

Prerequisite: Graduate standing
Typically offered in Spring only

PA 764 Budgeting and Financial Management (3 credit hours)
Examination of budgetary and financial management processes in governmental and nonprofit agencies. Budgetary and financial management theory, practice, and unanswered research questions.

Prerequisite: PA 512
Typically offered in Fall only

PA 765 Quantitative Research in Public Administration (3 credit hours)
Review of quantitative procedures commonly applied in public administration with emphasis on applications found in leading journals in the discipline. Exploration of data acquisition, appropriate research design, selection of procedures, data assumptions of procedures, and common errors in the research process and in statistical analysis.

Prerequisite: PA 515; ST 507
Typically offered in Spring only

PA 766 Advanced Quantitative Research in Public Administration (3 credit hours)
Review of advanced quantitative procedures commonly applied in public administration research with emphasis on multivariate models found in leading journals in the discipline. Illustrative topics include the application of specialized regression models, generalized linear models, event history models, mixed and multilevel models, and structural equation models to topics in public administration.

Prerequisite: PA 765
Typically offered in Fall only

PA 770 Contemporary Public Management (3 credit hours)
Current public management practices, including evaluation of their underlying theoretical assumptions and of empirical evidence about their effectiveness. Causes of recent shifts in public management theory; political implications of management choices; privatization in theory and practice; managerial use of performance measurement systems; customer feedback systems; worker incentive structures.

Prerequisite: PA 514
Typically offered in Spring only

PA 771 Seminar on Nonprofit Organizations (3 credit hours)
Course provides the necessary theoretical foundation to design scholarly research on nonprofit organizations, voluntary action, and the nonprofit sector. Topics focus on the historical and philosophical roots of the nonprofit sector, the theories used to frame scholarly research and answer contemporary research questions. Students assume a leadership role in shaping the course content. Doctoral students only.

PA 780 Independent Study (1-3 credit hours)
Independent research or readings by graduate students under direct supervision of individual faculty members. Students' work evaluated, based on reports, papers and exams.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

PA 785 Special Topics in Public Administration and Policy (1-6 credit hours)
In depth exploration of specialized or emerging topics in public administration or public policy. Student presentations on readings and research projects. Also used to test and develop new courses.

Typically offered in Fall and Spring

PA 803 Advanced Research Design (3 credit hours)
Philosophy and objectives of social scientific research with focus on basic and applied research, need for hypothesis development and testing as a basis of scientific research, inductive and deductive reasoning. Emphasis on preparation of research design of dissertation, published articles, and technical presentations. Students will present a research prospectus that will serve as the basis for their dissertation.

Prerequisite: Doctoral student in Public Administration; PA 765, Corequisite: At least two graduate methodology or statistics courses
Typically offered in Fall only

PA 810 Special Topics in Public Administration (1-6 credit hours)
Detailed investigation of contemporary topics in fields of public administration. Topic and mode of study determined by program faculty.

Prerequisite: Advanced Undergraduate standing including 12 hours in PS program, Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

PA 835 Readings and Research (1-3 credit hours)
To enable graduate students to pursue a subject of particular interest to them by doing extensive readings or research in that subject under direct, individual faculty supervision.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer
PA 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

PA 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Summer only

PA 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PA 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PA 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

PA 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

REL 200 Introduction to the Study of Religion (3 credit hours)
Historical, theoretical, and methodological introduction to the study of religion. Critical analysis of development of the discipline of Religious Studies. Preparation for all advanced study in Religious Studies theory and method, as well as training to study religious traditions of the world.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

REL 210 Religious Traditions of the World (3 credit hours)
Major Eastern and Western religious traditions with attention to their basic teachings and practices as well as to the historical, geographical, social, and political settings in which they have arisen and developed.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

REL 220 Religion in the Contemporary World (3 credit hours)
Engagement of diverse religious traditions with the contemporary world. Examination of topics such as religion and the environment, science, women and gender, the state, justice and conflict.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

REL 230 Asian Religions (3 credit hours)
Asian religious traditions in comparative perspective. Religious and cultural history through literature, film, and art of India, Pakistan, Bangladesh, Sri Lanka, Nepal, Afghanistan, China, Japan, Korea, and other countries in the region. Doctrine, practice, teaching tales, and issues of change and conflict.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

REL 298 Special Topics in Religious Studies (3 credit hours)
Selected studies in religion that do not appear regularly in the curriculum. Topics will be announced for each semester in which the course is offered.

REL 309/SOC 309 Religion and Society (3 credit hours)
Religious beliefs, practices and organizations addressed as social phenomena. Structural functionalism, conflict and subjectivism as theoretical orientations for understanding influences between religion and society. Relationship of religions to family, government, and economy and to social divisions, conflict and change.

P: 3 credits in SOC at the 200 level
GEP Humanities, GEP Social Sciences
Typically offered in Fall and Spring

REL 311 Introduction to the Old Testament (3 credit hours)
Study of Old Testament books [=Hebrew Bible, HB], examining their content, background and development. Comparisons of the biblical material with other Ancient Near Eastern literature. Assessment of contributions from archaeology and literary studies for clarifying the text. No prior knowledge of the subject matter is required.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

REL 312 Introduction to the New Testament (3 credit hours)
Literary and historical study of the New Testament in its Jewish and Greco-Roman contexts. Special attention to distinctive characteristics of the Gospels and their relationships, early controversies with Judaism and the emergence of church structure and teaching.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

REL 314 Introduction to Intertestamental Literature (3 credit hours)
Intertestamental literature in the context of Jewish history, institutions and beliefs of the Intertestamental Period (ca. 300 B.C.-ca. 100 A.D.)

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

REL 317 Christianity (3 credit hours)
Development of Christianity from its origins to the present; events, persons, ideas, beliefs and practices which were most significant in this development.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring
**REL 320/HI 320  Religion in American History** (3 credit hours)
Representative people, movements and thought in the major religions within the context of American society and culture.

*GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

**REL 332 Religious Cults, Sects, and Minority Faiths in America** (3 credit hours)
Religious cults, sects and minority faiths in America, including Mormonism, Christian Science and Jehovah's Witnesses. Also covers such alternate groups as the holiness-charismatic movement and the Unification Church. Origins, development and teachings of these groups within the context of American culture and religion.

*GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

**REL 331 The Hindu Tradition** (3 credit hours)
Basic religio-philosophical concepts, social institutions, and individual practices of Hindu civilization from earliest Vedic times to the present. Focus on major traditions: Action (karma), Knowledge (jnana), and Devotion (bhakti), with emphasis on disciplines (yoga), myth, symbol, art.

*GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

**REL 332 The Buddhist Traditions** (3 credit hours)
History and structure of the Buddhist tradition analyzed through the "three jewels": the Buddha, the Monastic Community (sangha), and the Teachings (dharma). Emphasis on fundamental religio-philosophical concepts, social history and ritual practices of Southern Buddhism, early Mahayana development, and Tantric ideals. Growth of the traditions in China and Japan.

*GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

**REL 333 Chinese Religions** (3 credit hours)
Survey of Chinese religions from prehistoric times to present. Confucianism, Daoism, primary Buddhist schools in China, spirit possession, divination and popular religious worship.

*GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

**REL 334 Japanese Religions** (3 credit hours)
Survey of various strands of Japanese religious life from prehistoric times until present. Kami worship; primary Buddhist schools in Japan; Japanese Christianity; Confucianism; and New Religions.

*GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

**REL 340 Islam** (3 credit hours)
Introductory survey of the Islamic religious tradition. Examination of the primary historical, literary, and theological sources for Islamic religious thought in global contexts. Topics include the Prophet Muhammad, the development of the early Muslim community, Islamic religious practice, Sunni and Shi'i Islam, Sufism, theology, law and Islamic art and architecture.

*GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

**REL 343/AFS 343 African American Religions** (3 credit hours)
History of religions among Americans of African descent from the period of the development of the transatlantic slave trade to the present. Exploration of the complex ways religion has shaped the lifeworld of African Americans.

*GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

**REL 350 Introduction to Judaism** (3 credit hours)
A survey of Jewish religious traditions from the bible through the present day. Evolution of major religious ideas through classical texts including torah, Talmud, philosophical and mystical literature, and contemporary fiction.

*GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

**REL 402/HI 402 Early Christianity to the Time of Eusebius** (3 credit hours)
Growth and diffusion of early Christianity from the end of the first century up to the time of Eusebius and the conversion of Constantine (early fourth century); Christianity in its Greco-Roman environment; Roman policy towards Christianity; heterodox C

Prerequisite, one of: REL 312, REL 317, or HI 207.

*GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

**REL 407/HI 407 Islamic History to 1798** (3 credit hours)
The history of the Islamic Near East to 1798. Topics include the East Mediterranean before Islam, Muhammad and the development of Islam, sources of Muslim civilization, Islamic law, science, philosophy, art and architecture, Islam in Spain, India, Asia and Africa, the Crusades, the Ottomans, Islam and Europe. Credit will not be given for both REL/HI 407 and REL/HI 507.

Prerequisite: 3 hrs HI or REL 300 or above

*GEP Global Knowledge, GEP Humanities
Typically offered in Fall only
REL 408/HI 408 Islam in the Modern World (3 credit hours)
Evolution of modern Islam from 17th century to the present. Primary emphasis on North Africa, the Middle East and South Asia. Pre-modern Islamicate empires, reform and revival. Historical origins of current issues in the Islamic world. Students cannot receive credit for both REL/HI 408 and REL/HI 508.

Prerequisite: 3 hours of history or religious studies
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

REL 412 Advanced Readings in the Christian Gospels (3 credit hours)
Close study of the varieties of gospel writings, both canonical and non-canonical, in early Christianity. Analysis of the constituent features of the gospels (parables, healing narratives, sermons), and their "pre-history"; the use of the gospels in the reconstruction of the life and ministry of Jesus; and critical methods in gospel research. Students may not receive credit for both REL 412 and REL 512.

P: REL 312 or REL 317
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

REL 413 The Life and Letters of the Apostle Paul (3 credit hours)
Intensive study of the apostle Paul and his writings in their historical, literary and religious contexts. Sources for the life and ministry of Paul; the structure and theology of the Pauline and deutero-Pauline epistles; the influence and image of Paul in early Christianity; and contemporary controversies and issues in the study of Paul. Students may not receive credit for both REL 413 and REL 513.

P: REL 312 or REL 317
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

REL 423 Religion and Politics in America (3 credit hours)
Issues and problems in religion and politics in the United States since 1900. Historical, theoretical, sociological, and cultural approaches to religion and politics. Inquiry into the relations between religion and the state. Responses of religious traditions to American social and political issues. Students cannot receive credit for both REL 423 and REL 523.

Prerequisite for REL 423: one 300-level course in religion, philosophy, or history
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

REL 424 Religion and Politics in Global Perspective (3 credit hours)
An interdisciplinary investigation of interfaces between religion and politics in select global hotspots. Possible topics include governmental systems, constitutional law, war, disaster, and development.
Prerequisites: For REL 424, 3 credits in one or more of the following: ANT, COM, HI, IS, PS, REL, SOC; for REL 524, graduate standing.

Prerequisite: 3 credits in one or more of the following: ANT, COM, HI, IS, PS, REL, SOC
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

REL 471/STS 471 Darwinism and Christianity (3 credit hours)
Evolutionary biology and Christianity. Darwin's evolutionary theory; neo-Darwinism; conflicts between evolutionary theory and Christian thought; methodological parallels and differences between science and religion; proposals for divine action in evolution.

Prerequisite: One course in religious studies, biological sciences, philosophy of science, or history of science. Credit is not allowed for both REL 471 and REL 571.
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

REL 472/WGS 472 Women and Religion (3 credit hours)
Historical, literary, and theological sources dealing with portrayals of women and women's religious experience in several religious traditions of the world through different historical periods, from ancient to modern. Impact of feminist theory on the academic study of religion; methodological issues surrounding the study of women's religious history; role of religion in shaping attitudes toward women and their status in society. Students cannot receive credit for both REL/WGS 472 and REL/WGS 572.

Prerequisite: one course in religious studies or women's and gender studies
GEP Humanities
Typically offered in Spring only

REL 473/WGS 473/REL 573/WGS 573 Religion, Gender, and Reproductive Technologies (3 credit hours)
Examines comparative religious ethics concerning gender marriage, parenthood, children, and the relationship of human beings to the "natural". Relates these views to new and emerging reproductive and genetic technologies. Compares the internally diverse perspectives of three major religious traditions with regard to their interpretations of these technologies. Analyzes the impact of particular uses of these technologies on the rights of women and girls. Students cannot earn credit for both REL 473 and REL 573.

Prerequisite: One 3 cr course in Philosophy (PHI) or Religious Studies (REL) or Women's and Gender Studies (WGS)
Typically offered in Fall only

REL 482 Religion and Conflict (3 credit hours)

Prerequisite: A 300 or above level Religion course
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

REL 489 Interpretations of Religion (3 credit hours)

P: One course in religion, philosophy, anthropology, history, or sociology.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring
REL 491 Advanced Readings in Theological and Religious Literature (3 credit hours)
Critical analysis of advanced theological works; close reading of primary texts; methods of interpretation (hermeneutics). Course may be used for individualized study programs by arrangement with the instructor.
Prerequisite: 300-level course in Religion

REL 496 Seminar in Religious Studies (3 credit hours)
Advanced research and writing in selected topics; application of contemporary and historical methods for the study of religion; hermeneutic theory. Open primarily to Religious Studies majors and minors.
Prerequisite: 300-level course in Religion

REL 498 Special Topics in Religious Studies (1-6 credit hours)
Detailed investigation of selected topics in religion. Topics determined by faculty members in consultation with head of the department. Course may be used for individualized study programs.
Prerequisite: 6 hours REL

REL 502/HI 502 Early Christianity to the Time of Eusebius (3 credit hours)
Growth and diffusion of early Christianity from the end of the first century up to the time of Eusebius and the conversion of Constantine (early fourth century); Christianity in its Greco-Roman environment; Roman policy towards Christianity; heterodox C
Prerequisite: Graduate standing
Typically offered in Fall only

REL 507/HI 507 Islamic History to 1798 (3 credit hours)
The history of the Islamic Near East to 1798. Topics include the East Mediterranean before Islam, Muhammad and the development of Islam, sources of Muslim civilization, Islamic law, science, philosophy, art and architecture, Islam in Spain, India, Asia and Africa, the Crusades, the Ottomans, Islam and Europe. Credit will not be given for both REL/HI 407 and REL/HI 507.
Prerequisite: Graduate Standing
Typically offered in Fall only

REL 508/HI 508 Islam in the Modern World (3 credit hours)
Evolution of modern Islam from 17th century to the present. Primary emphasis on North Africa, the Middle East and South Asia. Pre-modern Islamicate empires, reform and revival. Historical origins of current issues in the Islamic world. Students cannot receive credit for both REL/HI 408 and REL/HI 508.
Prerequisite: Graduate Standing
Typically offered in Fall only

REL 512 Advanced Readings in the Christian Gospels (3 credit hours)
Close study of the varieties of gospel writings, both canonical and non-canonical, in early Christianity. Analysis of the constituent features of the gospels (parables, healing narratives, sermons), and their "pre-history"; the use of the gospels in the reconstruction of the life and ministry of Jesus; and critical methods in gospel research. Students may not receive credit for both REL 412 and REL 512.
Prerequisite: Graduate standing
Typically offered in Fall and Spring

REL 513 The Life and Letters of the Apostle Paul (3 credit hours)
Intensive study of the apostle Paul and his writings in their historical, literary and religious contexts. Sources for the life and ministry of Paul; the structure and theology of the Pauline and deuto-Pauline epistles; the influence and image of Paul in early Christianity; and contemporary controversies and issues in the study of Paul. Students may not receive credit for both REL 413 and REL 513.
Prerequisite: Graduate standing
Typically offered in Spring only

REL 523 Religion and Politics in America (3 credit hours)
Issues and problems in religion and politics in the United States since 1900. Historical, theoretical, sociological, and cultural approaches to religion and politics. Inquiry into the relations between religion and the state. Responses of religious traditions to American social and political issues. Students cannot receive credit for both REL 423 and REL 523.
Prerequisite for REL 523: graduate standing
Typically offered in Spring only

REL 524 Religion and Politics in Global Perspective (3 credit hours)
An interdisciplinary investigation of interfaces between religion and politics in select global hotspots. Possible topics include governmental systems, constitutional law, war, disaster, and development.
Prerequisites: For REL 424, 3 credits in one or more of the following: ANT, COM, HI, IS, PS, REL, SOC; for REL 524, graduate standing.
R: Graduate Standing
Typically offered in Spring only

REL 571/STS 571 Darwinism and Christianity (3 credit hours)
Evolutionary biology and Christianity. Darwin's evolutionary theory; neo-Darwinism; conflicts between evolutionary theory and Christian thought; methodological parallels and differences between science and religion; proposals for divine action in an evo
Prerequisite: Graduate standing. Credit is not allowed for both REL 571 and REL 471.
Typically offered in Fall only

REL 572/WGS 572 Women and Religion (3 credit hours)
Historical, literary, and theological sources dealing with portrayals of women and women's religious experience in several religious traditions of the world through different historical periods, from ancient to modern. Impact of feminist theory on the academic study of religion; methodological issues surrounding the study of women's religious history; role of religion in shaping attitudes toward women and their status in society. Students cannot receive credit for both REL/WGS 472 and REL/ WGS 572.
Prerequisite: Graduate Standing
Typically offered in Spring only
REL 573/WGS 573/REL 473/WGS 473 Religion, Gender, and Reproductive Technologies (3 credit hours)
Examines comparative religious ethics concerning gender marriage, parenthood, children, and the relationship of human beings to the "natural". Relates these views to new and emerging reproductive and genetic technologies. Compares the internally diverse perspectives of three major religious traditions with regard to their interpretations of these technologies. Analyzes the impact of particular uses of these technologies on the rights of women and girls. Students cannot earn credit for both REL 473 and REL 573.
Prerequisite: One 3 cr course in Philosophy (PHI) or Religious Studies (REL) or Women's and Gender Studies (WGS)
Typically offered in Fall only

REL 582 Religion and Conflict (3 credit hours)
Restriction: Graduate Standing
Typically offered in Spring only

REL 589 Interpretations of Religion (3 credit hours)
Prerequisite: Graduate standing
Typically offered in Fall and Spring

REL 598 Special Topics in Religious Studies (1-6 credit hours)
Detailed investigation of selected topics in religion. Topics determined by faculty members in consultation with head of the department. Course may be used for individualized study programs. Students cannot receive credit for both REL 498 and REL 598 un

Typically offered in Fall, Spring, and Summer

Science, Technology and Society (STS)

STS 214 Introduction to Science, Technology, and Society (3 credit hours)
Introduction to the field of Science, Technology, and Society (STS), including most important STS scholars, major schools of thought, and important theoretical and empirical issues in STS.
GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

STS 257/ARS 257 Technology in the Arts (3 credit hours)
The interaction between technology and the arts with an emphasis on developments in Western art of the twentieth century. Historical and emerging issues include: sound and film recordings, the addition of sound to films, the impact of films and television on theater, the impact of radio, computer applications to music, the visual arts, and literature.
GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

STS 301 Science and Civilization (3 credit hours)
An inquiry into the scientific achievement and cultural impact of three different, but interrelated, models (or paradigms) of understanding the world and man's place in it; the Ancient-Medieval model of Aristotle, Ptolemy and Aquinas; the 17th century model of Newtonian physics; and the emerging, but fragmentary, 20th century model based upon the new physics of Einstein, Planck and Heisenberg.
Requisite: Sophomore Standing or Above
GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

STS 302 Contemporary Science, Technology and Human Values (3 credit hours)
Interdisciplinary evaluation of recent and potential influences of current scientific and technological developments on US and non-US societies. Emerging social, ethical, and intellectual issues include: The adequacy of contemporary scientific frameworks; the relations among science, technology, and society; the social consequences of scientific and technological applications, and human prospects and possibilities.
Prerequisite: Sophomore standing
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

STS 304 Ethical Dimensions of Progress (3 credit hours)
Multidisciplinary examination of traditional western notion of progress, focusing on ethical issues raised by concept of progress, and connections between science, technology and society. Places relationships such as engineering and social responsibility within the context of present day redefinitions of the notion of progress.
GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

STS 322 Technological Catastrophes (3 credit hours)
Interdisciplinary examination of the human, organizational and technical factors contributing to the causes and impacts of recent technological accidents such as the Bhopal chemical leak, the space shuttle Challenger explosion, the Chernobyl nuclear accident, and the Exxon Valdez oil spill. Evaluation of risk assessment, risk perception and risk communication strategies. Consideration of options for living with complex technological systems.
Prerequisite: Sophomore standing
GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer
STS 323  World Population and Food Prospects  (3 credit hours)
Examination of the dynamics of population size and food needs, production, distribution and utilization. Consequences of inadequate nutrition and food choices, efforts to increase the compatibility of effective food production systems and alternate crops and cropping systems examined.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

STS 325/PHI 325  Bio-Medical Ethics  (3 credit hours)
Interdisciplinary examination and appraisal of emerging ethical and social issues resulting from recent advances in the biological and medical sciences. Abortion, euthanasia, physician-assisted suicide, compromised infants, aids, reproductive technologies, and health care. Focus on factual details and value questions, fact-value questions, fact-value interplay, and questions of impact assessment and policy formulation.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

STS 402  Peace and War in the Nuclear Age  (3 credit hours)
An interdisciplinary examination of contemporary wars and international conflict, arms, races, nuclear strategy and defense policy, arms control, theories and strategies of peace.

GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

STS 403  Seminar in Science, Technology, and Society  (3 credit hours)
Capstone course for the Science, Technology, and Society (STS) major. Review of the principal theoretical and empirical issues of the field. Research project focused on each student's STS specialty.

Prerequisite: STS 214, STS or STB Majors
Typically offered in Fall and Spring

STS 405  Technology and American Culture  (3 credit hours)
Interdisciplinary study of the role of technology in American culture that examines the social, ideological, economic, and institutional contexts of technological change in nineteenth and/or twentieth-century America. Explores cultural impacts of transformative technological innovations, such as electricity, trains, telephones, radios, cars, airplanes, and computers, as reflected in popular cultural products like magazine/ newspaper articles, advertising, literature, music, museum exhibits, and/or film.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

STS 471/REL 471  Darwinism and Christianity  (3 credit hours)
Evolutionary biology and Christianity. Darwin's evolutionary theory; neo-Darwinism; conflicts between evolutionary theory and Christian thought; methodological parallels and differences between science and religion; proposals for divine action in an evolving world.

Prerequisite: One course in religious studies, biological sciences, philosophy of science, or history of science. Credit is not allowed for both REL 471 and REL 571.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

STS 490  Issues in Science, Technology, and Society  (3 credit hours)
Examination of a significant issue, method, or historical episode in the area of science, technology, and society.

Prerequisite: Junior standing.
Typically offered in Fall and Spring

STS 491  Independent Study in Science, Technology, and Society  (3 credit hours)
Independent investigation and discussion of a selected topic in science, technology, and society. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" to be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

STS 571/REL 571  Darwinism and Christianity  (3 credit hours)
Evolutionary biology and Christianity. Darwin's evolutionary theory; neo-Darwinism; conflicts between evolutionary theory and Christian thought; methodological parallels and differences between science and religion; proposals for divine action in an evolving world.

Prerequisite: Graduate standing. Credit is not allowed for both REL 571 and REL 471.
Typically offered in Fall only

Social Sciences (SSGE)

SSGE 295  Social Sciences Special Topics  (3 credit hours)
Special topics course offering for the general education Social Sciences category.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

Social Sciences and Global Knowledge (SSGK)

SSGK 295  Social Sciences and Global Knowledge Special Topics  (3 credit hours)
Special topics course offering for the general education Social Sciences and Global Knowledge categories. This course may be used for the Global Knowledge (GK) co-requisite and/or for the Social Sciences (SS) requirement.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall, Spring, and Summer

Social Sciences and U.S. Diversity (SSUS)

SSUS 295  Social Sciences and U.S. Diversity Special Topics  (3 credit hours)
Special topics course offering for the general education Social Sciences and U.S. Diversity categories. This course may be used for the U.S. Diversity (USD) co-requisite and/or for the Social Sciences (SS) requirement.

GEP Social Sciences, GEP U.S. Diversity
Social Work (SW)

SW 201 Introduction to Social Work (4 credit hours)
This course, the basis for all other social work courses, provides an introduction to generalist practice and an overview of social work practice in a variety of settings. Successful completion of this course is a prerequisite for all advanced SW courses. This course is designed to acquaint students with social services typical of most American communities: what they are, who uses them, their impact, who pays for them, and who works in them. 40-hour pre-professional placement required, intern liability insurance required. Transportation to and from agency and/or community settings is the responsibility of the student.

GEP U.S. Diversity
Typically offered in Fall and Spring

SW 260 Introduction to Gerontology: An Interdisciplinary Field of Practice (3 credit hours)
An integrative seminar in introducing students to gerontology as an interdisciplinary field of practice. The course provides an overview of topics such as the demography of older adults and the physical, cognitive, and psychosocial aspects of aging. The course also covers health care and social policies that impact older persons and caregivers along with the aging network of services. Students will discuss forms of oppression such as ageism, sexism, racism, able-body(ism), and homophobia that impacts work with older people as well as strategies to promote social and economic justice.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Summer only

SW 290 The Development of Social Welfare and Social Work in the U.S. (3 credit hours)
This course reviews the major policy and program developments in American social welfare and the emergence and development of professional social work. Emphasis will be on the socio-cultural context of policy and programs, and the ideas and ideals that shape social welfare. In addition, the basic elements of social policy development will be considered. This course provides the history, mission, philosophy, and evolution of social welfare policies and services that form the foundation of social welfare, particularly as they relate to poverty, racism, and efforts to address the needs of oppressed and marginalized populations.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

SW 300 Research Methods in Social Work (3 credit hours)
Course provides an overview of the principles and methods of basic social work research. Substantive research knowledge, quantitative and qualitative research methodology are highlighted. Research ethics within the context of social work purposes and values are emphasized. Course exposes students to how high quality research in social work is designed and conducted and how it can assist in making important decisions about the design and implementation of projects, programs, and policies that address the social needs of diverse groups.

P: ST 311; R: Social Work Majors/Minors
Typically offered in Fall, Spring, and Summer

SW 307 Social Welfare Policy: Analysis and Advocacy (3 credit hours)
Course enables students to understand the processes by which social welfare policies are developed and implemented as well as the ways in which people can intervene to affect these processes. Students have the opportunity to review recent developments in national and state social welfare policies and programs in major areas such as poverty, welfare, social security, housing, health and mental health care, and child welfare. The course focuses on the development of students' policy analysis and advocacy skills.

Prerequisite: SW 290
Typically offered in Fall, Spring, and Summer

SW 310 Human Behavior Theory for Social Work Practice (3 credit hours)
Designed to introduce theory regarding human life/development for students intending to practice social work. Students learn to recognize ways in which diversity characterizes and shapes the human experience and is critical to the formation of identity, the extent to which a culture's structures and values may oppress, marginalize, alienate, create or enhance privilege and power. Course surveys major theoretical frameworks and normative developmental variations. Students learn to apply these theories and knowledge from the liberal arts to understand biological, psychological, social, cultural, and spiritual development. Transportation to and from agency and/or community setting is the responsibility of the student.

Prerequisite: SW 201
Typically offered in Fall, Spring, and Summer

SW 312 Multicultural Social Work (3 credit hours)
Course prepares students to work with diverse groups of people locally and globally defined by gender, ethnicity, race, national origin, sexual orientation, income, physical and mental ability, age and religion. Emphasis is placed on defining and developing skills for culturally competent social work generalist practice with these populations through students’ self-examination, experiential learning, and critical reading of class material. This course helps students develop competencies in critical self-reflection, multicultural values and ethics, knowledge, awareness and skills in a variety of ways so that they can work against manifestations of social injustice. Students are expected to provide their own transportation as needed.

GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

SW 320 Social Work Practice I (4 credit hours)
First of a three-course sequence. Practice I presents the generalist social work practice method and focuses on interviewing skills, engaging clients in the helping process, and integrating theory and social work practice. It addresses ethical and professional standards and emphasizes understanding and applying systems and ecological frameworks to practice situations. It examines strengths-based assessment, the phases of the helping relationship, and the dynamics of change in interpersonal helping relationships, within a framework of human rights, social justice, and diversity. 40-hour preprofessional placement required; intern liability insurance required. Transportation to and from agency and/or community settings is the student's responsibility.

Corequisite: Social Work Majors, and a prerequisite or corequisite of SW 310
Typically offered in Fall, Spring, and Summer
SW 405 Social Work Practice II (4 credit hours)
Second of a three-course sequence (Practice I, II, and III). Practice II examines generalist social work roles and techniques with families and groups. Building on the foundation interviewing and engagement skills presented in Practice I, it focuses on assessment, planning, and intervention with individuals, families, and small groups within a framework of human rights, social justice, and diversity. 40-hour preprofessional placement is required, intern liability insurance is required. Transportation to and from agency and/or community settings is the student's responsibility.

Prerequisite: Social Work Majors, SW 320, Corequisite: SW 480/SW 408
Typically offered in Fall and Spring

SW 408 Social Work Practice III (3 credit hours)
Course prepares students for practice will organizations, communities, policy structures, and institutions that are viewed as both tools and targets for change efforts. Course emphasizes multiculturalism, diversity, and social justice in relation to social systems. It is designed to provide social work practitioners with the means to help organizations and communities empower themselves to make change through networking, political participation, leadership development, mobilization, utilization of resources, and other strategies and techniques. Transportation to and/or from community settings is the responsibility of the student.

Prerequisite: Social Work Majors, SW 320, Corequisite: SW 405, SW 480
Typically offered in Fall and Spring

SW 412/SW 512 Social Work in Schools (3 credit hours)
Models and roles relevant to school social work practice. Cooperative work with school personnel in the identification, prevention and treatment of social, emotional and behavioral problems of children and interventive techniques with parents and community groups. For individuals preparing for social work practice in the public schools and for school social workers seeking licensure. Credit not given for both SW 412 and SW 512. Instructor Permission Required.

Typically offered in Fall, Spring, and Summer

SW 413 African American Families: History, Tradition, and Community (3 credit hours)
Characteristics, traditions, history and strengths of African American families and their relationship to other social institutions, social advocacy and social policy development. African-centered worldview and relevant theory pertaining to best practice with African American families.

Prerequisite: Sophomore standing
Typically offered in Summer only

SW 415/SW 515 Child Welfare (3 credit hours)
Generalist perspective on the practice of public child welfare. History of child welfare, practices in child welfare, and current trends in child welfare programs. Skills needed to practice in child protective services, adoption, and foster care with specific attention to the North Carolina child welfare system. Application of cultural diversity and cultural competency integrated throughout as it relates to child welfare issues.

Prerequisite: SW 201
Typically offered in Fall, Spring, and Summer

SW 416/SW 516 Addiction Recovery and Social Work Practice (3 credit hours)
Knowledge and skills in identifying Alcohol and Other Drugs (AOD) problems, screening, assessment, intervention, referral, and prevention: history of AOD problems and treatment, AOD classification, effects and signs/symptoms of AOD, models of addiction, diversity, assessment, diagnosis, intervention, treatment modalities, mutual-help groups, family dynamics, prevention, and ethical considerations. Students cannot receive credit for both SW 416 and SW 516.

Prerequisite: SW 310
Typically offered in Fall, Spring, and Summer

SW 417/SW 517 Direct Practice with Older Adults (3 credit hours)
Physical, psychological, social, and cultural theories of the aging process as it relates to social work practice, social policy, and services for working with older adults and their families. Emphasis on mental and physical well-being, diversity, social and economic justice, intergenerational issues, policy and programs. Credit is not allowed for both SW 417 and SW 517.

Typically offered in Fall and Spring

SW 418 Child Welfare Seminar (1 credit hours)
Best practice seminar for participants in the NC Child Welfare Education Collaborative Program. Seminars focus on current issues in child welfare practice and policy. Topics vary from semester to semester. Students arrange own transportation for occasion.

Prerequisite: Students are Participants in the NC Child Welfare Education Collaborative Program
Typically offered in Fall and Spring

SW 420 The Legal Aspects of Social Work (3 credit hours)
Legal environment of the social work profession. Relationships among legal processes, the delivery of social work services and client problems.

Prerequisite: Social Work Majors and Social Work Minors
Typically offered in Fall and Spring

SW 423/SW 523 Social Work with Soldiers, Veterans, and Their Families (3 credit hours)
A basic overview of military life and the issues and challenges faced by military personnel, their families, friends, and community. The course provides a foundational guide to help professionals working with military families and to understand and address these issues and challenges.

R: Junior or Senior standing. Sophomores and Non-Degree may enroll with instructor approval.
Typically offered in Fall and Spring
SW 425/SW 525  Hunger and Homelessness  (3 credit hours)
This course will familiarize students with the history and experience of hunger and homelessness in contemporary American society. The course includes discussion, narrative readings, experiential exercises, movie reviews, field trips, and other media to expose students to issues of food insecurity and housing instability. Students will critique ideas of what it means to be "poor" and be exposed to the lives of individuals who do not have access to adequate food, housing, healthcare, and other basic needs. American social welfare policy, including governmental and local programs that address these issues, will be discussed. Students are responsible for transportation.

Restricted: Junior or Senior Standing. Sophomores and Non-Degree Students may enroll with instructor approval.

GEP U.S. Diversity
Typically offered in Fall and Spring

SW 440/SW 540  International Learning Experience in Social Work  (6 credit hours)
A seven week learning experience in Guatemala. Through this course, the student will develop a global perspective of social welfare and social work practice, will learn about the people and culture of the Lake Atitlan area of Guatemala, will learn the variety of resources available in response to social need, and will enhance or develop Spanish language competence. All costs associated with learning opportunities and activities for this course are included in the cost of the program.

GEP Global Knowledge
Typically offered in Summer only

SW 480  Preparation for Field Work  (1 credit hours)
Introduction to aspects of field placement process and necessary skills for a successful internship. Application, interview, ethical practice, documentation, supervision and learning contract.

Prerequisite: Social Work Majors, SW 320, Corequisite: SW 405, SW 408
Typically offered in Fall and Spring

SW 490  Field Seminar  (3 credit hours)
Weekly integrative seminar taken in conjunction with SW 491, Community-Based Field Internship. Field seminar provides students the opportunity to discuss and reflect upon their practice of social work skills through dialogue and discourse facilitated by a faculty member who develops a professional environment for students to discuss and reflect upon their agency-based field placement experience. Through organized group discussion and assignments, students use critical reflection pedagogy to discuss their application of professional social work.

Prerequisites: Social Work Majors, SW 405, SW 408, and SW 480; Corequisite: SW 491
Typically offered in Fall, Spring, and Summer

SW 491  Community-Based Field Practicum  (9 credit hours)
This nine-credit course is a co-requisite for, and is taken in conjunction with, SW 491 during the BSW student’s final semester. Students must complete a range of 450 to 480 hours of supervised field agency practicum in an approved community-based agency. It serves as a direct practice component of the culmination of knowledge gained in the BSW courses. Field placement provides students the opportunity to practice social work skills under the supervision of a professional social worker and apply evidence-informed practices, with emphasis on social and economic justice, in their work with individuals, families, groups, organizations, and communities.

"Corequisite: SW 490"
Typically offered in Fall, Spring, and Summer

SW 495  Special Topics in Social Work  (3 credit hours)
Detailed investigation of a topic in social work. Topic and mode of study determined by faculty member.

Typically offered in Fall, Spring, and Summer

SW 498  Independent Studies in Social Work  (1-6 credit hours)
Independent or small group study of a social work practice or social welfare area. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty.

Prerequisite: Junior standing or Senior standing, Social Work Majors or Social Work Minor, Nine credits in social work courses
Typically offered in Fall, Spring, and Summer

SW 500  Advanced Standing Seminar  (4 credit hours)
Orients advanced standing students to the Department and the MSW Program; provides connection between the BSW curriculum and advanced MSW curriculum; assures attainment of CSWE Foundation Curriculum Competencies; provides opportunities to demonstrate/evaluate practice skills of engagement, assessment, intervention, and evaluation; assists students with successful entry into advanced MSW program of study and advanced field placement. For graduate students in the advanced standing program.

Corequisite: SW 505
Typically offered in Summer only

SW 501  Social Work Policy, Services and Programs  (3 credit hours)
Provides students with an understanding of and critical perspective on the development of social systems, social policy and the profession of Social Work in the United States. Examination of the history, mission, philosophy, and evolution of social welfare policies and services that form the foundation of social welfare, particularly as they relate to poverty, racism, and efforts to address the needs of oppressed and marginalized populations.

Typically offered in Spring only

SW 505  Human Behavior and the Social Environment: Social Justice  (3 credit hours)
Theoretical and experiential knowledge related to oppression, privilege, and social and economic justice. Particular attention is given to persons and groups most affected by oppression and mechanisms that advance the achievement of a more just society.

Typically offered in Fall and Summer
SW 506 Human Behavior and the Social Environment: Individuals, Families, and Groups (3 credit hours)
An overview of normative individual and family development trajectories through the life cycle and survey of major theoretical frameworks and normative development variations: Theories of individual, familial, and group interaction and ways that informal groupings and support networks function to maintain individual and family well-being and stability. Admission to the MSW program or permission of the instructor.

Typically offered in Fall only

SW 510 Research Methods for Social Work (3 credit hours)
Social work research methods, interpretation of empirical research findings within the context of social work practice. Major activities include 1)identification of the steps of the research process, 2)utilization of mixed methodologies, 3)assessment of empirical research studies, and 4)discussion of human diversity and ethical issues in research design and implementation. Admission to the MSW Program and ST 311 or equivalent.

Prerequisite: ST 311
Typically offered in Spring only

SW 512/SW 412 Social Work in Schools (3 credit hours)
Models and roles relevant to school social work practice. Cooperative work with school personnel in the identification, prevention and treatment of social, emotional and behavioral problems of children and interventive techniques with parents and community groups. For individuals preparing for social work practice in the public schools and for school social workers seeking licensure. Credit not given for both SW 412 and SW 512.

Instructor Permission Required.

Typically offered in Fall and Spring

SW 515/SW 415 Child Welfare (3 credit hours)
Generalist perspective on the practice of public child welfare. History of child welfare, practices in child welfare, and current trends in child welfare programs. Skills needed to practice in child protective services, adoption, and foster care with specific attention to the North Carolina child welfare system. Application of cultural diversity and cultural competency integrated throughout as it relates to child welfare issues.

Prerequisite: SW 201
Typically offered in Fall, Spring, and Summer

SW 516/SW 416 Addiction Recovery and Social Work Practice (3 credit hours)
Knowledge and skills in identifying Alcohol and Other Drugs (AOD) problems, screening, assessment, intervention, referral, and prevention: history of AOD problems and treatment, AOD classification, effects and signs/symptoms of AOD, models of addiction, diversity, assessment, diagnosis, intervention, treatment modalities, mutual-help groups, family dynamics, prevention, and ethical considerations. Students cannot receive credit for both SW 416 and SW 516.

Prerequisite: SW 310
Typically offered in Fall, Spring, and Summer

SW 517/SW 417 Direct Practice with Older Adults (3 credit hours)
Physical, psychological, social, and cultural theories of the aging process as it relates to social work practice, social policy, and services for working with older adults and their families. Emphasis on mental and physical well-being, diversity, social and economic justice, intergenerational issues, policy and programs. Credit is not allowed for both SW 417 and SW 517.

Typically offered in Fall and Spring

SW 518 Child Welfare Seminar (1 credit hours)
Best practice seminar for participants in the NC Child Welfare Education Collaborative Program. Seminars focus on current issues in child welfare practice and policy. Topics vary from semester to semester. Students arrange own transportation for occasion.

Typically offered in Fall and Spring

SW 519 Evaluation of a Social Work Intervention (2 credit hours)
Second of three courses in social work research. Evaluating social work practice and health and human services programs within different research paradigms. Prepares students for collecting, analyzing, and reporting qualitative and quantitative data; includes laboratory experience. Restricted to students who have completed all foundation courses in the MSW program.

P: SW 505 & SW 510
Typically offered in Fall only

SW 520 SW Generalist Practice I (3 credit hours)
Provides the foundation knowledge and skills needed to engage and assess individuals, families and groups. Examines underlying theories and models of research-informed practice and evidence-based social work interventions with particular emphasis on the ecological systems model from a strengths perspective. Presents the phases and dynamics of change in interpersonal helping relationships within a framework of human rights, social justice, and diversity. Restricted to students admitted to the MSW program.

C: SW 505 and SW 651
Typically offered in Fall only

SW 521 SW General Practice II (3 credit hours)
Prepares students for Social Work practice within organizations, communities and policy structures. Emphasizes multiculturalism, diversity, and social justice in relation to social systems. Restricted to students admitted to the MSW program.

P: SW 505 & SW 520; C: SW 652
Typically offered in Spring only

SW 523/SW 423 Social Work with Soldiers, Veterans, and Their Families (3 credit hours)
A basic overview of military life and the issues and challenges faced by military personnel, their families, friends, and community. The course provides a foundational guide to help professionals working with military families and to understand and address these issues and challenges.

R: Junior or Senior standing. Sophomores and Non-Degree may enroll with instructor approval.
Typically offered in Fall and Spring
SW 524 Portrayals of Social Welfare in Urban Life  (3 credit hours)
This course provides an in-depth analysis of social policy development in the urban context and the multi-dimensional nature of environments, communities, and individuals. Popular media (newspaper and journal articles, film, television, and textbooks) will proxy as a microcosm of contemporary social welfare problems and purported solutions. Following an ethical and social justice paradigm, this course will examine the portrayals of the urban experience and the attendant social problems of life (crime, drugs, economic bifurcation, educational system, and the media) in an economically depressed or struggling major metropolitan area.

Typically offered in Fall, Spring, and Summer

SW 525/SW 425 Hunger and Homelessness  (3 credit hours)
This course will familiarize students with the history and experience of hunger and homelessness in contemporary American society. The course includes discussion, narrative readings, experiential exercises, movie reviews, field trips, and other media to expose students to issues of food insecurity and housing instability. Students will critique ideas of what it means to be "poor" and be exposed to the lives of individuals who do not have access to adequate food, housing, healthcare, and other basic needs. American social welfare policy, including governmental and local programs that address these issues, will be discussed. Students are responsible for transportation.

Restricted: Junior or Senior Standing. Sophomores and Non-Degree Students may enroll with instructor approval.

GEP U.S. Diversity
Typically offered in Fall and Spring

SW 540/SW 440 International Learning Experience in Social Work  (6 credit hours)
A seven week learning experience in Guatemala. Through this course, the student will develop a global perspective of social welfare and social work practice, will learn about the people and culture of the Lake Atitlan area of Guatemala, will learn the variety of resources available in response to social need, and will enhance or develop Spanish language competence. All costs associated with learning opportunities and activities for this course are included in the cost of the program.

GEP Global Knowledge
Typically offered in Summer only

SW 550 Advanced Social Work Practice with Families  (3 credit hours)
Theories, concepts, and skills needed for practice with diverse, at-risk family populations. Includes overview of historical and current social work approaches to family intervention as well as skill development in contemporary intervention methods. Focuses on understanding families within their cultural and community contexts, and presents several family intervention models useful for helping families build on their strengths to cope with a variety of family constellations, changes, and challenges.

Prerequisite: SW 652, Corequisite: SW 654
Typically offered in Spring only

SW 551 Social Work Practice with Children and Adolescents  (3 credit hours)
Focuses on assessment and intervention strategies for clinical practice with children and adolescents. Explores issues common to these client groups.

Prerequisite: SW 521 and SW 652
Typically offered in Fall only

SW 557 SW Program Development and Grant Writing  (3 credit hours)
This course provides a comprehensive introduction to program development and grant writing in social work. The course examines the major steps in the process including problem identification, needs assessment, program planning, and resource identification and development. It is designed to provide a hands-on approach to developing grant writing and other resource development skills. Restricted to students who have completed all foundation courses in a related graduate program.

Typically offered in Spring and Summer

SW 560 Advanced Policy Practice with Organizations and Communities  (3 credit hours)
Second of two courses on social policy. Examines how social workers collaborate with organizations and communities to intervene in social policy. Strategies for policy practice include values clarification, legislative advocacy, analytic advocacy, and implementation advocacy. These strategies build upon concepts and skills from community development, social planning, and community organizing. Emphasis is given to working with economically disadvantaged and historically disempowered communities. Restricted to students who have completed all foundation courses in the MSW program.

Prerequisite: SW 501 & SW 521
Typically offered in Spring and Summer

SW 561 Social Work Administration and Supervision  (3 credit hours)
Addresses the theoretical frameworks and functions of managing human service organizations. Explores personal and professional values and ethical dilemmas in exercising leadership in the management of culturally diverse community groups, boards and committee meetings. Issues of staff development, team building, group decision-making, problem solving strategies, legal structure, governance, funding, accountability systems, and human resources will be discussed. Restricted to students who have completed all foundation courses in the MSW program.

Prerequisite: SW 521 & SW 652
Typically offered in Fall and Summer

SW 571 Community Mental Health  (3 credit hours)
Focuses on social work practice in the field of Mental Health. Reviews policy and practice as it pertains to the promotion of mental health, the prevention of mental illnesses, and the delivery of psychosocial treatment. Strategies and practice for use at the individual, family, group, organizational, community, and societal levels are explored. Master of social work required.

Prerequisite: SW 691

SW 580 Social Work Professional Seminar  (4 credit hours)
Capstone course taken in the final semester of the MSW program intended to help students integrate all coursework in preparation for graduation and professional practice. Directs students to apply promising practices to their professional work and encourages articulate, critical thinking about ethical dilemmas in their professional role.

Prerequisite: SW 653
SW 581  Advanced Social Work Practice with Individuals  (3 credit hours)
Prepares the student for advanced generalist practice with individuals who are experiencing a range of complex life challenges. Focus on traditional and emerging social work practice theories used by social workers to assist individuals in experiencing

Prerequisite: SW 521 and SW 652
Typically offered in Fall only

SW 582  Advanced Social Work Practices with Groups  (3 credit hours)
Focuses on advanced social work practice with groups. Uses ecological systems and empowerment perspectives to explore major theories of social work practice with groups. Critical examination of contemporary issues in designing and evaluation group inter

Prerequisite: SW 521 and SW 652; Corequisite: SW 653
Typically offered in Fall only

SW 583  Advanced Social Work Practice with Family Systems  (3 credit hours)
Theories, concepts, and skills needed for practice with diverse, at-risk families. Overview of historical and current social work approaches to family intervention as well as skill development in contemporary methods. Focuses on understanding families within their cultural and community contexts and presents several family intervention models useful for helping families build on their strengths to cope with a variety of family constellations, changes, and challenges experienced throughout their lifespan. Restricted to students who have completed all foundation courses in the MSW program.

Prerequisite: SW 521 and SW 652; Corequisite: SW 653
Typically offered in Fall only

SW 590  Social Work Capstone  (2 credit hours)
Integration of ecological systems and empowerment perspectives with concepts of intersectionality and covert and overt oppression in group and organizational life leading to design and implementation of a capstone project reflecting mastery of all curri

Typically offered in Spring only

SW 595  Special Topics in Social Work  (3-6 credit hours)
In-depth exploration of specialized or emerging topics in social work or social welfare. Topic of current interest and mode of study determined by faculty member. Also used to test and develop new courses.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

SW 630  Independent Study in Social Work  (1-3 credit hours)
An independent study addressing an area of social work practice or social welfare.

Prerequisite: Master of Social Work, SW 510
Typically offered in Fall, Spring, and Summer

SW 651  Social Work Field Internship I  (5 credit hours)
First course in a two-course foundation sequence that provides students the opportunity to use generalist practice social work skills in a field agency under the supervision of an MSW social work practitioner.

C: SW 505 & SW 520
Typically offered in Fall only

SW 652  Social Work Field Internship II  (5 credit hours)
Second course in a two-course foundation field internship sequence that provides students the opportunity to use generalist practice social work skills in a field agency under the supervision of an MSW social work practitioner.

Prerequisite: SW 520 and SW 651. Corequisite: SW 521
Typically offered in Spring only

SW 653  Advanced Social Work Field Internship I  (5 credit hours)
First course in the advanced field internship sequence that provides students with the opportunity to use advanced generalist practice social work in a field agency under the supervision of an MSW social work practitioner.

C: SW 512 or 557 or 561 or 581 or 582
Typically offered in Fall only

SW 654  Advanced Social Work Field Internship II  (5 credit hours)
Second course in the advanced field internship sequence that provides students the opportunity to use advanced generalist practice social work skills in a field agency under the supervision of an MSW social work practitioner.

Prerequisite: SW 653; Corequisite: SW 560 or SW 561 or SW 583 or SW 590
Typically offered in Spring only

**Sociology (SOC)**

SOC 202  Principles of Sociology  (3 credit hours)
Introduction to sociology. Analyses of key processes and institutions including interaction, inequality, organization, socialization, and social change. Addresses experiences and outcomes of diverse groups in U.S. society. Includes core sociological concepts, methods, theories.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

SOC 203/SOC 203A  Current Social Problems  (3 credit hours)
Examination of social problems linked to structures of economic, political, gender and racial inequality; including poverty, disease, racism, sexism, unemployment, psychological distress, educational failure, environmental destruction and violence. Possible solutions viewed from a variety of perspectives. Includes core sociological concepts, methods and theories.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

SOC 203A/SOC 203  Current Social Problems  (3 credit hours)
Examination of social problems linked to structures of economic, political, gender and racial inequality; including poverty, disease, racism, sexism, unemployment, psychological distress, educational failure, environmental destruction and violence. Possible solutions viewed from a variety of perspectives. Includes core sociological concepts, methods and theories.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

SOC 204/WGS 204  Sociology of Family  (3 credit hours)
Contemporary American family structures and processeses and their development. Focus on socialization, mate selection, marital adjustment and dissolution. Includes core sociological concepts, methods, theories.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer
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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
<th>Description</th>
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<tbody>
<tr>
<td>SOC 205</td>
<td><strong>Jobs and Work</strong></td>
<td>(3 credit)</td>
<td>Work experience in terms of intrinsic and extrinsic rewards for worker. Work experience as intersection of occupation, industry, organization, region, and time period. Research skills for comparing job options to individual goals. Includes core sociological theories, concepts and methods.</td>
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<td></td>
<td><strong>GEP Social Sciences</strong></td>
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<td><strong>Typically offered in Fall and Spring</strong></td>
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<tr>
<td>SOC 206</td>
<td><strong>Social Deviance</strong></td>
<td>(3 credit)</td>
<td>Social processes in the creation and maintenance of deviant populations: classification, objectification of social meanings, functions of deviant groups and social outcomes of the deviance-ascription process. Includes core sociological concepts, methods, theories.</td>
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<td><strong>GEP Social Sciences</strong></td>
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<td><strong>Typically offered in Fall, Spring, and Summer</strong></td>
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<tr>
<td>SOC 207</td>
<td><strong>Language and Society</strong></td>
<td>(3 credit)</td>
<td>Introduction to the intersections of language, society and the individual, and the role of language in social interaction, socialization, ideologies, inequality and social change. Focus on language variation related to race, class, gender, and other social identities. Includes core sociological and sociolinguistics concepts, methods, theories.</td>
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<td></td>
<td><strong>GEP Interdisciplinary Perspectives, GEP Social Sciences, GEP U.S. Diversity</strong></td>
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<td><strong>Typically offered in Fall and Spring</strong></td>
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<tr>
<td>SOC 211</td>
<td><strong>Community and Health</strong></td>
<td>(3 credit)</td>
<td>Course introduces students to the fields of community sociology and population health. It focuses on how structural characteristics of communities influence health disparities, as well as the sociocultural, economic, political, and environmental determinants of physical and mental health and well-being.</td>
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<td>SOC 212</td>
<td><strong>Race in America</strong></td>
<td>(3 credit)</td>
<td>Introduction to race and racism in the United States. Analysis of the key role that racism has played in US history and how racism has shaped opportunities and outcomes for people living in the US.</td>
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<td><strong>GEP Social Sciences, GEP U.S. Diversity</strong></td>
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<td><strong>Typically offered in Fall and Spring</strong></td>
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<tr>
<td>SOC 220</td>
<td><strong>Cultural Geography</strong></td>
<td>(3 credit)</td>
<td>Investigates the world's past and present cultural diversity by studying spatial patterns of population, language, religion, material and non-material culture, technology and livelihoods, communities and settlements and political organization and interaction.</td>
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<td>GEO 220</td>
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<td><strong>GEP Global Knowledge, GEP Social Sciences</strong></td>
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<td><strong>Typically offered in Fall and Spring</strong></td>
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<td></td>
<td><strong>SOC 241/SOC 241A Sociology of Agriculture and Rural Society</strong></td>
<td>(3 credit)</td>
<td>Application of sociological concepts, methods, theories and styles of reasoning to major social problems facing rural America. Changing structure of agriculture; social impact of agricultural technology; rural community growth and decline; rural industrialization, rural poverty, natural resources and environmental issues in rural America. Includes core sociological concepts, methods, theories.</td>
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<td></td>
<td><strong>GEP Social Sciences</strong></td>
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<td><strong>Typically offered in Fall and Spring</strong></td>
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<tr>
<td>SOC 241</td>
<td><strong>Sociology of Agriculture and Rural Society</strong></td>
<td>(3 credit)</td>
<td>Application of sociological concepts, methods, theories and styles of reasoning to major social problems facing rural America. Changing structure of agriculture; social impact of agricultural technology; rural community growth and decline; rural industrialization, rural poverty, natural resources and environmental issues in rural America. Includes core sociological concepts, methods, theories.</td>
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<td><strong>GEP Social Sciences</strong></td>
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<td><strong>Typically offered in Fall and Spring</strong></td>
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<tr>
<td>SOC 251</td>
<td><strong>Technology in Society and Culture</strong></td>
<td>(3 credit)</td>
<td>Processes of social and cultural change with a focus on role of technological innovation. Cross-cultural emphasis. Workplace changes and societal risks in U.S. and non-U.S. societies associated with technological innovations. Special attention to the role of scientists and engineers in socio-cultural change. Topical case studies apply course concepts and principles. Core sociological and anthropological concepts, methods, theories.</td>
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<td><strong>GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Social Sciences</strong></td>
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<td><strong>Typically offered in Fall, Spring, and Summer</strong></td>
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<tr>
<td>SOC 295</td>
<td><strong>Special Topics in Sociology</strong></td>
<td>(1-3 credit)</td>
<td>Offered as needed to present 200-level subject materials not normally available in regular course offerings or for new courses on a trial basis.</td>
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<td><strong>Typically offered in Fall, Spring, and Summer</strong></td>
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<tr>
<td>SOC 300</td>
<td><strong>Social Research Methods</strong></td>
<td>(4 credit)</td>
<td>Basic methods of social research, research design, sampling, data collection, measurement, and analysis; the relationship between theory and research. Laboratory exercises on computer applications.</td>
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<td><strong>P: SOC 202 ; C: ST 311</strong></td>
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<td><strong>GEP Social Sciences</strong></td>
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<td><strong>Typically offered in Fall, Spring, and Summer</strong></td>
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<tr>
<td>SOC 301</td>
<td><strong>Human Behavior</strong></td>
<td>(3 credit)</td>
<td>The development of personality as a consequence of social interactions and behavior of individuals in social contexts. Processes of learning, socialization, social perception, organization, stability and change of attitudes, norms, norm-formation and conformity, social roles and role strain, interpersonal attraction, and intergroup and intragroup relations.</td>
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<td><strong>P: 3 credits in 200-level SOC</strong></td>
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<td><strong>GEP Social Sciences</strong></td>
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<td><strong>Typically offered in Fall and Spring</strong></td>
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SOC 304/WGS 304 Gender and Society (3 credit hours)

P: 3 credits in SOC at the 200-level
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

SOC 305/AFS 305 Racial and Ethnic Relations (3 credit hours)
Study of the nature of the relationships among racial and ethnic groups in societies around the world but with emphasis on the United States. Explores topics such as inequalities of wealth, power, and status, racism, conflict, and social boundaries among groups. Current trends in intergroup relations are discussed.

Prerequisite: 3 cr. in SOC, 200 level
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

SOC 306 Criminology (3 credit hours)
Study of processes whereby behavior is defined as crime and persons are identified as criminals. Includes a sociological investigation of agencies of law enforcement, adjudication, corrections and prevention; patterns of criminal behavior; explanations of variations in criminality with emphasis on sociocultural and sociopsychological theories.

Prerequisite: 3 cr. in SOC, 200 level
GEP Social Sciences
Typically offered in Fall and Spring

SOC 309/REL 309 Religion and Society (3 credit hours)
Religious beliefs, practices and organizations addressed as social phenomena. Structural functionalism, conflict and subjectivism as theoretical orientations for understanding influences between religion and society. Relationship of religions to family, government, and economy and to social divisions, conflict and change.

P: 3 credits in SOC at the 200 level
GEP Humanities, GEP Social Sciences
Typically offered in Fall and Spring

SOC 311 Community Relationships (3 credit hours)
Institutions, organizations and agencies found in modern communities; social problems and conditions with which they deal; their interrelationships and trends toward comprehensive planning.

Prerequisite: 3 cr. in SOC, 200 level
GEP Social Sciences
Typically offered in Fall and Spring

SOC 342 International Development (3 credit hours)
Sociological explanations of global patterns of development, with an emphasis on how the global political economy has evolved over time and how this contributes to social, economic, and environmental changes. Focus on the Global South in particular. Contemporary issues (such as migration and global food insecurity) will be included.

P: 3 credits in 200-level SOC
GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall only

SOC 350 Food and Society (3 credit hours)
Relationships among individuals, groups, and organizations in the production, consumption, and distribution of food. Influences of gender, class, race, and ethnicity. Impacts of laws and regulations, markets, and social movements.

Prerequisite: 3 credits of a 200-level Sociology
GEP Social Sciences
Typically offered in Spring only

SOC 351 Population and Planning (3 credit hours)

Prerequisite: 3 credits in SOC at the 200 level
GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall only

SOC 381 Sociology of Medicine (3 credit hours)
Use of theory and empirical studies to understand the social etiology of disease health practices, practitioners, and institutions, and the special area of mental health. Historical as well as contemporary examples of social influences on, and effects of, health throughout the world, but especially in the United States. Core sociological concepts, methods, theories.

Prerequisite: 200 level Sociology
GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

SOC 395 Special Topics in Sociology (1-3 credit hours)
Offered as needed to present 300-level subject materials not normally available in regular course offerings or for new courses on a trial basis. This course is repeatable innumerable times as long as a different topic is addressed each time.

Prerequisite: 3 credits of a 200-level Sociology
Typically offered in Fall, Spring, and Summer

SOC 400 Theories of Social Structure (3 credit hours)
Contributions of Durkheim, Marx, Weber and others to contemporary macro-level sociological theories. Origins and development of functionalist and conflict approaches. Theories of social solidarity, class structure, the state, bureaucratization, ideology. Uses of original works.

Prerequisite: 3 cr. in SOC, 200 level
Typically offered in Fall and Spring

SOC 401 Theories of Social Interaction (3 credit hours)
Contributions of Weber, Simmel, Mead, Homans, Goffman and others to contemporary micro-level sociological theories. Origins and development of symbolic interaction, ethnomethodology, exchange theory and dramaturgy. Theories of the self, social construction of reality, emotions, interpersonal relationships. Interrelationship of theory and research; use of original works.

Prerequisite: 3 cr. in SOC, 200 level
Typically offered in Fall, Spring, and Summer

SOC 402 Urban Sociology (3 credit hours)
Urban social structures emphasizing determinants and consequences of changes in urban places and life styles. Current urban problems and various approaches to urban social planning.

Prerequisite: SOC 300
SOC 404 Families and Work (3 credit hours)
Sociological analysis of the interplay between economy and family. How men and women make decisions regarding work and family. Theory and research techniques appropriate to the student of work/family conflicts.
Prerequisite: SOC 200 level, SOC 300
Typically offered in Spring only

SOC 405 Racism in the U.S. (3 credit hours)
The course will examine the nature of racism in American society and its correlates: prejudice, discrimination, racial conflict, and racial oppression. Emphasis on the history and development of racism in the U.S. as well as its impact on minority groups. Sociological explanations for the emergence and continuation of racism.
Prerequisite: SOC 300

SOC 407/WGS 407 Sociology of Sexualities (3 credit hours)
Prerequisite: 3 hours SOC 200 level, 300 level
Typically offered in Fall only

SOC 410 Sociology of Organizations (3 credit hours)
Application of sociological theories to study of organizational structures and processes. Special attention to control and coordination, relations with other organizations, and decision making.
Prerequisite: 3 cr. in SOC, 200 level; SOC 300

SOC 413 Criminal Justice Field Work (4 credit hours)
Supervised observation and experience in a criminal justice agency. Study of relationships between ongoing programs and relevant political and sociological theory and research. Weekly seminars, small groups and individual conferences. Presentation of an integrative report.
Prerequisite: SOC 306 and PS 305, Senior standing in Criminal Justice option
Typically offered in Fall, Spring, and Summer

SOC 414 Social Class (3 credit hours)
The universality of social inequality, its bases and consequences. Relationship of social inequality to social class, life chances, life styles and social mobility. Theories and research methods pertinent to the study of social class.
Prerequisite: SOC 300

SOC 418 Sociology of Education (3 credit hours)
Prerequisite: SOC 300
Typically offered in Fall only

SOC 425 Juvenile Delinquency (3 credit hours)
Prerequisite: 3 cr. in SOC 200-level; SOC 300
Typically offered in Fall and Spring

SOC 427 Sociology of Law (3 credit hours)
Sociological concepts, theories and research of law as social control. Social forces behind the creation, maintenance and application of law in American Society.
Prerequisite: 3 cr. in SOC 200-level; SOC 300
Typically offered in Fall only

SOC 428 Formal Institutions of Social Control (3 credit hours)
Development, structure and behavior of formal institutions of social control in the United States (police, courts, corrections); divergent philosophies of punishment that guide the juvenile and adult criminal justice system, dimensions of inequality that influence processing decisions and effectiveness of formal institutions in controlling violations of legal norms.
Prerequisite: 3 hours SOC 200 level; SOC 300
Typically offered in Fall only

SOC 429 Quantitative Data Analysis in Sociology (3 credit hours)
Analysis of quantitative data in sociology, including relationship between theory and research, operationalization and measurement of concepts, descriptive and inferential statistics using computer statistical software, interpreting statistical findings and writing research papers. Sociology and Criminology majors or consent of the instructor.
Prerequisite: SOC 300 or ST 311 or equivalent
Typically offered in Fall only

SOC 430 Community and Crime (3 credit hours)
Neighborhood development, structure and processes as related to delinquency, crime and criminality. Divergent theories of the effect of neighborhood context on crime and crime on neighborhood processes. The interaction of person and neighborhood context. Implications of community processes for social control.
Prerequisite: 3 credits in SOC 200 level; SOC 300
Typically offered in Fall only

SOC 432/PS 432 Violence, Terrorism, and Public Policy (3 credit hours)
The course examines interpersonal and group violence in contemporary societies and the causes for its occurrences. Specific forms of violence that will be examined include domestic violence, gangs, homicide, and terrorism, domestically and internationally. Throughout the course students will use data to critically evaluate policies and practices to prevent and control violence and will examine potential solutions to the problems of violence.
Prerequisite: SOC 300 or PS 371
Typically offered in Fall and Spring

SOC 440 Social Change (3 credit hours)
Sources, processes and consequences of social change on macro and micro levels. Applications of classical and contemporary theories to historical and modern examples of social change in international, national, regional, community, and institutional settings. Examples of empirical studies and appropriate methodologies for each level of analysis.
Prerequisite: 3 cr. in SOC, 200 level; SOC 300
Typically offered in Spring only
SOC 445 Inequality, Ideology, and Social Justice (3 credit hours)  
Systematically addresses the question of why people believe what they do about the legitimacy of inequality; explores the role of self-interest, secular and religious values, considers specific types of ideology such as meritocracy, racism, sexism, colonialism; applies various theories to explain patterns of belief; looks at the role of media and propaganda in shaping beliefs.  
Prerequisite: 3 hours of 200-level SOC and SOC 300  
Typically offered in Fall only

SOC 450 Environmental Sociology (3 credit hours)  
Systematic relations between natural environment and human societies. Dependency on the natural world. Population technology, cultural and economic influences on ecosystems. Development of environmentalism and alternative models for understanding threats and potentials. current environmental issues and considerations of their global contexts.  
Prerequisite: 3 hours SOC 200 level, SOC 300  
Typically offered in Fall only

SOC 457 Corporate Power in America (3 credit hours)  
Examines the nature, distribution, and exercise of power in U.S. society. Emphasizes corporate power and its relationship to government. Topics include membership in the upper class and the power elite, media and shaping of public opinion, the culture of politics, formation of political consciousness, and the emergence of oppositional and reactionary social movements.  
Prerequisite: (SOC 202 or SOC 203) and SOC 300  
Typically offered in Spring only

SOC 465 Social Aspects of Mental Health (3 credit hours)  
A survey of the role of social environment and life experiences in mental health and mental disorder, focusing on the link between social inequality and emotional inequality. Topics include the social construction of mental illness and the classification process, social distribution of mental health, explanations of mental health differences. Special emphasis on adolescent and adult traumas that shape the life course.  
Prerequisite: SOC 300  
Typically offered in Spring only

SOC 467 Developing Societies (3 credit hours)  
An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.  
Prerequisite: Six hrs. SOC or ANT or Graduate standing or PBS status

SOC 476 Social Problems (3 credit hours)  
Definition of major problems posed for development sociology and exploration of social barriers and theoretical solutions for development set forth with regard to newly developing countries. Review of significant past strategies and presentation of main  
Prerequisite: Six hrs. SOC

SOC 483 Special Problems in Sociology (1-6 credit hours)  
A learning experience in sociological research that utilizes facilities and resources which are external to the campus. Students are placed with organizations to apply sociological concepts in planning or conducting a research project. Contact the Sociology Department for details on course content and requirements.  
Prerequisite: Sophomore standing  
Typically offered in Fall, Spring, and Summer

SOC 489 Special Problems in Sociology (1-3 credit hours)  
A learning experience in sociological research that utilizes campus facilities and resources. Arrangements must be initiated by the student and approved by the instructor prior to the experience. Contact the Sociology Department for details on course content and requirements.  
Prerequisite: Sophomore standing  
Typically offered in Fall, Spring, and Summer

SOC 498 Independent Study in Sociology (1-6 credit hours)  
A detailed investigation of a topic in sociology. Topic and mode of study determined by the faculty member(s) in consultation with the department head. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled"  
Prerequisite: Six hours SOC above the 200 level  
Typically offered in Fall, Spring, and Summer

SOC 508 Social Organization (3 credit hours)  
Introduction to study of social structure. Focus on inequality, work, organizations, the economy, the state. Classic writings and their impacts.  
Prerequisite: SOC 400 or SOC 701

SOC 509 Population Problems (3 credit hours)  
Examination of population growth, rates of change and distribution. Emphasis on functional roles of population, i.e., age, sex, race, residence, occupation, marital status and education. Stress on population dynamics fertility, mortality and migration. Analysis on population policy in relation to national and international goals stressing a world view.  
Prerequisite: SOC 202

SOC 514 Developing Societies (3 credit hours)  
Definition of major problems posed for development sociology and exploration of social barriers and theoretical solutions for development set forth with regard to newly developing countries. Review of significant past strategies and presentation of main  
Prerequisite: Six hrs. SOC or ANT or Graduate standing or PBS status

SOC 531 Special Problems in Sociology (1-6 credit hours)  
A learning experience in sociological research that utilizes facilities and resources which are external to the campus. Students are placed with organizations to apply sociological concepts in planning or conducting a research project. Contact the Sociology Department for details on course content and requirements.  
Prerequisite: Sophomore standing  
Typically offered in Fall, Spring, and Summer

SOC 533 The Community (3 credit hours)  
The community viewed in sociological perspective as a functioning entity. Presentation and application of a method of analysis to eight "dimensions," with emphasis on the unique types of understanding to be derived from measuring each dimension. Finally, analysis of effect of change on community integration and development.  
Prerequisite: Six hrs. SOC

SOC 591 Special Topics In Sociology (1-6 credit hours)  
An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.  
Typically offered in Spring only

SOC 601 Seminar (1-3 credit hours)  
Appraisal of current literature; presentation of research papers by students; progress reports on departmental research; review of developing research methods and plans; reports from scientific meetings and conferences; other professional matters. Credit  
Typically offered in Fall only

SOC 610 Special Topics In Sociology (1-6 credit hours)  
An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.  
Typically offered in Fall, Spring, and Summer
SOC 642 Practicum In Sociology (1-6 credit hours)
Opportunity for student under supervision of graduate advisory committee chair and organization/agency supervisor to develop and demonstrate competency in the area of graduate specialization through application of sociological knowledge to practical experiences.

Prerequisite: Graduate standing in the Master of Sociology program and nine hrs. of SOC at the 500-600 level
Typically offered in Fall, Spring, and Summer

SOC 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SOC 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final exam. Credits Arranged

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SOC 693 Master’s Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SOC 695 Master’s Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SOC 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

SOC 699 Master’s Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master’s degree and are writing and defending their thesis. Credits arranged

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SOC 701 Classical Sociological Theory (3 credit hours)
The interdependence of theory and research in sociology; major theoretical classics in the discipline and how they provide foundations for subsequent developments and for analysis in substantive areas.

Requisite: Admission to SOC Graduate Program
Typically offered in Fall only

SOC 702 Contemporary Sociological Theory (3 credit hours)
Works by major figures representing leading schools of sociological theory in the post-World War II period studied as primary sources. Underlying assumptions made explicit, the structure of the theory, including propositions, examined critically and discussion of relationships with other theoretical perspectives.

Prerequisite: SOC 701

SOC 705 Historical Materialism Approaches to Social Theory (3 credit hours)
This sociological theory course will cover the development of Marxist social thought from the 19th century to the present. We will explore themes, arguments, and debates during this era, concentrating on theoretical developments and syntheses in the historical materialist traditions, and explore their relevance and application for sociological research. Issues and topics will be broadly organized around theories of class, gender, race, power, ideology, culture, capitalist development, science, social crises, social change, and social justice.

Typically offered in Spring only

SOC 707 Quantitative Sociological Analysis (3 credit hours)
Introduction to application of common quantitative methodologies in sociology including multiple regression and path analysis. Emphasis on selecting appropriate analytical techniques, model estimation and sociological interpretation of findings.

Prerequisite: Graduate standing
Typically offered in Spring only

SOC 708 Advanced Sociological Analysis (3 credit hours)
Examination of advanced analysis techniques adaptable to needs of sociological research. Special attention given to causal analysis, analysis of change and aggregate versus individual level data analyses. Consideration of sociological examples. Attention to emerging issues and techniques.

Prerequisite: SOC 711, ST 507 or ST 711
Typically offered in Fall only

SOC 710 Teaching Sociology (3 credit hours)
The objective of this course is for students to further their skills in teaching sociology. Students will plan an undergraduate course, construct a teaching philosophy, evaluate a variety of teaching techniques, and demonstrate an understanding of teaching as a sociological phenomenon.

Prerequisite: Admission to sociology graduate program
Typically offered in Spring only

SOC 711 Research Methods In Sociology I (3 credit hours)
Issues in philosophy of science, causation, relationship of theory and research. Qualitative, experimental and survey design methodologies.

Requisite: Admission to SOC Graduate Program
Typically offered in Spring only

SOC 712 Advanced Survey Research Methods (3 credit hours)
Advanced survey methodology including research design, sampling, questionnaire development and surveys using the World Wide Web. Designing and executing substantive and methodological studies using surveys to perationalize behavioral and social constructs and to test hypotheses.

Prerequisite: SOC 711 and SOC 707
Typically offered in Spring only
SOC 713  Applied Research  (3 credit hours)
Studies research process with emphasis upon its application to action problems. Stress upon development of research design to meet action research needs.
Prerequisite: Admission to SOC Graduate Program
Typically offered in Fall only

SOC 715  Qualitative Sociological Methods and Analysis  (3 credit hours)
Survey of qualitative sociological research methods. Practice in research design and evaluation, multiple forms of data gathering and data analysis. Theoretical and epistemological issues as related to qualitative sociology, with special attention to critical and feminist epistemological debates.
Prerequisite: Graduate standing
Typically offered in Fall only

SOC 721  Deviant Behavior  (3 credit hours)
Topics include: the inevitability of deviance and its social utility; cross-cultural variations in appearance and behavioral cues for labeling the deviant; descriptive and explanatory approaches to kinds and amounts of deviance in contemporary American society; social change, anomie and social disorganization theories; the process of stigmatization; formal and informal societal responses to deviance and the deviant; social action implications.
Prerequisite: Six hrs. SOC or ANT or Graduate standing or PBS status

SOC 722  Social Control  (3 credit hours)
Examination of need, functions, utilization and effects of both informal and formal social control mechanisms. Emphasis and critical evaluation of theoretical perspectives on social control and the empirical support for these positions.
Prerequisite: Six hrs. SOC above 200 level or Graduate standing or PBS status

SOC 723  Research On Crime and Deviance  (3 credit hours)
Major topics including an examination of conceptual problems and research issues and methods in study of crime and deviance; an assessment of current research on crime causation and deviance processes; an examination of research on social control processes and agencies; and an assessment of social action and evaluative research. A variety of substantive topics dealt with in the context of above topical areas including: delinquency, drug usage, mental illness, obesity, stuttering, suicide, prostitution, homicide and rape.
Prerequisite: SOC 721

SOC 725  Gender and Crime  (3 credit hours)
This seminar will provide an overview of the literatures on gender, crime and violence. The course framework and readings emphasize the social structures of gender, social constructions of gender, symbolic meaning systems, and intersections of race, class and gender. We will examine theoretical approaches and empirical research that informs our understanding of the gendered commission of offending.
Typically offered in Fall and Spring

SOC 727  Comparative Societies  (3 credit hours)
Sociological analysis of societies around the world with particular reference to North and South America. Special emphasis given to cultural and physical setting, population composition, levels of living, relationship of the people to the land, structure and function of major institutions and forces making for change.
Prerequisite: Six hrs. SOC

SOC 731  Survey of Family Sociology  (3 credit hours)
Examination of structural and demographic continuities and changes for American families in general and within major subgroups (e.g., race, ethnicity, social class). Consideration of historical and cross-cultural comparisons. Assessment of the impact of families upon their members and the dynamics of marital and family relationships.
Prerequisite: Graduate standing
Typically offered in Fall only

SOC 732  Contemporary Family Theory and Research  (3 credit hours)
Emphasis on contemporary research, theory and methodological techniques used by sociologists studying families. Critical examination of where field is now and where it appears to be heading. Primarily for graduate students designing or doing research about families.
Prerequisite: SOC 731

SOC 736  Social Stratification  (3 credit hours)
The theoretical background, methodological approaches and analysis of the consequences of systems of stratification. Emphasis on static and dynamic qualities of stratification systems on relations within and between societies. Attention to the integrative and divisive quality of stratification as expressed in life styles, world views, etc.
Requisite: Admission to SOC Graduate Program
Typically offered in Fall only

SOC 737/WGS 737  Sociology Of Gender  (3 credit hours)
Theories about the development and maintenance of gender. Historical development of gender stratification. How individuals “do gender” in their daily lives. Contemporary research and substantive readings about gender in public and intimate relations.
Prerequisite: Graduate student, SOC 736 or 731
Typically offered in Fall only

SOC 738  Race and Ethnic Inequality  (3 credit hours)
Theoretical and methodological approaches and critical debates on race. Impact of racial discrimination on inequality. Effects of inequality on community institutions. Formation of attitudes and identities.
Requisite: Admission to SOC Graduate Program
Typically offered in Spring only

SOC 739/WGS 739  Social Psychology Of Inequality  (3 credit hours)
The effects of race, class and gender inequality on the formation of group consciousness, self-evaluations, emotions, values, attitudes and beliefs. Attention to interpersonal processes through to reproduction of inequality in everyday life.
Requisite: Admission to SOC Graduate Program
Typically offered in Spring only
SOC 746 Sociological Social Psychology (3 credit hours)
Central issues in sociological social psychology, including formation of the self, effects of social structure on individual development, emergence of ritualized interaction and tension between individual agency and societal constraint. Emphasis on symbolic interactionist and dramaturgical perspectives.
Prerequisite: SOC 401

SOC 752 Work and Industry (3 credit hours)
Control of economy and workplace. Special attention to economic restructuring, the labor process and recent workplace innovations. Theories include managerialism, bank hegemony and deskilling. Historical studies complement analyses of contemporary settings and issues.
Prerequisite: SOC 400 or SOC 508 or SOC 701

SOC 753 Inequality in Work and the Economy (3 credit hours)
Sociological study of structural inequality in labor markets and workplaces with implications for class, race, gender, and spatial disparities in employment-related outcomes. Special attention is paid to job quality, spatial disparities in employment opportunity, and processes contributing to race and gender disparities in job attainment and rewards.
Prerequisite: SOC 701
Typically offered in Spring only

SOC 754 Economic Sociology (3 credit hours)
Embeddedness of economic action by individuals, firms, and states within a social context. Topics include globalization, restructuring, the informal economy, social capital, spatial organization, labor markets and role of the state.
Prerequisite: SOC 701
Typically offered in Spring only

SOC 755 Global Institutions and Markets (3 credit hours)
This course introduces students to sociological and related perspectives on the dynamics of global production and consumption processes, focusing in particular on how they shape and are shaped by their organizational, political, cultural, and natural environments.
Prerequisite: Graduate standing
Typically offered in Spring only

SOC 761 Contemporary Debates in Food & Environment (3 credit hours)
This course will be organized around contemporary debates related to the intersections between food and race, class, and gender inequalities. We will focus largely on recent books on these topics, with attention to both their substantive findings as well as the methods and theory employed.
Prerequisite: Graduate standing
Typically offered in Spring only

SOC 762 Sociology of Food Systems (3 credit hours)
This course examines the social relations surrounding the production, distribution, and consumption of food. Sociologists of food display considerable diversity in their theoretical approaches, research methods, and empirical foci. This course will traverse social science research and theorizing to offer an analytic taste on what we eat, how we produce and procure it, who benefits, what we think about it, and how it fits with contemporary social life and institutions.
Prerequisite: Graduate standing
Typically offered in Fall only

SOC 763 Environmental Sociology (3 credit hours)
This is a survey course in environmental sociology. We begin with a discussion of the emergence and development of environmental sociology, followed by an overview of theoretical perspectives in the field. We then conduct a survey of topics that have typically been addressed in the area. These topics include: environmental concern and values, environmental health, environmental inequality, environmental movements, technological disasters, and global environmental issues. Throughout the course we survey theoretical concerns as they relate to various topics within the field.
Prerequisite: Graduate standing
Typically offered in Fall only

SOC 791 Special Topics In Sociology (1-6 credit hours)
An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.
Typically offered in Fall, Spring, and Summer

SOC 810 Special Topics In Sociology (1-6 credit hours)
An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.
Typically offered in Fall, Spring, and Summer

SOC 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

SOC 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

SOC 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

SOC 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer
SSC 200 Soil Science Laboratory (1 credit hours)
Hands-on laboratory experience in fundamentals of soils including origin, composition and classification; their physical, chemical, and biological properties; significance of these properties to soil-plant relationships, soil management and the environment.
Corequisite: SSC 200
GEP Natural Sciences
Typically offered in Fall and Spring

SSC 332 Environmental Soil Microbiology (3 credit hours)
Analysis of the effects of soil environments on microbial growth. Relationships and significance of microbes to mineral transformations, plant development, and environmental quality. Management of soil microorganisms in different ecosystems.
Prerequisite: BIO 181 and SSC 200
Typically offered in Spring only

SSC 410 Soil Judging for Land Evaluation (1 credit hours)
Lecture and field-based course on describing, classifying, and interpreting soils in their natural setting. Topics will focus on a particular land region that will change each term. The course is in preparation for the regional soil judging contest in the Fall and the national soil judging contest in the Spring. Lectures explain land evaluation techniques and include soil morphology, genesis, and classification. Urban and agricultural applications will be considered. The course meets once per week for 8 weeks. Three field trips will be required and count as field work. The weekly meeting time is TBA. Students who complete the class have the option of participating in a regional, intercollegiate, Soil Judging Contest during each fall semester. Participation in the national contest during the spring semester depends on qualifying at the regional level the previous fall.
Prerequisite: SSC 200
Typically offered in Fall and Spring
SSC 421 Role of Soils in Environmental Management (3 credit hours)
Importance of soils in land application of municipal, industrial and agricultural wastes; onsite disposal of domestic wastewater; bioremediation of contaminated sites; erosion and sedimentation control; farm nutrient management; and nonpoint source water pollution.
Prerequisite: SSC 200
Typically offered in Fall only

SSC 427 Biological Approaches to Sustainable Soil Systems (3 credit hours)
Ecological and biochemical concepts will be applied to managing soils in agro-ecological settings such as organic and conventionally managed farms and gardens, emphasizing microbial transformations of nutrients and matter. Topics covered include soil organic matter formation and fractionation, decomposition, microbial assimilation of nutrients, fertilizer management, tillage, crop rotations, cover crop management. Companion course SSC 428 and SSC 341 recommended.
Prerequisite: SSC 200 or equivalent, BIO 181 or 183, and CH 101
Typically offered in Fall only

SSC 428/HS 428 Service-Learning in Urban Agriculture Systems (1 credit hour)
Course provides students a hands-on experience in urban agriculture with under-served youth in the Raleigh area. Students partner with a community gardening organization to provide knowledge and experience in soil science and agriculture to youth with the goals of increasing urban food security and developing student leadership skills. Particular emphasis is places on reflecting on course activities and deepening of skills related to extension, outreach, and working with diverse populations. Course designed to be taken as a companion course to SSC 427, however can be taken as a stand-alone course.
Prerequisite: SSC 200 or equivalent, BIO 181 or 183, and CH 101
Typically offered in Fall only

SSC 440/SSC 540 Geographic Information Systems (GIS) in Soil Science and Agriculture (3 credit hours)
Geographic information systems (GIS), global positioning system (GPS), and remote sensing to manage spatially variable soils, vegetation, other natural resources. Develop: function understanding of GIS principles, working knowledge of ArcGIS, problem-solving/critical-thinking necessary to use GIS to characterize and manage soils, agriculture, natural resources. Introduction to GIS; Maps/Cartography; Vector/Raster Data Models; Georeferencing/Coordinate Systems; Spatial Data Sources; GPS/GPS skills/ Remote Sensing; Statistics/Interpolation; Precision Agriculture; Computer Aided Design and GIS; Creating Analyzing 3-D Surfaces. Credit not given for both SSC 440 and SSC 540.
Prerequisite: SSC 200
Typically offered in Fall and Spring

SSC 442 Soil and Environmental Biogeochemistry (3 credit hours)
Quantitative approaches to the cycling of elements and chemical species in soils and the environment, including carbon and organic contaminants, non-metallic macronutrients, metals and metalloids.
Prerequisite: SSC 200 and (CH 101, or CH 201, or CH 220, or CH 221)
Typically offered in Spring only

SSC 452 Soil Classification (4 credit hours)
Genesis, morphology, and classification of soils; characterization of soils according to their diagnostic properties; interpreting soil use potential; emphasis on North Carolina soils and their taxonomy; field exercise in soil mapping and site evaluation; several field trips, one overnight.
Prerequisite: SSC 200
Typically offered in Spring only

SSC 455 Soils, Environmental Quality and Global Challenges (3 credit hours)
As the world population grows to 9 billion people by 2050, we will be pressed to increase food security, respond to the consequences of a changing climate, and improve human health -- all while protecting the environment and maintaining natural resources. Soils play a critical role in many of these challenges. The goal of this course is to teach students how soils regulate environmental quality through a host of chemical, physical and biological processes. We will examine a series of global challenges, assess their related environmental issues and policies, and analyse the roles of soils in each issue.
Prerequisite: SSC 200 or ES 100 or Instructor permission
Typically offered in Fall only

SSC 461 Soil Physical Properties and Plant Growth (3 credit hours)
Soil physical properties and their influence on plant growth and environmentally sound land use; soil solid-porosity-density relationships, soil water, heat and air relations and transport. Principles and applications of these topics using current literature in agronomy, turf, horticulture, water quality, waste management and urban land use.
Prerequisite: SSC 200
Typically offered in Fall only

SSC 462 Soil-Crop Management Systems (3 credit hours)
Unites principles of soil science and crop science with those of allied areas into realistic agronomic applications; practical studies in planning and evaluation of soil and crop management systems.
Prerequisite: CS 213 and CS 414 and SSC 342 and Senior standing
Typically offered in Spring only

SSC 470/SSC 570 Wetland Soils (3 credit hours)
Wetland definitions, concepts, functions and regulations; chemical, physical and morphological characteristics of wetland soils. Wetland soil identification using field indicators and monitoring equipment; principles of wetland creation, restoration and mitigation. Special project required for SSC 570. Two mandatory field trips. Field trips for distance education students are not required but optional. Credit will not be given for both SSC 470 and SSC 570.
Prerequisite: SSC 200, SSC 452 recommended
Typically offered in Fall, Spring, and Summer

SSC 473/BAE 473/BAE 573/SSC 573 Introduction to Hydrologic and Water Quality Modeling (3 credit hours)
Concepts in basic hydrologic, erosion and chemical transport used in modeling. Evaluation of typical hydrologic and water quality models on watershed systems. Project examples using state-of-the-art models. Credit will not be given for both BAE 473 and BAE 573.
Prerequisite: BAE 371
Typically offered in Fall only
SSC 511  Soil Physics  (4 credit hours)
Soil physical properties and theory of selected instrumentation to measure them. Topics including soil solids, soil water, air and heat. Emphasis on transport processes and the energy concept of soil and water.
Prerequisite: SSC 200, PY 212
Typically offered in Fall only

SSC 521  Soil Chemistry  (3 credit hours)
A consideration of the chemical and colloidal properties of clay and soil systems, including ion exchange and retention, soil solution reactions, solvation of clays and electrokinetic properties of clay-water systems.
Prerequisite: SSC 200, one yr. of general inorganic chemistry
Typically offered in Spring only

SSC 532/MB 532  Soil Microbiology  (4 credit hours)
Soil as a medium for microbial growth, the relation of microbes to important mineral transformations in soil, the importance of biological equilibrium and significance of soil microbes to environmental quality.
Prerequisite: MB 351, CH 220

SSC 540/SSC 440  Geographic Information Systems (GIS) in Soil Science and Agriculture  (3 credit hours)
Geographic information systems (GIS), global positioning system (GPS), and remote sensing to manage spatially variable soils, vegetation, other natural resources. Develop: function understanding of GIS principles, working knowledge of ArcGIS, problem-solving/critical-thinking necessary to use GIS to characterize and manage soils, agriculture, natural resources. Introduction to GIS; Maps/Cartography; Vector/Raster Data Models; Georeferencing/Coordinate Systems; Spatial Data Sources; GPS/GPS skills/Remote Sensing; Statistics/Interpolation; Precision Agriculture; Computer Aided Design and GIS; Creating Analyzing 3-D Surfaces. Credit not given for both SSC 440 and SSC 540.
Prerequisite: SSC 200
Typically offered in Fall and Summer

SSC 541  Soil Fertility  (3 credit hours)
Soil conditions affecting plant growth and the chemistry of soil and fertilizer interrelationships. Factors affecting the availability of nutrients. Methods of measuring nutrient availability.
Prerequisite: SSC 341

SSC 545  Remote Sensing Applications in Soil Science and Agriculture  (3 credit hours)
Overview of remote sensing including history, evolution, vocabulary, and physical principles, i.e., electromagnetic radiation and its interaction with matter. Distant and proximate remote sensing techniques (aerial photography, satellite imaging, radar, lidar, etc.), hardware, and platforms and their application in the characterization and management of soils and crops. Development of strategies for incorporating remote sensing into soil and agronomic research, and of practical skills for processing, analysis, display, and discussion of remote sensing data with applications in soil science and agriculture.
Prerequisite: SSC 200, PY 212

SSC 551  Soil Morphology, Genesis and Classification  (3 credit hours)
Prerequisite: SSC 200

SSC 552  Environmental Applications Of Soil Science  (3 credit hours)
Identification and evaluation of basic factors influencing movement of potential pollutants through soil and their underlying strata. Development of understanding of processes of soil and site evaluation for waste disposal and transport of pollutants.
Prerequisite: SSC 200
Typically offered in Fall only

SSC 570/SSC 470  Wetland Soils  (3 credit hours)
Wetland definitions, concepts, functions and regulations; chemical, physical and morphological characteristics of wetland soils. Wetland soil identification using field indicators and monitoring equipment; principles of wetland creation, restoration and mitigation. Special project required for SSC 570. Two mandatory field trips. Field trips for distance education students are not required but optional. Credit will not be given for both SSC 470 and SSC 570.
Prerequisite: SSC 200, SSC 452 recommended
Typically offered in Fall, Spring, and Summer

SSC 573/SSC 473/BAE 473/BAE 573  Introduction to Hydrologic and Water Quality Modeling  (3 credit hours)
Concepts in basic hydrologic, erosion and chemical transport used in modeling. Evaluation of typical hydrologic and water quality models on watershed systems. Project examples using state-of-the-art models. Credit will not be given for both BAE 473 and BAE 573.
Prerequisite: BAE 371
Typically offered in Fall only

SSC 590  Special Problems  (1-6 credit hours)
Special problems in various phases of soils. Emphasis placed on review of recent and current research. Credits Arranged
Prerequisite: SSC 200

SSC 592  Special Topics in Soil Science  (1-6 credit hours)
Special Topics in Soil Science. Topics of contemporary interest in soil science.
Typically offered in Fall, Spring, and Summer

SSC 601  Seminar  (1 credit hours)
A maximum of two semester hours allowed toward the master's degree, but any number toward the doctorate. Scientific articles, progress reports in research and special problems of interest to soil scientists reviewed and discussed.
Prerequisite: Graduate standing in SSC
Typically offered in Fall and Spring
SSC 609 Colloquium In Soil Science  (1-3 credit hours)  
Seminar-type discussions and lectures on specialized and advanced topics in soil science. Credits Arranged  
Prerequisite: Graduate standing in SSC  
Typically offered in Fall and Spring  

SSC 620 Special Problems  (1-6 credit hours)  
Special problems in various phases of soils. Emphasis placed on review of recent and current research. Credits Arranged  
Prerequisite: SSC 200  
Typically offered in Fall and Spring  

SSC 685 Master's Supervised Teaching  (1-3 credit hours)  
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment and evaluate the student upon completion of the assignment.  
Prerequisite: Master's student  
Typically offered in Fall and Spring  

SSC 688 Non-Thesis Masters Continuous Registration - Half Time Registration  (1 credit hours)  
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.  
Prerequisite: Master's student  
Typically offered in Fall, Spring, and Summer  

SSC 689 Non-Thesis Master Continuous Registration - Full Time Registration  (3 credit hours)  
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.  
Prerequisite: Master's student  
Typically offered in Fall, Spring, and Summer  

SSC 690 Master's Exam  (1-9 credit hours)  
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam. Credits Arranged  
Prerequisite: Master's student  
Typically offered in Fall, Spring, and Summer  

SSC 693 Master's Supervised Research  (1-9 credit hours)  
Instruction in research and research under the mentorship of a member of the Graduate Faculty.  
Prerequisite: Master's student  
Typically offered in Fall, Spring, and Summer  

SSC 695 Master's Thesis Research  (1-9 credit hours)  
Thesis Research  
Prerequisite: Master's student  
Typically offered in Fall, Spring, and Summer  

SSC 696 Summer Thesis Research  (1 credit hours)  
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.  
Prerequisite: Master's student  
Typically offered in Summer only  

SSC 699 Master's Thesis Preparation  (1-9 credit hours)  
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis. Credits arranged  
Prerequisite: Master's student  
Typically offered in Fall, Spring, and Summer  

SSC 720 Soil and Plant Analysis  (3 credit hours)  
Theory and advanced principles of utilization of chemical instruments to aid research on the heterogeneous systems of soils and plants.  
Prerequisite: PY 212; CH 315; at least three soils courses including SSC 341  
Typically offered in Spring only  

SSC 725/TOX 725/CS 725/HS 725 Pesticide Chemistry  (1 credit hours)  
Chemical properties of pesticides including hydration and solvation, ionization, volatilization, lipophilicity, molecular structure and size, and reactivity and classification according to chemical description, mode of action or ionizability. Taught during the first 5 weeks of semester. Drop date is last day of 3rd week of the minicourse.  
Prerequisite: CH 201 or CH 203) and (CH 221 or CH 225)  
Typically offered in Spring only  

SSC 727/TOX 727/CS 727/HS 727 Pesticide Behavior and Fate In the Environment  (2 credit hours)  
Sorption/desorption, soil reactivity, movement, volatilization, bioavailability, degradation and stability of pesticides in the environment. Taught during the last 10 weeks of semester. Drop date is last day of 3rd week of the minicourse.  
Prerequisite: CS(HS,SSC,TOX) 725,SSC 200  
Typically offered in Spring only  

SSC 771/BAE 771 Theory Of Drainage--Saturated Flow  (3 credit hours)  
Discussion of physical concepts and properties of fluids and porous media in relation to soil-water movement. Derivation and discussion of the fundamental laws and equations governing saturated flow in porous media. Analysis of mathematical solutions of  
Prerequisite: MA 301  
Typically offered in Fall only  

SSC 790 Special Topics  (1-6 credit hours)  
The study of special problems and selected topics of current interest in soil science and related fields.  
Typically offered in Fall only  

SSC 801 Seminar  (1 credit hours)  
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.  
Typically offered in Fall and Spring
### SSC 809 Colloquium in Soil Science (1-3 credit hours)
Seminar-type discussions and lectures on specialized and advanced topics in soil science. Credits Arranged
Prerequisite: Graduate standing in SSC
Typically offered in Fall, Spring, and Summer

### SSC 820 Special Problems (1-6 credit hours)
Special problems in various phases of soils. Emphasis placed on review of recent and current research. Credits Arranged
Prerequisite: SSC 200
Typically offered in Fall and Spring

### SSC 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

### SSC 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

### SSC 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

### SSC 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

### SSC 896 Summer Dissertation Research (1 credit hour)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

### Statistics (ST)

#### ST 101 Statistics by Example (3 credit hours)
Sampling, experimental design, tables and graphs, relationships among variables, probability, estimation, hypothesis testing. Real life examples from the social, physical and life sciences, the humanities and sports. Credit not allowed if student has prior credit for another ST course

**GEP Mathematical Sciences**
Typically offered in Fall and Spring

#### ST 114 Statistical Programming (3 credit hours)
This is an introductory course in computer programming for statisticians using Python. Emphasis is on designing algorithms, problem solving, and forming good coding practices: methodical development of programs from specifications; documentation and style; appropriate use of control structures such as loops, of data types such as arrays; modular program organization; version control. Students will become acquainted with core statistical computational problems through examples and coding assignments, including computation of histograms, boxplots, quantiles, and least squares regression.

Restriction: Statistics majors only
Typically offered in Fall only

#### ST 305 Statistical Methods (4 credit hours)

Prerequisite: MA 141; Corequisite: ST 307
Typically offered in Fall and Spring

#### ST 307 Introduction to Statistical Programming- SAS (1 credit hours)
An introduction to using the SAS statistical programming environment. The course will combine lecture and a virtual computing laboratory to teach students how to use the SAS system for: basic data input and manipulation; graphical displays of univariate data.
Corequisite: ST 305 or ST 312 or ST 372 or Prerequisite: ST 350 or BUS 350
Typically offered in Fall and Spring

#### ST 308 Introduction to Statistical Programming - R (1 credit hours)
Introduction to the statistical programming language R. The course will cover: reading and manipulating data; use of common data structures (vectors, matrices, arrays, lists); basic graphical representations.
Typically offered in Spring only
ST 311 Introduction to Statistics (3 credit hours)
Examining relationships between two variables using graphical techniques, simple linear regression and correlation methods. Producing data using experiment design and sampling. Elementary probability and the basic notions of statistical inference including confidence interval estimation and tests of hypothesis. One and two sample t-tests, one-way analysis of variance, inference for count data and regression. Credit not allowed if student has prior credit for another ST course or BUS 350

GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

ST 312 Introduction to Statistics II (3 credit hours)
A further examination of statistics and data analysis. Inference for comparing multiple samples, experimental design, analysis of variance and post-hoc tests. Inference for correlation, simple regression, multiple regression, and curvilinear regression. Analysis of contingency tables and categorical data. No credit for students who have credit for ST 305.

Prerequisite: ST 311
GEP Mathematical Sciences
Typically offered in Fall and Spring

ST 350/BUS 350 Economics and Business Statistics (3 credit hours)
Introduction to statistics applied to management, accounting, and economic problems. Emphasis on statistical estimation, inference, simple and multiple regression, and analysis of variance. Use of computers to apply statistical methods to problems encountered in management and economics.

Prerequisite: MA 114
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

ST 370 Probability and Statistics for Engineers (3 credit hours)
Calculus-based introduction to probability and statistics with emphasis on Monte Carlo simulation and graphical display of data on computer workstations. Statistical methods include point and interval estimation of population parameters and curve and s

Prerequisite: MA 241
Typically offered in Fall, Spring, and Summer

ST 371 Introduction to Probability and Distribution Theory (3 credit hours)
Basic concepts of probability and distribution theory for students in the physical sciences, computer science and engineering. Provides the background necessary to begin study of statistical estimation, inference, regression analysis, and analysis of variance.

Prerequisite: MA 241, Corequisite: MA 242
Typically offered in Fall and Spring

ST 372 Introduction to Statistical Inference and Regression (3 credit hours)
Statistical inference and regression analysis including theory and applications. Point and interval estimation of population parameters. Hypothesis testing including use of t, chi-square and F. Simple linear regression and correlation. Introduction to multiple regression and one-way analysis of variance.

Prerequisite: ST 371
Typically offered in Fall and Spring

ST 380 Probability and Statistics for the Physical Sciences (3 credit hours)
Introduction to probability models and statistics with emphasis on Monte Carlo simulation and graphical display of data on computer laboratory workstations. Statistical methods include point and interval estimation of population parameters and curve and s

Prerequisite: MA 241
Typically offered in Fall only

ST 401 Experiences in Data Analysis (4 credit hours)
This course will allow students to see many practical aspects of data analysis. Each section of this course will expose students to the process of data analysis in a themed area such as biostatistics or environmental statistics. Students will see problems of data collection and analysis through a combination of classroom demonstrations, hands on computer activities and visits to local industries.

Prerequisite: Permission of Instructor and either ST 311 or ST 305
Typically offered in Summer only

ST 404/GPH 404 Epidemiology and Statistics in Global Public Health (3 credit hours)
This course will provide a general introduction to the quantitative methods used in global health, combining elements of epidemiology and biostatistics. The course will focus on linear and logistic regression, survival analysis, traditional study designs, and modern study designs. Students will learn fundamental principles in epidemiology, including statistical approaches, and apply them to topics in global public health. The course prerequisite is a B- or better in one of these courses: ST 305, ST 311, ST 350, ST 370, or ST 371. In addition, a B- or better in GPH 201 is strongly recommended.

Pre-requisite: B- or better in one of these courses: ST 305, ST 311, ST 350, ST 370, or ST 371
Typically offered in Fall only

ST 405/ST 505 Applied Nonparametric Statistics (3 credit hours)
Statistical methods requiring relatively mild assumptions about the form of the population distribution. Classical nonparametric hypothesis testing methods, Spearman and Kendall correlation coefficients, permutation tests, bootstrap methods, and nonparametric regressions will be covered.

Prerequisite: ST 508 or ST 512 or ST 514 or ST 516
Typically offered in Fall only

ST 412/MA 412 Long-Term Actuarial Models (3 credit hours)
Long-term probability models for risk management systems. Theory and applications of compound interest, probability distributions of failure time random variables, present value models of future contingent cash flows, applications to insurance, health care, credit risk, environmental risk, consumer behavior and warranties.

Prerequisite: MA 241 or MA 231, Corequisite: MA 421, BUS(ST) 350, ST 301, ST 305, ST 311, ST 361, ST 370, ST 371, ST 380 or equivalent
Typically offered in Fall only

ST 413/MA 413 Short-Term Actuarial Models (3 credit hours)
Short-term probability models for risk management systems. Frequency distributions, loss distributions, the individual risk model, the collective risk model, stochastic process models of solvency requirements, applications to insurance and business decisions.

Prerequisite: MA 241 or MA 231, and one of MA 421, ST 301, ST 305, ST 370, ST 371, ST 380, ST 421.
Typically offered in Summer only
ST 421 Introduction to Mathematical Statistics I (3 credit hours)
First of a two-semester sequence of mathematical statistics, primarily for undergraduate majors in Statistics. Introduction to probability, univariate and multivariate probability distributions and their properties, distributions of functions of random variables, random samples and sampling distributions. Credit is not allowed for both ST 421 and MA 421.
Prerequisite: MA 242
Typically offered in Fall and Spring

ST 422 Introduction to Mathematical Statistics II (3 credit hours)
Second of a two-semester sequence of mathematical statistics, primarily for undergraduate majors in Statistics. Random samples, point and interval estimators and their properties, methods of moments, maximum likelihood, tests of hypotheses, elements of nonparametric statistics and elements of general linear model theory.
Prerequisite: ST 421 or MA 421
Typically offered in Fall and Spring

ST 430 Introduction to Regression Analysis (3 credit hours)
Regression analysis as a flexible statistical problem solving methodology. Matrix review; variable selection; prediction; multicolinearity; model diagnostics; dummy variables; logistic and non-linear regression. Emphasizes use of computer.
Prerequisites: (ST 305 or ST 312 or ST 372) and ST 307 and (MA 305 or MA 405)
Typically offered in Fall and Spring

ST 431 Introduction to Experimental Design (3 credit hours)
Experimental design as a method for organizing analysis procedures. Completely randomized, randomized block, factorial, nested, Latin squares, split-plot and incomplete block designs. Response surface and covariance adjustment procedures. Stresses use of computer.
Prerequisites: (ST 305 or ST 312 or ST 372) and ST 307
Typically offered in Fall, Spring, and Summer

ST 432 Introduction to Survey Sampling (3 credit hours)
Design principles pertaining to planning and execution of a sample survey. Simple random, stratified random, systematic and one- and two-stage cluster sampling designs. Emphasis on statistical considerations in analysis of sample survey data. Class project on design and execution of an actual sample survey.
Prerequisites: (ST 305 or ST 312 or ST 372) and ST 307
Typically offered in Fall and Spring

ST 433/ST 533 Applied Spatial Statistics (3 credit hours)
Introduction to statistical models and methods for analyzing various types of spatially referenced data. The focus is on applications with real data and their analysis with statistical programs such as R and SAS. Students are required to write, modify, and run computer code in order to complete homework assignments and final projects.
P: ST 422 and ST 430
Typically offered in Spring only

ST 434/ST 534 Applied Time Series (3 credit hours)
Statistical models and methods for the analysis of time series data using both time domain and frequency domain approaches. A brief review of necessary statistical concepts and R will be given at the beginning. Analyses of real data sets using the static
Prerequisite: ST 422 and ST 430
Typically offered in Fall only

ST 435/ST 535 Statistical Methods for Quality and Productivity Improvement (3 credit hours)
Use of statistics for quality control and productivity improvement. Control chart calculations and graphing, process control and specification; sampling plans; and reliability. Computer use will be stressed for performing calculations and graphing.
Prerequisite: (ST 305 or ST 312 or ST 372) and ST 307
Typically offered in Fall only

ST 437/ST 537 Applied Multivariate and Longitudinal Data Analysis (3 credit hours)
An introduction to use of statistical methods for analyzing multivariate and longitudinal data collected in experiments and surveys. Topics covered include multivariate analysis of variance, discriminant analysis, principal components analysis, factor analysis, covariance modeling, and mixed effects models such as growth curves and random coefficient models. Emphasis is on use of a computer to perform statistical analysis of multivariate and longitudinal data.
Prerequisite: ST 422 and ST 430
Typically offered in Spring only

ST 440/ST 540 Applied Bayesian Analysis (3 credit hours)
Introduction to Bayesian concepts of statistical inference; Bayesian learning; Markov chain Monte Carlo methods using existing software (SAS and OpenBUGS); linear and hierarchical models; model selection and diagnostics.
Prerequisite: ST 422 and ST 430
Typically offered in Spring only

ST 442/CSC 442 Introduction to Data Science (3 credit hours)
Overview of data structures, data lifecycle, statistical inference. Data management, queries, data cleaning, data wrangling. Classification and prediction methods to include linear regression, logistic regression, k-nearest neighbors, classification and regression trees. Association analysis. Clustering methods. Emphasis on analyzing data, use and development of software tools, and comparing methods.
Prerequisite: (MA 305 or MA 405) and (ST 305 or ST 312 or ST 370 or ST 372 or ST 370 or ST 380) and (CSC 111 or CSC 112 or CSC 113 or CSC 114 or CSC 116 or ST 314 or ST 445)
Typically offered in Fall only

ST 445 Introduction to Statistical Computing and Data Management (3 credit hours)
Detailed discussion of the program data vector and data handling techniques that are required to apply statistical methods. Topics are based on the current content of the Base SAS Certification Exam and typically include: importing, validating, and exporting of data files; manipulating, subsetting, and grouping data; merging and appending data sets; basic detail and summary reporting; and code debugging. Additional topics with practical applications, such as graphics and advanced reporting, may also be introduced. Statistical methods for analyzing data are not covered in this course. Regular access to a computer for homework and class exercises is required. Previous exposure to SAS is expected.
Prerequisite: (ST 305 or ST 312 or ST 372) and ST 307
Typically offered in Fall and Spring
ST 446  Intermediate SAS Programming with Applications  (3 credit hours)
This course covers a wide range of SAS skills that build on the topics introduced in ST 445: Introduction to Statistical Computing and Data Management. In particular, many topics related to the Advanced SAS Certification Exam are covered in order to help students prepare for that exam. However, an additional goal of equal importance is to synthesize statistical content such as regression, distributional assumptions for inference, and power from multiple courses through simulation- and graphics-based investigations.
Prerequisite: ST 430 and ST 445
Typically offered in Spring only

ST 491  Statistics in Practice  (3 credit hours)
Mentored experience in applied statistical analysis. Students will work in small groups in collaboration with local scientists to answer real questions about real data. The experience involves mentoring by both the project scientist and the instructor.
P: ST 430
Typically offered in Spring only

ST 495  Special Topics in Statistics  (1-6 credit hours)
Offered as needed to present material not normally available in regular departmental course offerings, or for offering new courses on a trial basis.
Typically offered in Fall, Spring, and Summer

ST 497  Professional Experience in Statistics  (1-3 credit hours)
Mentored professional experience in statistics. A minimum of 45 hours must be completed for each credit hour earned. The experience must be arranged in advance by the student and approved by the Department of Statistics prior to enrollment. Approval requires completion of the Statistics Department's Experiential Learning Contract, which must be signed by the student, their professional mentor, and their academic advisor. Professional mentors are encouraged to require a research paper or poster presentation as part of the work expectations when appropriate. Students should refer to their curriculum requirements for possible restrictions on the total number of ST 497 credit hours that may be applied to their degree.
Prerequisite: Sophomore Standing. Students are responsible for identifying their own research mentor and experience.
Typically offered in Fall, Spring, and Summer

ST 499  Research Experience in Statistics  (1-3 credit hours)
Mentored research experience in statistics. A minimum of 45 hours must be completed for each credit hour earned. The experience must be arranged in advance by the student and approved by the Department of Statistics prior to enrollment. Approval requires completion of the Statistics Department's Experiential Learning Contract, which must be signed by the student, their research mentor, and their academic advisor. Research mentors are encouraged to require a research paper or poster presentation as part of the work expectations when appropriate. Students should refer to their curriculum requirements for possible restrictions on the total number of ST 499 credit hours that may be applied to their degree.
Prerequisite: Sophomore Standing. Students are responsible for identifying their own research mentor and experience.
Typically offered in Fall, Spring, and Summer

ST 501  Fundamentals of Statistical Inference I  (3 credit hours)
First of a two-semester sequence in probability and statistics taught at a calculus-based level. Probability: discrete and continuous distributions, expected values, transformations of random variables, sampling distributions. Credit not given for both ST 701 and ST 501. Note: this course will be offered in person (Fall) and online (Summer).
Prerequisite: MA 242 or equivalent
Typically offered in Fall and Summer

ST 502  Fundamentals of Statistical Inference II  (3 credit hours)
Second of a two-semester sequence in probability and statistics taught at a calculus-based level. Statistical inference: methods of construction and evaluation of estimators, hypothesis tests, and interval estimators, including maximum likelihood. Credit not given for both ST 702 and ST 502. Note: this course will be offered in person (Spring) and online (Fall).
Prerequisite: ST 501
Typically offered in Fall and Spring

ST 503  Fundamentals of Linear Models and Regression  (3 credit hours)
Estimation and testing in full and non-full rank linear models. Normal theory distributional properties. Least squares principle and the Gauss-Markov theorem. Estimability, analysis of variance and co variance in a unified manner. Practical model-building in linear regression including residual analysis, regression diagnostics, and variable selection. Emphasis on use of the computer to apply methods with data sets. Credit not given for both ST 705 and ST 503. Note: this course will be offered in person (Spring) and online (Summer).
P: ST 501 and MA 405 or equivalent (Linear Algebra); C: ST 502
Typically offered in Spring and Summer

ST 505/ST 405  Applied Nonparametric Statistics  (3 credit hours)
Statistical methods requiring relatively mild assumptions about the form of the population distribution. Classical nonparametric hypothesis testing methods, Spearman and Kendall correlation coefficients, permutation tests, bootstrap methods, and nonparametric regressions will be covered.
Prerequisite: ST 508 or ST 512 or ST 514 or ST 516
Typically offered in Fall only
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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>ST 506</td>
<td>Sampling Animal Populations</td>
<td>(3 credits)</td>
<td>Statistical methods applicable to sampling of wildlife populations, including capture-recapture, removal, change in ratio, quadrant and line transect sampling. Emphasis on model assumptions and study design.</td>
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<td>Prerequisite: ST 512</td>
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<td>Typically offered in Fall only</td>
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<tr>
<td>ST 507</td>
<td>Statistics For the Behavioral Sciences I</td>
<td>(3 credits)</td>
<td>A general introduction to the use of descriptive and inferential statistics in behavioral science research. Methods for describing and summarizing data presented, followed by procedures for estimating population parameters and testing hypotheses concerning summarized data.</td>
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<td>Prerequisite: Graduate standing</td>
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<td>Typically offered in Spring only</td>
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<tr>
<td>ST 508</td>
<td>Statistics For the Behavioral Sciences II</td>
<td>(3 credits)</td>
<td>Introduction to use of statistical design principles in behavioral science research. Presentation of use of a statistical model to represent structure of data collected from a designed experiment or survey study. Opportunities provided for use of a computer to perform analyses of data, to evaluate proposed statistical model and to assist in post-hoc analysis procedures. Least squares principles used to integrate topics of multiple linear regression analysis, the analysis of variance and analysis of covariance.</td>
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<td>Prerequisite: Graduate standing</td>
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<td>Typically offered in Fall and Spring</td>
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<tr>
<td>ST 511</td>
<td>Statistical Methods For Researchers I</td>
<td>(3 credits)</td>
<td>Basic concepts of statistical models and use of samples; variation, statistical measures, distributions, tests of significance, analysis of variance and elementary experimental design, regression and correlation, chi-square.</td>
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<td>Prerequisite: Graduate Standing</td>
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<td>Typically offered in Fall, Spring, and Summer</td>
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<tr>
<td>ST 512</td>
<td>Statistical Methods For Researchers II</td>
<td>(3 credits)</td>
<td>Covariance, multiple regression, curvilinear regression, concepts of experimental design, factorial experiments, confounded factorials, individual degrees of freedom and split-plot experiments. Computing laboratory addressing computational issues and use of statistical software.</td>
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<td>Prerequisite: ST 511 or ST 513 or ST 517</td>
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<td>Prerequisite: Graduate standing</td>
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<td>Typically offered in Fall and Spring</td>
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<tr>
<td>ST 514</td>
<td>Statistics For Management and Social Sciences II</td>
<td>(3 credits)</td>
<td>Linear regression, multiple regression and concepts of designed experiments in an integrated approach, principles of the design and analysis of sample surveys, use of computer for analysis of data.</td>
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<td>Prerequisite: ST 513</td>
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<td>Typically offered in Spring and Summer</td>
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<tr>
<td>ST 515</td>
<td>Experimental Statistics for Engineers I</td>
<td>(3 credits)</td>
<td>General statistical concepts and techniques useful to research workers in engineering, textiles, wood technology, etc. Probability distributions, measurement of precision, simple and multiple regression, tests of significance, analysis of variance, enumeration data and experimental design.</td>
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<td>Prerequisite: Graduate standing</td>
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<td>Typically offered in Fall and Spring</td>
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<tr>
<td>ST 516</td>
<td>Experimental Statistics For Engineers II</td>
<td>(3 credits)</td>
<td>General statistical concepts and techniques useful to research workers in engineering, textiles, wood technology, etc. Probability distributions, measurement of precision, simple and multiple regression, tests of significance, analysis of variance, enumeration data and experimental designs.</td>
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<td>Prerequisite: ST 515</td>
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<td>Typically offered in Fall and Spring</td>
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<tr>
<td>ST 517</td>
<td>Applied Statistical Methods I</td>
<td>(3 credits)</td>
<td>Course covers basic methods for summarizing and describing data, accounting for variability in data, and techniques for inference. Topics include basic exploratory data analysis, probability distributions, confidence intervals, hypothesis testing, and regression analysis. This is a calculus-based course. Statistical software is used; however, there is no lab associated with the course. Credit not given for this course and ST 511 or ST 513 or ST 515. This course does NOT count as an elective towards a degree or a minor in Statistics. Note: the course will be offered in person (Fall) and online (Fall and Summer).</td>
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<td>Prerequisites: MA 241 or equivalent (Calculus II) and MA 405 or equivalent (Linear Algebra)</td>
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<td>Typically offered in Fall and Summer</td>
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<tr>
<td>ST 518</td>
<td>Applied Statistical Methods II</td>
<td>(3 credits)</td>
<td>This second course in statistics for graduate students is intended to further expand students' background in the statistical methods that will assist them in the analysis of data. Course covers many fundamental analysis methods currently used to analyze a wide array of data, mostly arising from designed experiments. Topics include multiple regression models, factorial effects models, general linear models, mixed effect models, logistic regression analysis, and basic repeated measures analysis. This is a calculus-based course. Statistical software is used, however, there is no lab associated with the course. Credit not given for this course and ST 512 or ST 514 or ST 516. Note: this course will be offered in person (Spring) and online (Fall and Spring).</td>
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<td>Prerequisite: ST 517</td>
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<td>Typically offered in Fall and Spring</td>
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<tr>
<td>ST 519/EMS 519</td>
<td>Teaching and Learning of Statistical Thinking</td>
<td>(3 credits)</td>
<td>This course is designed to bridge theory and practice on how students develop understandings of key concepts in data analysis, statistics, and probability. Discussion of students’ understandings, teaching strategies and the use of manipulatives and technology tools. Topics include distribution, measures of center and spread, sampling, sampling distribution, randomness, and law of large numbers. Must complete a first level graduate statistics course (ST 507, ST 511, or equivalent) before enrolling.</td>
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<td>Prerequisite: ST 507 or ST 511</td>
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<td>Typically offered in Spring only</td>
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ST 520 Statistical Principles of Clinical Trials (3 credit hours)
Corequisite: ST 501 or ST 521 or ST 701
Typically offered in Fall only

ST 524 Statistics In Plant Science (3 credit hours)
Principles and techniques of planning, establishing and executing field and greenhouse experiments. Size, shape and orientation of plots; border effects; estimation of size of experiments for specified accuracy; subsampling plots and yields for laboratory analysis; combining data from a series of years and/or locations; rotation experiments; repeated measures data; multiple comparisons in variety trial results; selection of predictors in multiple regression; introduction to interspecies and intraspecies plant competition experiments and models.
Prerequisite: ST 512
Typically offered in Fall only

ST 531 Experimental Design (3 credit hours)
Overview and comparison of observational studies and designed experiments followed by a thorough discussion of design principles. Review of estimation and inference for regression and ANOVA models from an experimental design perspective. Review of design and analysis for completely randomized, randomized complete block, and Latin square designs. Designs and analysis methods for factorial experiments, general blocking structures, incomplete block designs, confounded factorials, split-plot experiments, and fractional factorial designs. Examples used to illustrate application and analysis of these designs.
Prerequisite: ST 512, or ST 515, or ST 516, or ST 517, or ST 703
Typically offered in Fall only

ST 533/ST 433 Applied Spatial Statistics (3 credit hours)
Introduction to statistical models and methods for analyzing various types of spatially referenced data. The focus is on applications with real data and their analysis with statistical programs such as R and SAS. Students are required to write, modify, and run computer code in order to complete homework assignments and final projects.
P: ST 422 and ST 430
Typically offered in Spring only

ST 534/ST 434 Applied Time Series (3 credit hours)
Statistical models and methods for the analysis of time series data using both time domain and frequency domain approaches. A brief review of necessary statistical concepts and R will be given at the beginning. Analyses of real data sets using the stati
Prerequisite: ST 422 and ST 430
Typically offered in Fall only

ST 535/ST 435 Statistical Methods for Quality and Productivity Improvement (3 credit hours)
Use of statistics for quality control and productivity improvement. Control chart calculations and graphing, process control and specification; sampling plans; and reliability. Computer use will be stressed for performing calculations and graphing.
Prerequisite: (ST 305 or ST 312 or ST 372) and ST 307
Typically offered in Fall only

ST 537/ST 437 Applied Multivariate and Longitudinal Data Analysis (3 credit hours)
An introduction to use of statistical methods for analyzing multivariate and longitudinal data collected in experiments and surveys. Topics covered include multivariate analysis of variance, discriminant analysis, principal components analysis, factor analysis, covariance modeling, and mixed effects models such as growth curves and random coefficient models. Emphasis is on use of a computer to perform statistical analysis of multivariate and longitudinal data.
Prerequisite: ST 422 and ST 430
Typically offered in Spring only

ST 540/ST 440 Applied Bayesian Analysis (3 credit hours)
Introduction to Bayesian concepts of statistical inference; Bayesian learning; Markov chain Monte Carlo methods using existing software (SAS and OpenBUGS); linear and hierarchical models; model selection and diagnostics.
Prerequisite: ST 422 and ST 430
Typically offered in Spring only

ST 542 Statistical Practice (3 credit hours)
This course will provide a discussion-based introduction to statistical practice geared towards students in the final semester of their Master of Statistics degree. Note: the course will be offered in person (Fall) and online (Spring and Summer).
Typically offered in Fall, Spring, and Summer

ST 544 Applied Categorical Data Analysis (3 credit hours)
This course focuses on the concepts, methods, and models used to analyze categorical data, particularly contingency tables, count data and binary/binomial type of data. The topics covered include Pearson Chi-squared independence test for contingency tables, measures of marginal and conditional associations, small-sample inference, logistic regression models for independent binary/binomial data and many extended models for correlated binary/binomial data including matched data and longitudinal data. The course emphasizes the implementation of methods/models using SAS and the interpretation of the results from the output.
Prerequisite: ST 512 or ST 514 or ST 515 or ST 516
Typically offered in Fall only

ST 546/MA 546 Probability and Stochastic Processes I (3 credit hours)
Modern introduction to Probability Theory and Stochastic Processes. The choice of material is motivated by applications to problems such as queueing networks, filtering and financial mathematics. Topics include: review of discrete probability and continuous random variables, random walks, markov chains, martingales, stopping times, erodicity, conditional expectations, continuous-time Markov chains, laws of large numbers, central limit theorem and large deviations.
Prerequisite: MA 421 and MA 425 or MA 511
Typically offered in Fall only
ST 555 Statistical Programming I (3 credit hours)
An introduction to programming and data management using SAS, the industry standard for statistical practice. Detailed discussion of the program data vector and data handling techniques that are required to apply statistical methods. Topics are based on the current content of the Base SAS Certification Exam and typically include: importing, validating, and exporting of data files; manipulating, subsetting, and grouping data; merging and appending data sets; basic detail and summary reporting; and code debugging. Additional topics with practical applications are also introduced, such as graphics and advanced reporting. Statistical methods for analyzing data are not covered in this course. Regular access to a computer for homework and class exercises is required. Previous exposure to SAS is not expected.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

ST 556 Statistical Programming II (3 credit hours)
Statistical procedures for importing/managing complex data structures using SQL, automated analysis using macro programming, basic simulation methods and text parsing/analysis procedures. Students learn SAS, the industry standard for statistical practice. Regular access to a computer for homework and class exercises is required.

P: ST 555 or Base SAS Certification
Typically offered in Spring and Summer

ST 557 Using Technology to Teach Statistics (3 credit hours)
This course will provide statistics educators with an in-depth introduction to applying technology for teaching college statistics. In this course, students will explore a variety of available statistical packages, demonstration applets, and other technologies for teaching statistics. Students will learn pedagogy that helps structure learning activities around these technologies. Students will also learn to identify key elements in technologies that support pedagogical goals.

P: ST 508 or ST 512
Typically offered in Fall only

ST 558 Data Science for Statisticians (3 credit hours)
Methods for reading, manipulating, and combining data sources including databases. Custom functions, visualizations, and summaries. Common analyses done by data scientists. Methods for communicating results including dashboards. Regular access to a computer for homework and class exercises is required.

Prerequisites: (ST 511 or ST 517 or equivalent) and (ST 555 or equivalent)
Typically offered in Fall and Summer

ST 561/ECG 561 Applied Econometrics I (3 credit hours)
Introduction and application of econometrics methods for analyzing cross-sectional data in economics, and other social science disciplines, such as OLS, IV regressions, and simultaneous equations models. Students should have had a statistical methods course at the 300 level or above as well as Calculus I and II.

Typically offered in Fall only

ST 562 Data Mining with SAS Enterprise Miner (3 credit hours)
This is a hands-on course using modeling techniques designed mostly for large observational studies. Estimation topics include recursive splitting, ordinary and logistic regression, neural networks, and discriminant analysis. Clustering and association analysis are covered under the topic “unsupervised learning,” and the use of training and validation data sets is emphasized. Model evaluation alternatives to statistical significance include lift charts and receiver operating characteristic curves. SAS Enterprise Miner is used in the demonstrations, and some knowledge of basic SAS programming is helpful.

Prerequisite: ST 512 or ST 514 or ST 515 or ST 516 or ST 517
Typically offered in Spring only

ST 563 Introduction to Statistical Learning (3 credit hours)
This course will introduce common statistical learning methods for supervised and unsupervised predictive learning in both the regression and classification settings. Topics covered will include linear and polynomial regression, logistic regression and discriminant analysis, cross-validation and the bootstrap, model selection and regularization methods, splines and generalized additive models, principal components, hierarchical clustering, nearest neighbor, kernel, and tree-based methods, ensemble methods, boosting, and support-vector machines.

Prerequisite: ST 512 or ST 514 or ST 515 or ST 517
Typically offered in Summer only

ST 590 Special Topics (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

ST 601 Seminar (1 credit hours)
Typically offered in Fall, Spring, and Summer

ST 610 Topics in Stat (1-6 credit hours)
Special topics in Statistics.

ST 630 Independent Study (1-3 credit hours)
Typically offered in Fall, Spring, and Summer

ST 635 Readings (1-3 credit hours)
Typically offered in Spring only

ST 641 Statistical Consulting (1 credit hours)
Participation in regularly scheduled supervised statistical consulting sessions with faculty member and client. Consultant's report written for each session. Regularly scheduled meetings with course instructor and other student consultants to present an

Prerequisite: ST 512 and ST 702
Typically offered in Fall, Spring, and Summer

ST 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ST 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer
**ST 693 Master's Supervised Research** (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student  
Typically offered in Fall, Spring, and Summer

**ST 695 Master's Thesis Research** (1-9 credit hours)
Thesis Research

Prerequisite: Master's student  
Typically offered in Fall, Spring, and Summer

**ST 696 Summer Thesis Research** (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student  
Typically offered in Summer only

**ST 699 Master's Thesis Preparation** (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis. Credits Arranged

Prerequisite: Master's student  
Typically offered in Fall, Spring, and Summer

**ST 701 Statistical Theory I** (3 credit hours)
Probability tools for statistics: description of discrete and absolutely continuous distributions, expected values, moments, moment generating functions, transformation of random variables, marginal and conditional distributions, independence, orderstatistics, multivariate distributions, concept of random sample, derivation of many sampling distributions.

Typically offered in Fall only

**ST 702 Statistical Theory II** (3 credit hours)
General framework for statistical inference. Point estimators: biased and unbiased, minimum variance unbiased, least mean square error, maximum likelihood and least squares, asymptotic properties. Interval estimators and tests of hypotheses: confidence intervals, power functions, Neyman-Pearson lemma, likelihood ratio tests, unbiasedness, efficiency and sufficiency.

Prerequisite: ST 701  
Typically offered in Spring only

**ST 703 Statistical Methods I** (3 credit hours)
Introduction of statistical methods. Examples include multiple linear regression, concepts of experimental design, factorial experiments, and random-effects modeling. A computing laboratory addresses computational issues and use of statistical software. This course is a prerequisite for most advanced courses in statistics. This section is restricted to statistics and closely related majors.

R: 17STPHD Students Only  
Typically offered in Fall only

**ST 704 Statistical Methods II** (3 credit hours)
This course will introduce many methods that are commonly used in applications. Examples include: model generation, selection, assessment, and diagnostics in the context of multiple linear regression (including penalized regression); linear mixed models; generalized linear models; generalized linear mixed models; nonparametric regression and smoothing; and finite-population sampling basics. Coverage will include some theory, plus implementation using SAS and/or R.

Prerequisite: ST 703; Corequisites: ST 702 and ST 705  
Typically offered in Spring only

**ST 705 Linear Models and Variance Components** (3 credit hours)

Corequisite: ST 702  
Typically offered in Spring only

**ST 706/MA 706/OR 706 Nonlinear Programming** (3 credit hours)
An advanced mathematical treatment of analytical and algorithmic aspects of finite dimensional nonlinear programming. Including an examination of structure and effectiveness of computational methods for unconstrained and constrained minimization. Specia

Prerequisite: OR(IE,MA) 505 and MA 425  
Typically offered in Spring only

**ST 708 Applied Least Squares** (3 credit hours)
Least squares estimation and hypothesis testing procedures for linear models. Consideration of regression, analysis of variance and covariance in a unified manner. Emphasis on use of the computer to apply these techniques to experimental (including unequal cell sizes) and survey situations.

Prerequisite: ST 512  
Typically offered in Fall only

**ST 711 Design Of Experiments** (3 credit hours)
Review of completely randomized, randomized complete block and Latin square designs and basic concepts in the techniques of experimental design. Designs and analysis methods in factorial experiments, confounded factorials, response surface methodology, change-over design, split-plot experiments and incomplete block designs. Examples used to illustrate application and analysis of these designs.

Prerequisite: ST 512 or ST 516  
Typically offered in Fall only

**ST 715 Theory Of Sampling Applied To Survey Design** (3 credit hours)

Prerequisite: ST 422, ST 512  
Typically offered in Fall only
ST 721/GN 721 Genetic Data Analysis (3 credit hours)
Prerequisite: ST 430 and GN 311
Typically offered in Spring only

ST 730 Applied Time Series Analysis (3 credit hours)
An introduction to use of statistical methods for analyzing and forecasting data observed over time. Trigonometrical regression, periodogram/spectral analysis. Smoothing. Autoregressive moving average models. Regression with autocorrelated errors. Linear filters and bivariate spectral analysis. Stress on methods and applications; software implementations described and used in assignments.
Prerequisite: ST 512
Typically offered in Fall only

ST 732 Longitudinal Data Analysis (3 credit hours)
Introduction to modeling longitudinal data; Population-averaged vs. subject-specific modeling; Classical repeated measures analysis of variance methods and drawbacks; Review of estimating equations; Population-averaged linear models; Linear mixed effects models; Maximum likelihood, restricted maximum likelihood, and large sample theory; Review of nonlinear and generalized linear regression models; Population-averaged models and generalized estimating equations; Nonlinear and generalized linear mixed effects models; Implications of missing data; Advanced topics (including Bayesian framework, complex nonlinear models, multi-level hierarchical models, relaxing assumptions on random effects in mixed effects models, among others). Implementation in SAS and R.
Prerequisites: ST 702 and ST 705
Typically offered in Spring only

ST 733 Spatial Statistics (3 credit hours)
Introduction to the theory and methods of spatial data analysis including: visualization; Gaussian processes; spectral representation; variograms; kriging; computationally-efficient methods; nonstationary processes; spatiotemporal and multivariate models.
Prerequisite: ST 705
Typically offered in Spring only

ST 740 Bayesian Inference and Analysis (3 credit hours)
Introduction to Bayesian inference; specifying prior distributions; conjugate priors, summarizing posterior information, predictive distributions, hierarchical models, asymptotic consistency and asymptotic normality. Markov Chain Monte Carlo (MCMC) methods and the use of existing software(e.g., WinBUGS).
Prerequisite: ST 702
Typically offered in Fall only

ST 744 Categorical Data Analysis (3 credit hours)
Statistical models and methods for categorical responses including the analysis of contingency tables, logistic and Poisson regression, and generalized linear models. Survey of asymptotic and exact methods and their implementation using standard statistical software.
Prerequisite: ST 512 and ST 702
Typically offered in Spring only

ST 745 Analysis of Survival Data (3 credit hours)
Statistical methods for analysis of time-to-event data, with application to situations with data subject to right-censoring and staggered entry, including clinical trials. Survival distribution and hazard rate; Kaplan-Meier estimator for survival distribution and Greenwood's formula; log-rank and weighted long-rank tests; design issues in clinical trials. Regression models, including accelerated failure time and proportional hazards; partial likelihood; diagnostics.
Prerequisite: ST 502 or ST 702
Typically offered in Spring only

ST 746/MA 746 Introduction To Stochastic Processes (3 credit hours)
Markov chains and Markov processes, Poisson process, birth and death processes, queuing theory, renewal theory, stationary processes, Brownian motion.
Prerequisite: MA 405 and MA(ST) 546 or ST 521
Typically offered in Spring only

ST 747/MA 747 Probability and Stochastic Processes II (3 credit hours)
Fundamental mathematical results of probabilistic measure theory needed for advanced applications in stochastic processes. Probability measures, sigma-algebras, random variables, Lebesgue integration, expectation and conditional expectations w.r.t.sigma algebras, characteristic functions, notions of convergence of sequences of random variables, weak convergence of measures, Gaussian systems, Poisson processes, mixing properties, discrete-time martingales, continuous-time markov chains.
Prerequisite: MA(ST) 546
Typically offered in Spring only

ST 748/MA 748 Stochastic Differential Equations (3 credit hours)
Prerequisite: MA(ST) 747
Typically offered in Fall only
ST 750/ECG 750 Introduction to Econometric Methods (3 credit hours)
Introduction to principles of estimation of linear regression models, such as ordinary least squares and generalized least squares. Extensions to time series and panel data. Consideration of endogeneity and instrumental variables estimation. Limited dependent variable and sample selection models. Attention to implementation of econometric methods using a statistical package and microeconomic and macroeconomic data sets.
Prerequisite: ST 421; Corequisite: ST 422
Typically offered in Fall only

ST 751/ECG 751 Econometric Methods (3 credit hours)
Introduction to important econometric methods of estimation such as Least Squares, instrumental Variables, Maximum Likelihood, and Generalized Method of Moments and their application to the estimation of linear models for cross-sectional economic data. Discussion of important concepts in the asymptotic statistical analysis of vector process with application to the inference procedures based on the aforementioned estimation methods.
Prerequisite: ST 421, ST 422
Typically offered in Spring only

ST 752/ECG 752 Time Series Econometrics (3 credit hours)
The characteristics of macroeconomic and financial time series data. Discussion of stationarity and non-stationarity as they relate to economic time series. Linear models for stationary economic time series: autoregressive moving average (ARMA) models;
Prerequisite: ECG(ST) 751
Typically offered in Fall only

ST 753/ECG 753 Microeconometrics (3 credit hours)
The characteristics of microeconomic data. Limited dependent variable models for cross-sectional microeconomic data: logit/probit models; tobit models; methods for accounting for sample selection; count data models; duration analysis; non-parametricmethyl
Prerequisite: ECG 751
Typically offered in Spring only

ST 755 Advanced Analysis Of Variance and Variance Components (3 credit hours)
Expected mean squares, exact and approximate tests of hypotheses for balanced and unbalanced data sets. Fixed, mixed and random models. Randomization theory. Estimation of variance components using regression, MINQUE and general quadratic unbiased estimation theory.
Prerequisite: ST 512, ST 552
Typically offered in Spring only

ST 756/GN 756 Computational Molecular Evolution (3 credit hours)
Prerequisite: GN 311 and ST 511
Typically offered in Fall only

ST 757/HS 757/GN 757 Quantitative Genetics Theory and Methods (3 credit hours)
The essence of quantitative genetics is to study multiple genes and their relationship to phenotypes. How to study and interpret the relationship between phenotypes and whole genome genotypes in a cohesive framework is the focus of this course. We discuss how to use genomic tools to map quantitative trait loci, how to study epistasis, how to study genetic correlations and genotype-by-environment interactions. We put special emphasis in using genomic data to study and interpret general biological problems, such as adaptation and heterosis. The course is targeted for advanced graduate students interested in using genomic information to study a variety of problems in quantitative genetics.
Prerequisite: ST 511
Typically offered in Fall only

ST 758 Computation for Statistical Research (3 credit hours)
Computational tools for research in statistics, including applications of numerical linear algebra, optimization and random number generation, using the statistical language R. A project encompassing a simulation experiment will be required.
Prerequisite: ST 702 and ST 705
Typically offered in Fall only

ST 771/BMA 771/MA 772 Biomathematics I (3 credit hours)
Role of theory construction and model building in development of experimental science. Historical development of mathematical theories and models for growth of one-species populations (logistic and off-shoots), including considerations of age distributions (matrix models, Leslie and Lopez; continuous theory, renewal equation). Some of the more elementary theories on the growth of organisms (von Bertalanffy and others; allometric theories; cultures grown in a chemostat). Mathematical theories oftwo and more species systems (predator-prey, competition, symbiosis; leading up to present-day research) and discussion of some similar models for chemical kinetics. Much emphasis on scrutiny of biological concepts as well as of mathematical structureof models in order to uncover both weak and strong points of models discussed. Mathematical treatment of differential equations in models stressing qualitative and graphical aspects, as well as certain aspects of discretization. Difference equation models.
Prerequisite: Advanced calculus, reasonable background in biology
Typically offered in Fall only

ST 772/BMA 772/MA 772 Biomathematics II (3 credit hours)
Continuation of topics of BMA 771. Some more advanced mathematical techniques concerning nonlinear differential equations of types encountered in BMA 771; several concepts of stability, asymptotic directions, Liapunov functions; different time-scales. Comparison of deterministic and stochastic models for several biological problems including birth and death processes. Discussion of various other applications of mathematics to biology; some recent research.
Prerequisite: BMA 771, elementary probability theory
Typically offered in Spring only
ST 773/BMA 773/MA 773/OR 773  Stochastic Modeling  (3 credit hours)

Prerequisite: BMA 772 or ST (MA) 746
Typically offered in Spring only

ST 779 Advanced Probability for Statistical Inference  (3 credit hours)
Sets and classes, sigma-fields and related structures, probability measures and extensions, random variables, expectation and integration, uniform integrability, inequalities, L_{p}-spaces, product spaces, independence, zero-one laws, convergence notions, characteristic functions, simplest limit theorems, absolute continuity, conditional expectation and conditional probabilities, martingales.

Prerequisite: ST 702
Typically offered in Fall only

ST 784 Multivariate Analysis  (3 credit hours)

Prerequisite: ST 522
Typically offered in Spring only

ST 790 Advanced Special Topics  (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

ST 793 Advanced Statistical Inference  (3 credit hours)
Statistical inference with emphasis on the use of statistical models, construction and use of likelihoods, general estimating equations, and large sample methods. Includes introduction to Bayesian statistics and the jackknife and bootstrap.

Prerequisite: ST 702
Typically offered in Spring only

ST 801 Seminar  (1 credit hours)
Typically offered in Fall and Spring

ST 810 Advanced Topics in Statistics  (1-3 credit hours)
Typically offered in Fall and Spring

ST 830 Independent Study  (1-3 credit hours)
Typically offered in Fall and Spring

ST 835 Readings  (1-3 credit hours)
Typically offered in Spring only

ST 841 Statistical Consulting  (1 credit hours)
Participation in regularly scheduled supervised statistical consulting sessions with faculty member and client. Consultant's report written for each session. Regularly scheduled meetings with course instructor and other student consultants to present an

Prerequisite: ST 512 and ST 702
Typically offered in Fall only

ST 885 Doctoral Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ST 890 Doctoral Preliminary Examination  (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ST 893 Doctoral Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ST 895 Doctoral Dissertation Research  (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ST 896 Summer Dissertation Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

ST 899 Doctoral Dissertation Preparation  (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Sustainable Materials and Technology (SMT)

SMT 200 Introduction to Sustainable Materials and Technology  (3 credit hours)
The overall goal of the class is to introduce the students to the properties and production, and environmental implications, of common materials, including biobased, metals, plastics and mineral based. The class will connect the structure and mechanical properties of these common materials with the technology used for producing the materials from raw ingredients, and also the processing of these materials into useful items. In addition to the material properties, the environmental impacts, e.g., emissions of carbon, water, and pollutants, will be discussed. The concepts of embodied energy, mass and energy balances, water and land use will all be considered. The concept of Life Cycle Analysis will be introduced and used to evaluate the production of different building materials.

Restriction: SMT majors or with the permission of the instructor
Typically offered in Fall only
SMT 201 Sustainable Materials for Green Housing (2 credit hours)
Sustainable Materials for Green Housing

GEP Interdisciplinary Perspectives
Typically offered in Spring only

SMT 202 Anatomy and Properties of Renewable Materials (3 credit hours)
Formation, cell morphology, cell wall, structure of softwoods, hardwoods, and other renewable materials; variability, naturally occurring defects, biological deterioration, and basic physical and mechanical properties of renewable materials in relation to products utilization. Techniques on hand lens and microscopic identification of renewable materials.

GEP Natural Sciences
Typically offered in Fall only

SMT 203 Physical Properties of Sustainable Materials (4 credit hours)
Basic concepts involving the interaction of sustainable materials with moisture, heat, and electricity. Concepts needed to perform calculations related to material balance, energy balance, mass transfer by diffusion, and heat transfer by conduction. Principles and application of basic techniques for characterizing the physical properties of materials and for drying of lumber.

Typically offered in Spring only

SMT 206 Wood Manufacturing Site Visits (1 credit hours)
Examples of the practical implementation of the value added processes within the wood products industry. Visits to wood products industries will be representative of the primary breakdown and secondary value added product operations that will expand an

P: SMT 240
Typically offered in Summer only

SMT 210 Sustainable Materials Internship (1 credit hours)
Experience in the forest products or related industries with a departmentally selected employer. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student a

Prerequisite: Completion of summer practicum
Typically offered in Fall, Spring, and Summer

SMT 232 Recycling to Create a Sustainable Environment (2 credit hours)
The goal of this class is to link the impetus for recycling and recycled materials to the building of a sustainable world. Recycling efficiencies for various materials will be examined as well as recycling practices and attitudes in other parts of the world. This course will explore the technology, economics, markets, trade and social impacts due to the recycling of materials. Case studies will provide an in-depth examination of the problems and potentials for the recycling of selected recycled materials. The use of Life Cycle Analysis (LCA) to evaluate recycling alternatives will be introduced. The economic, policy, social and resource availability drivers for recycling will be examined as well as the technological, economic, market and social barriers to recycling.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

SMT 240 Introduction to Wood Products Industries (2 credit hours)
An introduction to wood products including the products and their characteristics produced by the primary and secondary wood products industries, pulp and paper industry, energy and chemical products produced from wood.

P: SMT 202 or permission of the instructor
Typically offered in Spring only

SMT 293 Independent Study in Sustainable Materials & Technology (1-6 credit hours)
Independent Study for Sustainable Materials & Technology students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enr

Typically offered in Fall and Summer

SMT 294 Independent Study in Sustainable Materials & Technology (1-6 credit hours)
Independent Study for Sustainable Materials & Technology students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enr

Typically offered in Fall and Summer

SMT 295 Special Topics in Sustainable Materials and Technology (1-3 credit hours)
Special Topics in Wood Products at the 200 level for offering of courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

SMT 301 Chemistry of Sustainable Materials (3 credit hours)
Introduction of polymer science concepts (thermal transitions, molecular weight, viscoelasticity) to sustainable materials such as wood, cork, starch, silk, etc. Detailed instruction on the chemistry of sustainable materials including reactivity, decay, the chemical aspects of thermal treatments, the separation of sustainable materials into their individual components, the reactivity and modification of the individual components, and the conversion of sustainable materials into energy products.

Prerequisite: CH 101 and CH 102 and CH 220
Typically offered in Spring only

SMT 302 Processing of Biomaterials (4 credit hours)
Principles of the manufacturing processes used in the sustainable and renewable materials industries. Content includes primary and secondary manufacturing, theory of machining basics, and biomaterials-based composite fabrication. Field trips might require meeting outside of class time.

Prerequisite: SMT 202 or SMT 203
Typically offered in Spring only

SMT 308 Wood Processing (4 credit hours)
Principles of the manufacturing processes used in the wood products industries. Content includes primary and secondary manufacturing, theory of machining basics, and solid wood and wood-based composite fabrication. Field trips might require meeting outside of class time.

SMT 202 and SMT 240 or permission of the instructor
Typically offered in Fall only
SMT 310 Introduction to Industrial Ecology (3 credit hours)
In this course, students will explore the main concepts of industrial ecology for sustainable materials. Students will learn about environmental supply chain, manufacturing of products from sustainable materials such as wood and agricultural materials, and how we can learn from nature to close the manufacturing loop. To support the activities in these technical areas, students will also learn how to better manage time, how to work efficiently in teams, and how best to interact with their co-workers.

GEP Interdisciplinary Perspectives
Typically offered in Fall only

SMT 320 Industrial Chemical Pollutants (2 credit hours)
Introduction to the sources, fates, and analysis of common chemical pollutants from industrial sources. Content will focus predominantly on chemicals from industries related to the production and use of sustainable materials such as wood, bamboo, cork, silk, renewable plastics, etc.

P: SMT 301
Typically offered in Spring only

SMT 330 Project Management for Sustainability (3 credit hours)
Main concept and principles of Project Management (PM). Different tools utilized in project management will be covered. Relationship between project management and sustainability will be emphasized. With the concepts and tools learned in class, students will learn how to better manage their time, how to work efficiently in teams, and how best to interact with their superiors.

Restriction: Junior or Senior Standing
Typically offered in Fall only

SMT 340 Sustainable Materials Business Marketing (3 credit hours)
This course will examine the business and marketing approaches in the forest products industry from a theoretical as well as an applied perspective. Students will learn the importance of business processes and how products, price, distribution, and promotion plays a role in the purchase behavior of consumers. Students will analyze situations and cases to solve real and hypothetical business problems in the forest products industry.

Typically offered in Spring only

SMT 341 Mechanical Properties of Sustainable Materials (4 credit hours)

Prerequisite: MA 121 and PY 211 and SMT 203
Typically offered in Spring only

SMT 344 Sustainable Composites and Biopolymers (3 credit hours)
Manufacture, properties, and processing of lignocellulosic composites and polymers such as laminates, strandboard, particleboard, fiberboard, and nanocomposites. Principles and application of basic techniques for manufacture and testing of composites according to product and quality standards.

Prerequisite: SMT 301 and Senior standing in SMT
Typically offered in Fall only

SMT 450 Sustainable Business and Innovation (2 credit hours)
Theories, practice and case studies of sustainability and innovation in corporate settings. Content will include sustainability and environmental management, innovation, new business development and R&D, change management, corporate strategy and strategic alignment.

Prerequisite: Junior or senior standing
Typically offered in Fall only

SMT 483 Capstone in Sustainable Materials and Technology (3 credit hours)
Capstone course in sustainable materials and technology; integration of sustainable material and technology concepts with economic, environmental, and societal considerations; case studies and practicum in sustainable materials and technologies.

Restricted to students with Senior Standing in SMT
Typically offered in Spring only

SMT 493 Independent Study in Sustainable Materials & Technology (1-6 credit hours)
Independent Study for Sustainable Materials & Technology students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-S

Typically offered in Fall, Spring, and Summer

SMT 494 Independent Study in Sustainable Materials & Technology (1-6 credit hours)
Independent Study for Sustainable Materials & Technology students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-S

Typically offered in Fall, Spring, and Summer

Technology Education (TED)

TED 530 Foundations for Teaching Technology (3 credit hours)
Three topics related to teaching technology at the secondary and post-secondary levels: philosophical and historical foundations; methodology and curriculum development; and current trends and issues. Emphasis is on developing critical thinking skills, research, technology skill development, and writing procedures.

Prerequisite: Graduate standing
Typically offered in Fall only

TED 532 Current Trends in Technical Graphics Education (3 credit hours)
Current trends in the technology, techniques, and theories relating to technical graphics education. Discussion will center on assigned readings and student-researched presentations on topical subjects. Readings will be drawn from journals and texts, on-line databases and articles, and current news media sources.

Prerequisite: Graduate standing
Typically offered in Fall only
TED 534 Instructional Design in Technical and Technology Education (3 credit hours)
Create instructional activities for technical and technology education. Examine learning theories appropriate for technical and technology education. Explore and apply models for instructional design. Examine issues relative to electronic application.
Prerequisite: Graduate standing
Typically offered in Spring only

TED 536 Scientific and Technical Visualization: Theory and Practice (3 credit hours)
Theory and practice of scientific and technical visualization as a means of displaying scientific data and concepts using graphical methods. Both practitioner and theory driven models of communication are considered. How computer and print graphics can be used in student leadership in the management of a safe learning environment.
Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

TED 551 Technology Education: A Discipline (3 credit hours)
Defines essential attributes of technology and examines the relationship between technology education and related disciplines. Analyzes the theory, models, and literature that constitute the foundation of technology education. Synthesizes relevant research and identifies areas of needed research.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

TED 552 Curricula for Emerging Technologies (3 credit hours)
Analyze advanced technologies and develop instructional programs for technology education curricula in secondary schools. Topics include technologies in production, transportation and communication.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

TED 555 Developing and Implementing Technology Education (3 credit hours)
Technology Education curriculum trends, standards, design, implementation and management. Students will analyze current curricular trends and develop strategies for implementing and managing technology education programs.
Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

TED 556 Laboratory Management and Safety in TED (3 credit hours)
Laboratory management, planning, and safety considerations for technology education. Analysis of recent research, environmental factors, development of a safety system, safety education, and legal implications. Use of student leaders in management of a safe learning environment. Offered by Distance Education Only
Prerequisite: Graduate standing
Typically offered in Spring only

TED 558 Teaching Creative Problem Solving (3 credit hours)
Provides teachers with the opportunity to study the research associated with creativity and apply these theories to implement a creative problem solving program.
Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

TED 601 Practicum in Technology Education (1-6 credit hours)
Faculty supervised experience in educational, industrial or governmental setting where a student analyzes activities associated with planning, implementing and evaluating instructional and/or services in technology education. This plan is developed by students and approved by supervisor.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Spring

TED 602 Practicum in TED (1-3 credit hours)
Typically offered in Summer only

TED 610 Special Topics in Technology Education (1-6 credit hours)
Individual or group of special topics in professional education. The faculty member determines the topic and mode of study after discussion with students.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TED 621 Special Problems in Technology Education (1-6 credit hours)
Guided independent or group or current problems in technology education.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TED 641 Internship in Technology Education (3 credit hours)
Classroom teachers will document products of learning to include: content pedagogy, student development, multiple instructional strategies, motivation and management, professional growth and community involvement.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TED 646 Field-based Research in Technology Education (3 credit hours)
Employ methods of field-based research to examine and improve instructional effectiveness and student achievement.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TED 655 Internship in Graphic Communications Education (3 credit hours)
Mentoring during a higher education level teaching experience in the field of technical graphics with emphasis on providing help in teaching visualization, graphical sciences, and technical graphics standards. *Course is offered as needed to 2-3 students at a time (independent study).
Prerequisite: TED 530 or EOE 751 with Consent of Instructor
Typically offered in Fall and Spring

TED 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.
Prerequisite: Master's student
Typically offered in Fall and Spring
TED 690 Master's Examination (1-9 credit hours)
For students in non-thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.
Prerequisite: Master's student
Typically offered in Spring and Summer

TED 692 Research Project in Technology Education (1-6 credit hours)
A project or problem in research in education for graduate students, supervised by members of graduate faculty. The research chosen on the basis of individual students' interests and not to be part of thesis or dissertation research.
Prerequisite: ELP 732
Typically offered in Spring only

TED 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall and Spring

TED 695 Master's Thesis Research (1-9 credit hours)
Thesis research.
Typically offered in Fall, Spring, and Summer

TED 696 Summer Thesis Res (1 credit hours)

TED 709 Seminar in Technology Education (1-3 credit hours)
Seminar type course with topics selected for each class with attention given to broad concepts of and issues facing technology education at each level of delivery and implementation.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Spring

TED 751 Technology Education: A Discipline (3 credit hours)
Defines essential attributes of technology and examines the relationship between technology education and related disciplines. Analyzes the theory, models, and literature that constitute the foundation of technology education. Synthesizes relevant research and identifies areas of needed research.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

TED 752 Curricula for Emerging Technologies (3 credit hours)
Analyzes advanced technologies and develop instructional programs for technology education curricula in secondary schools. Topics include technologies in production, transportation and communication.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

TED 755 Developing and Implementing Technology Education (3 credit hours)
Technology Education curriculum trends, standards, design, implementation and management. Students will analyze current curricular trends and develop strategies for implementing and managing technology education programs.
Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

TED 756 Planning of Change in TED (3 credit hours)
Theories, research, strategies and practices needed to function as a technology education change agent; demonstrate a working knowledge of planned change in technology education; observe, assess, design and competently plan intervention strategies and apply use behavioral tools to achieve success.
Typically offered in Summer only

TED 757 Leadership Development in TED (3 credit hours)
Research, development and practice of individual and organizational leadership in technology education. Content builds leadership knowledge, skill and practice with emphasis on student assessment and development.
Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

TED 758 Teaching Creative Problem Solving (3 credit hours)
Provides teachers with the opportunity to study the research associated with creativity and apply these theories to implement a creative problem solving program.
Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

TED 801 Practicum in Technology Education (1-6 credit hours)
Faculty supervised experience in educational, industrial or governmental setting where a student analyzes activities associated with planning, implementing and evaluating instructional and/or services in technology education. This plan is developed by student and approved by supervisor.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TED 810 Special Topics in Technology Education (1-6 credit hours)
Individual or group of special topics in professional education. The faculty member determines the topic and mode of study after discussion with students.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TED 821 Special Problems in Technology Education (1-6 credit hours)
Guided independent or group or current problems in technology education.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Spring

TED 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

TED 896 Summer Dissert Res (1 credit hours)

TED 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer
Technology Engineering and Design Education (TDE)

**TDE 101 Introduction to Technology Education** (1 credit hours)
Orientation to technology teacher education curricula. Overview of the philosophy, objectives and scope of technology education programs in the public schools, multicultural and individual differences of students. A study of current technology issues will be conducted throughout the course.

*Typically offered in Fall only*

**TDE 110 Materials & Processes Technology** (3 credit hours)
Basic knowledge and skills needed to process common materials and produce functional products of woods, metals, plastics, and composite materials. Includes laboratory safety, use of hand tools, operation of materials, and teaching strategies. Laboratory experiences in materials testing and construction of multi-material projects.

*Typically offered in Fall and Spring*

**TDE 131 Technology through Engineering and Design I** (3 credit hours)
Study of engineering and design processes used to solve technological problems, innovate and invent. Students will actively design, model and test solutions to technological problems and explore methods to teach middle and high school students about engineering design and the design process.

*Prerequisite: TDE 110
Typically offered in Spring only*

**TDE 202 Introduction to Teaching Technology Engineering and Design Education** (2 credit hours)
This course introduces students to teaching technology, engineering, and design in middle and secondary schools. Students will become familiar with state standards and national recommendations for teaching technology, engineering, and design. The co-requisite for this course has a required fieldwork component in local middle and secondary schools, and students are responsible for their own transportation to and from their field experience sites. Students are required to purchase internship liability insurance to participate in this course. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge.

*Prerequisite: Sophomore standing; Corequisite: ED 204
Typically offered in Spring only*

**TDE 205 Desktop Publishing and Imaging Technology** (3 credit hours)
An introduction to digital document production and techniques. Explores software packages used in producing documents for print. Structured for public school teachers and other interested persons, the course introduces basic standards and concepts of page layout, copyright and trademark laws, document usability, readability, and methods of document production.

*Typically offered in Fall and Spring*

**TDE 220 Civil Engineering Graphics** (3 credit hours)
Civil engineering graphics is an introductory course in basic graphic principles for constructed facilities. The emphasis is on sketching and CAD (computer-aided design) drawing skills and how specific construction systems and materials selected for a design affect production of civil engineering drawings for buildings, residences, and other constructed facilities through CAD. Topics include orthographic and axonometric engineering drawing of site plans, plat plans, section details, utility structure details, elevations and related topics. Restricted to Civil Engineering Majors.

*Typically offered in Fall and Spring*

**TDE 230 Scientific and Technical Visualization** (3 credit hours)
Scientific and technical visualization is an introductory course providing orientation to communication of scientific and technical information with graphics. Using current practice in science, technology, and engineering disciplines as the context, the class will use general and discipline-specific techniques to explore how to effectively communicate with graphics. Both manual and current software and computer technologies will be used to design and create graphics. Students will also learn to critically examine and discuss graphics produced by themselves and others.

*Prerequisite: TDE 205
Typically offered in Spring only*

**TDE 261 Digital Media Education** (3 credit hours)
Image creation and control, aesthetics, production processes and environments, and media transfer are explored. This course emphasizes concepts of audio and video design, various digital media technologies, and nonlinear editing concepts through laboratory experiments and projects in radio, television, original audio development, and video production. TDE Majors or instructor permission.

*Typically offered in Spring only*

**TDE 331 Technology Through Engineering and Design II** (3 credit hours)
Students will explore the contributions of systems engineering for developing and sustaining our designed world. Appropriate measurement, analysis and simulation tools will be used to make informed decisions and solve problems. Students will explore methods to teach middle and high school students about engineering design and the design process. TDE Majors or instructor approval.

*Prerequisite: TDE 131
Typically offered in Fall only*

**TDE 351 Ceramics: The Art and Craft of Clay** (3 credit hours)
Contemporary and historical examples of the art and craft of ceramics will be studied. Experiences in designing ceramic forms and expressing individual ideas through the medium of clay.

**GEP Visual and Performing Arts**

**TDE 359 Electronics Technology** (3 credit hours)
Direct current, alternating current, and semiconductors. Measurement and circuit behavior. Experimentation with application circuits.

*Prerequisite: Junior Standing
Typically offered in Fall only*
TDE 371 Emerging Issues in Technology (3 credit hours)
Examination of current and projected technology topics which are growing in importance but are not presently reflected in the Technology Education programs of NC public schools. Laboratory experiences include development, revision, and field testing of appropriate learning activities for middle and high school students in the selected topic areas.
Prerequisite: TDE 131
Typically offered in Fall only

TDE 385 Robotics Education (3 credit hours)
This course is an introduction to design and invention system control mechanisms and robot sensors. Students will classify foundational technical developments in autonomous and computer- and radio-control robot teleoperations. Students will explore the history and evolution of robots and automation and their social, economic, industrial, and educational impacts.
Prerequisite: Senior standing.
Typically offered in Spring only

TDE 386 Robotics Education Lab (3 credit hours)
Students will apply technological problem solving skills toward 21st century design and innovation. This includes experiences multiple robotics design and invention systems and related programming and designing, prototyping, and programming an autonomous robot to resolve a real world issue.
Corequisite: TDE 385
Typically offered in Spring only

TDE 407 Field Work in Technology Education (6 credit hours)
A supervised off-campus field experience in Technology, Engineering, and Design Education that relates on-the-job experiences in the field to the technical competencies that are the content of the curriculum. This course has a required fieldwork component in a workplace, and students are responsible for their own transportation to and from their field experience sites.
Co-requisite: TDE 452, Senior Standing
Typically offered in Spring only

TDE 452 Lab Planning in Technology Education (3 credit hours)
Laboratory planning, management, and safety for technology education. Physical layout, selection, specification, and cost of equipment; the safe operation, repair and maintenance of power and hand tools; specification of expendable supplies, estimating, and ordering.
Restriction: Senior Standing; Corequisite: TDE 407 or TDE 457
Typically offered in Spring only

TDE 456 Curriculum and Methods in Technology Education (4 credit hours)
Methods of teaching Technology Education. Emphasis on curriculum development, instructional methods, laboratory instruction, meeting needs of special populations, and management of student organizations. Field experiences and course assignments two hours each week. Students are responsible for their own transportation.
Prerequisite: Technology Education Majors, Admittance to teacher education candidacy
Typically offered in Fall only

TDE 457 Student Teaching in Technology Education (8 credit hours)
Skills and techniques involved in teaching technology education through practice in a public school setting. The co-requisite for this course has a required fieldwork component in local middle and secondary schools, and students are responsible for their own transportation to and from their field experience sites. Students are required to purchase internship liability insurance to participate in this course. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge.
Prerequisite: TDE 456 and Corequisite: TDE 452
Typically offered in Spring only

TDE 481 Research & Development in Technology Education (3 credit hours)
Senior design, research, and development experience in technology education. Students research a problem, ideate potential solutions, select a final solution, construct a prototype, and complete a final report analyzing the chosen solution.
Prerequisite: TDE 331
Typically offered in Fall only

TDE 490 Special Problems in Technology Education (1-6 credit hours)
Supervised, independent investigation in a defined area of interest in Technology Education.
Prerequisite: Junior standing.
Typically offered in Fall only

TDE 495 Senior Seminar in Technology Education (3 credit hours)
An in-depth investigation of a topic or a set of problems and/or issues in Technology Education.
Prerequisite: Junior standing.
Typically offered in Fall and Spring

TDE 498 Independent Study in Technology Education (1-3 credit hours)
Individual or group study of special topics in professional technology education. The topic and mode of study are determined by the faculty member after discussion with the student. May be repeated for a maximum of 6 credits. Individualized/Independent
Prerequisite: Junior standing.
Typically offered in Spring and Summer

Textile and Apparel Management (TAM)

TAM 589 Special Studies In Textile Management and Technology (1-4 credit hours)
New or special course on developments in textile management and technology. Specific topics and prerequisites vary.
Prerequisite: Senior standing
Typically offered in Fall and Spring
Textile Chemistry (TC)

**TC 530 The Chemistry Of Textile Auxiliaries** (3 credit hours)
Industrially important textile chemicals used for enhancing fiber and fabric properties such as durable press, water repellency, anti-soiling, flame retardancy, softness, stiffness, lubricity and other uses. Correlation of effect with structure, end-use influences, interaction with fabric and fibers, sources and synthetic routes, economic and environmental considerations.

Prerequisite: One yr. of organic chemistry
Typically offered in Spring only

**TC 561/MSE 561 Organic Chemistry Of Polymers** (3 credit hours)
Principles of step reaction and addition polymerizations; copolymerization; emulsion polymerization; ionic polymerization; characterization of polymers; molecular structure and properties.

Prerequisite: TC 461 and CH 231 or CH 431
Typically offered in Fall only

**TC 565 Polymer Applications and Technology** (3 credit hours)
Poly(olefins), poly(vinyl chloride), poly(vinyl acetate), poly(urethanes), epoxies, silicones, styrene copolymers used as textile finishes, nonwoven binders, fabric coatings, composites, adhesives, foams, carpet backing adhesives. Emphasis upon synthesis, industrial processes, properties and products.

Prerequisite: One yr. of organic chemistry, TC 461
Typically offered in Spring only

**TC 589/TE 589/TMS 589 Special Studies In Textile Engineering and Science** (1-4 credit hours)
New or special course on developments in textile engineering and science. Specific topics and prerequisites identified vary. Generally used for first offering of a new course.

Prerequisite: Senior standing or Graduate standing
Typically offered in Fall, Spring, and Summer

**TC 601 Seminar** (1 credit hours)
Discussion of scientific articles and presentations; review and discussion of student papers and research problems.

Typically offered in Fall and Spring

**TC 630 Independent Study** (1-3 credit hours)
Typically offered in Fall and Spring

**TC 685 Master's Supervised Teaching** (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall only

**TC 689 Non-Thesis Master Continuous Registration - Full Time Registration** (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

**TC 690 Master's Examination** (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

**TC 693 Master's Supervised Research** (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

**TC 695 Master's Thesis Research** (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall and Spring

**TC 696 Summer Thesis Research** (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

**TC 699 Master's Thesis Preparation** (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis. Credits arranged

Prerequisite: Master's student
Typically offered in Fall only

**TC 704 Fiber Formation--Theory and Practice** (3 credit hours)
Practical and theoretical analysis of the chemical and physical principles underlying conventional methods of converting bulk polymer to fiber; rheology; melt, dry and wet polymer extrusion; fiber drawing; heat setting; general theory applied to unit processes.

Prerequisite: MA 341, PY 208
Typically offered in Spring only

**TC 705 Theory Of Dyeing** (3 credit hours)

Prerequisite: CH 433
Typically offered in Spring only
TC 706 Color Science (3 credit hours)
Basis of modern techniques for color specification, measurement, control and communication. Applications of color science to textiles, plastics, color reproduction, computer-based imaging and display systems. Basic concepts taught by computer color graphics.
Prerequisite: Senior standing or Graduate standing in TC, Corequisite: TC 707
Typically offered in Fall only

TC 707 Color Laboratory (1 credit hours)
Exercises with modern methods and equipment to aid in understanding color perception, color science and color measurement. Computer color graphics exercises for comprehension of basic concepts. Independent projects in color science. Limited enrollment.
Prerequisite: Senior standing or Graduate standing in TC, Corequisite: TC 706
Typically offered in Fall only

TC 710/FPS 710 Science of Dye Chemistry, Dyeing, Printing and Finishing (3 credit hours)
The primary course purpose is to gain a strong fundamental understanding of the chemistry and technology of preparation, dyes, dyeing and finishes. Emphasis will be on the chemistry of different bleach activators, surfactants, photophysics and photochemistry of FWAs, modulations of dyes structures to influence color, tintorial strength, light fastness, wash fastness and aggregation. Chemistry of different dye classes will be studied with emphasis on structure-property relationships and dye-fiber interactions. Dyeing isotherms (Nernst and Langmuir), kinetics of dyeing with emphasis on derivation of Nernst and Langmuir based on thermodynamics and kinetics principles will be covered with practical examples of dyeing at different temperature and how to calculate thermodynamic parameters of dyeing (entropy, standard affinity and isotherm constants of Nernst and Langmuir). Chemistry of different finishes, including soil release, chemistry of flame retardants and mechanisms of flame retardancy, antimicrobial and water and oil repellency, will be covered with emphasis on structure-property relationships.
Prerequisite: Graduate Standing and C or better in CH221 or CH225 and CH223 or CH227
Typically offered in Fall and Spring

TC 720 Chemistry Of Dyes and Color (3 credit hours)
Correlation of color and chemical constitution, synthetic routes for popular dyes of all important types; electronic mechanisms for reactive dyes; chemistry of dye interactions with light, washing and other in-use influences; economic and environmental considerations.
Prerequisite: (CH 221 or CH 225) and (CH 223 or CH 227)
Typically offered in Spring only

TC 771 Polymer Microstructures, Conformations and Properties (3 credit hours)
Exploration of connections between microstructures and properties of polymers afforded by analysis of their conformational characteristics. Analysis of NMR spectroscopy and conformational energy estimates to establish polymer microstructures and resultant sizes and shapes of polymer chains, which then related to their unique and rich variety of physical properties.
Prerequisite: CH 220
Typically offered in Fall only

TC 791 Special Topics In Textile Science (1-6 credit hours)
Intensive treatments of selected topics in textile, polymer and fiber science.
Prerequisite: Senior standing or Graduate standing
Typically offered in Fall and Spring

TC 792 Special Topics In Fiber Science (1-6 credit hours)
Study of selected topics of particular interest in various advanced phases of fiber science.
Typically offered in Fall and Spring

TC 896 Summer Dissertation (1 credit hours)

Textile Engineering (TE)

TE 105 Textile Engineering: Materials and Systems (2 credit hours)
Introduction to textile engineering, polymers and fibers with emphasis on applications. Discussions of what makes macromolecules unique and pairing of material properties to a given application. Other discussions by various TE faculty giving students a picture of the breadth of the program. This course will also help develop leadership/team work skills and oral/written communications.
Corequisite: CH 101
Typically offered in Spring only

TE 110 Computer-Based Modeling for Engineers (3 credit hours)
Introductory course in computer-based modeling and programming using Visual Basic for Applications. Emphasis on algorithm development and engineering problem solving. Methodical development of VBA within applications like Microsoft Excel and Access from specifications; documentation, style; control structures; classes and methods; data types and data abstraction; object-oriented programming and design; graphical user interface design. Projects: design problems from electrical, industrial, textile, and financial systems. Functional relationships will be given and programs will be designed and developed from a list of specifications.
Prerequisite: E 115, Corequisite: MA 141
Typically offered in Fall and Spring

TE 200 Introduction to Polymer Science and Engineering (3 credit hours)
Science and engineering of large molecules. Correlation of molecular structure and properties of polymers in solution and in bulk. Introductory polymer synthesis and kinetics. Analysis of physical methods for characterization of molecular weight, morphology, rheology, and mechanical behavior. The content will be focused on polymer synthesis, structure, and properties. The course will focus on a thorough understanding of polymer concepts and definitions, equations to calculate properties, and equipment used to measure properties.
Prerequisite: Grade of C- or better CH 101
Typically offered in Fall and Spring

TE 201 Fiber Science (4 credit hours)
Structure, physical and mechanical properties of fibers; structure of fiber assemblies. Structure/property relations. Laboratory exercises in characterization of fiber properties.
Prerequisite: CH 101 and (Grade of C- or better in MA 131 or MA 141)
Typically offered in Fall and Spring
TE 205 Analog and Digital Circuits (4 credit hours)  
Fundamentals of analog and digital circuit analysis and design. The course will present the systematic analysis and design of AC and DC circuits using Ohms and Kirchhoff's laws, the node voltage method, Thevenin and Norton's theorem, Laplace Transforms, resistance, capacitance, inductance, operational amplifiers, and frequency response. Next, the design of combinatorial and synchronous sequential circuit design will be covered using Karnaugh maps, laws of Boolean algebra, flip-flops, state machines, and latches. Laboratory exercises will supplement the topics presented in class.

Prerequisite: (MAE 206 or CE 214) and MA 242  
Typically offered in Fall only

TE 302 Textile Manufacturing Processes and Systems II (4 credit hours)  

Prerequisite: TE 301 and C- or better in TE/ISE 110  
Typically offered in Spring only

TE 303 Thermodynamics for Textile Engineers (3 credit hours)  
Introduction to the concept of energy and the laws governing the transfer and transformation of energy with an emphasis on thermodynamic properties and the First and Second Laws of Thermodynamics. The fundamentals of thermodynamics will be emphasized, although more advanced topics and problems will be heavily utilized.

Prerequisite: MA 242, PY 208  
Typically offered in Fall only

TE 401 Textile Engineering Design I (4 credit hours)  
The design process including initial specification, design constraints, sources of information and design strategy. Development of fact-finding ability in areas unfamiliar to the student. Analysis of existing designs and the development of improved or new designs.

Prerequisite: TE 302  
Typically offered in Fall only

TE 402 Textile Engineering Design II (4 credit hours)  
Application of textile engineering principles using team approach to design, construct and analyze novel engineering solutions to textile industry problems. Evaluation of design to assess the impact on worker, industry and society.

Prerequisite: TE 401  
Typically offered in Spring only

TE 404 Textile Engineering Quality Improvement (3 credit hours)  
Defining and quantifying quality of textile products; quality improvement using statistical process control (SPC) and design of experiment (DOE) techniques.

Prerequisite: ST 370 and C- or better in TE/ISE 110  
Typically offered in Spring only

TE 424 Textile Engineering Quality Improvement Laboratory (1 credit hours)  
Application of process improvement methods to textile systems using statistical software. Laboratory supplements lecture material presented in TE 404.

Corequisite: TE 404  
Typically offered in Spring only

TE 435/CHE 435 Process Systems Analysis and Control (3 credit hours)  
Dynamic analysis and continuous control of chemical and material engineering processes. Process modeling; stability analysis, design and selection of control schemes. Solution of differential equations using Laplace transform techniques.

Prerequisite: (MA 341 and TE 205) or CHE 312  
Typically offered in Fall and Spring

TE 440/TE 540 Textile Information Systems Design (3 credit hours)  
Textile information system design, real-world constraints. Principles of hardware, software, security and ethics issues. Emphasis on solving a real world problem. Credit will not be given for both TE 440 and TE 540.

Typically offered in Fall only

TE 463 Polymer Engineering (3 credit hours)  
Chemical and physical properties of polymers and fibers; thermodynamics of crystallization, time dependent phenomena, fracture mechanics and rheology. Advanced topics in extrusion.

Prerequisite: MSE 201 or BME 203; and Corequisite: TE 303, MAE 301, or MSE 301  
Typically offered in Fall only

TE 466/BME 466/TE 566/BME 566 Polymeric Biomaterials Engineering (3 credit hours)  
In-depth study of the engineering design of biomedical polymers and implants. Polymeric biomaterials, including polymer synthesis and structure, polymer properties as related to designing orthopedic and vascular grafts. Designing textile products as biomaterials including surface modification and characterization techniques. Biodegradable polymers.

Prerequisite: PY 208 and (TE 200 or CH 220 or CH 221 or CH 225) and (MAE 206 or CE 214)  
Typically offered in Fall only

TE 467/BME 467 Mechanics of Tissues & Implants Requirements (3 credit hours)  
Application of engineering and biological principles to understand the structure and performance of tendons, ligaments, skin, and bone; bone mechanics; viscoelasticity of soft biological tissues; models of soft biological tissues; mechanics of skeletal muscle; and tissue-derived devices as well as interfaces between native tissues and synthetic devices.

Prerequisite: (ZO 160 or BIO 183) and (MAE 214 or CE 225)  
Typically offered in Spring only
TEXTILE ENGINEERING

**TE 492  Special Topics in Textile Engineering**  (1-3 credit hours)
Presentation of material not normally available in regular course offerings or offering of new courses on a trial basis. Credits and content determined by faculty member in consultation with the Department Head.

*Typically offered in Fall and Spring*

**TE 505  Textile Systems and Control**  (3 credit hours)
Theory and application of instruments and control systems used in modern textile plants. Description of basic instruments and computer systems along with their use in process control, production control, research and development.

Prerequisite: TE 305, CSC 114

*Typically offered in Spring only*

**TE 533/TT 533/TTM 533  Lean Six Sigma Quality**  (3 credit hours)
Systematic approach (Lean Six Sigma philosophy) for improving products and processes. Defining the improvement opportunity, measurement system analysis, data collection, statistical analysis, design of experiment (DOE) methods, and statistical process control (SPC) methods.
Application of Lean Six sigma methods to improve product or process.

Prerequisite: ST 361 and ST 371, or equivalent

*Typically offered in Spring only*

**TE 540/TE 440  Textile Information Systems Design**  (4 credit hours)
Textile information system design, real-world constraints. Principles of hardware, software, security and ethics issues. Emphasis on solving a real world problem. Credit will not be given for both TE 440 and TE 540.

*Typically offered in Fall only*

**TE 550  Clothing Comfort and Personal Protection Science**  (3 credit hours)
The course presents scientific principles for characterization and development of comfortable and/or protective textiles and clothing. Properties associated with human tactile response, thermal comfort and heat stress are emphasized. Inherent issues of balancing comfort versus protection are illustrated by research studies on performance garments or protective clothing systems. Methods and standards for evaluating comfort and protective performance range from bench level instruments to system level tests for ensembles using instrumented manikins, human clothing wear trials, and physiological tests.

R: Graduate Standing or Permission of Instructor

*Typically offered in Fall only*

**TE 551  Human Physiology for Clothing and Wearables**  (3 credit hours)
This course addresses key principles involved in the interaction between textiles and the human being: basic anatomy and physiology, individual differences, heat balance and ergonomics. Effects of climate and clothing systems on physiology and ability to perform work, and thermal strain of active, clothed humans will be the focus. Students will conduct thermal analysis of human heat balance, including the influence of clothing. Measurements techniques related to exercise physiology, and application of sensors and instruments systems will be discussed.

R: Graduate Standing or Permission of Instructor

*Typically offered in Fall only*

**TE 562/OR 562/ISE 562  Simulation Modeling**  (3 credit hours)
This course concentrates on design, construction, and use of discrete/continuous simulation object-based models employing the SIMIO software, with application to manufacturing, service, and healthcare. The focus is on methods for modeling and analyzing complex problems using simulation objects. Analysis includes data-based modeling, process design, input modeling, output analysis, and the use of 3D animation with other graphical displa; assisted modeling is used to extend models and enhance re-usability.

*Typically offered in Spring only*

**TE 565/TMS 565  Textile Composites**  (3 credit hours)
Fiber architecture of textiles used for composites. Manufacturing processes and geometric quantification. Basic analysis for predicting elastic properties. Interrelationship of elastic properties and geometric quantities. Failure criteria for these mate

Prerequisite: MA 341, MAE 206

*Typically offered in Fall only*

**TE 566/BME 566/TE 466/BME 466  Polymeric Biomaterials Engineering**  (3 credit hours)
In-depth study of the engineering design of biomedical polymers and implants. Polymeric biomaterials, including polymer synthesis and structure, polymer properties as related to designing orthopedic and vascular grafts. Designing textile products as biomaterials including surface modification and characterization techniques. Bioresorbable polymers.

Prerequisite: PY 208 and (TE 200 or CH 220 or CH 221 or CH 225) and (MAE 206 or CE 214)

*Typically offered in Fall only*

**TE 570/PY 570  Polymer Physics**  (3 credit hours)
Polymer microstructures, polymer solutions, polymer physical states (including amorphous polymers, crystalline polymers, polymer melts, melting of polymers, glass-transition, and other transitions), polymer blends, polymer mechanical properties, polymer viscoelasticity and flow, multicomponent polymer systems, and modern polymer topics. The physics of polymer fibers. Graduate standing or permission of instructor.

*Typically offered in Fall only*

**TE 589/TMS 589/TC 589  Special Studies In Textile Engineering and Science**  (1-4 credit hours)
New or special course on developments in textile engineering and science. Specific topics and prerequisites identified vary. Generally used for first offering of a new course.

Prerequisite: Senior standing or Graduate standing

*Typically offered in Fall, Spring, and Summer*

**TE 601  Seminar**  (1 credit hours)

*Typically offered in Fall and Spring*

**TE 630  Independent Study**  (1-3 credit hours)

*Typically offered in Fall, Spring, and Summer*

**TE 676  Special Projects**  (1-3 credit hours)

*Typically offered in Spring only*
Typically offered in Fall, Spring, and Summer

MA 141
Prerequisite: MT 105 or TT 105 or PCC 101; Corequisite: MA 131 or

Problems related to fiber science are solved. Students are introduced to tools that will help them reflect on how polymer structure, fiber properties and utilization are explored. Also, measuring the physical properties of fibers. Relationships between behaviors of fibers (including their mechanical, thermal, optical, frictional, electrical, and moisture management properties), and methods of analyzing, describing and identifying unoriented and oriented crystalline or amorphous materials. Laboratory emphasis on study of fibers and polymers through transmission microscopy with polarized light.

Prerequisite: TMS 212
Typically offered in Fall only

TMS 214 Yarn and Fabric Formation and Properties Lab (1 credit hours)
The development of products from textiles and fibrous materials is a critical component of new product development in many industries. This laboratory course provides hands-on exercises and demonstrations of key textile and fiber-based products are manufactured.

Prerequisite: TMS 212
Typically offered in Fall only

Typically offered in Fall only

Prerequisite: TMS 211
Typically offered in Fall and Summer

Master's Thesis Lab (1-3 credit hours)
The development of products from textiles and fibrous materials is a critical component of new product development in many industries, including textiles, retail, plastics, composites, transportation, and architecture. This course provides the technical information required for scientists to understand how textile and fiber-based products are manufactured, with a practical view to combining the new knowledge with a molecular level understanding of fibers for unique new product development.

Prerequisite: TMS 211
Typically offered in Fall and Summer

Typically offered in Fall and Spring

Typically offered in Fall only

Art and science of light and electron microscopy; theoretical and practical aspects of visibility, resolution and contrast. Laboratory practice in assembling, testing and using various microscopes and accessories in analyzing, describing and identifying unoriented and oriented crystalline or amorphous materials. Laboratory emphasis on study of fibers and polymers through transmission microscopy with polarized light.

Prerequisite: MA 242, PY 208, TC 203
Typically offered in Fall only

Typically offered in Fall and Spring

Typically offered in Fall and Spring

Typically offered in Fall only

Typically offered in Spring only

Typically offered in Fall only

Textile Materials Science (TMS)

TMS 211 Introduction to Fiber Science (3 credit hours)
Properties of fibers are related to their classification, chemical structure, type and origin - which helps with their identification and classification. Covered in this course are principles of fiber formation and the physical behaviors of fibers (including their mechanical, thermal, optical, frictional, electrical, and moisture management properties), and methods of measuring the physical properties of fibers. Relationships between polymer structure, fiber properties and utilization are explored. Also, students are introduced to tools that will help them reflect on how problems related to fiber science are solved.

Prerequisite: MT 105 or TT 105 or PCC 101; Corequisite: MA 131 or MA 141

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

Typically offered in Fall only

Typically offered in Fall only

Typically offered in Fall only

Typically offered in Fall only

Typically offered in Fall and Spring

Typically offered in Fall and Spring

Typically offered in Fall and Spring

Typically offered in Fall only

Typically offered in Fall only

Textile Composites (3 credit hours)
Fiber architecture of textiles used for composites. Manufacturing processes and geometric quantification. Basic analysis for predicting elastic properties. Interrelationship of elastic properties and geometric quantities. Failure criteria for these materials.

Prerequisite: MA 341, MAE 206
Typically offered in Spring only
TMS 589/TC 589/TE 589  Special Studies In Textile Engineering and Science  (1-4 credit hours)
New or special course on developments in textile engineering and science. Specific topics and prerequisites identified vary. Generally used for first offering of a new course.

Prerequisite: Senior standing or Graduate standing
Typically offered in Fall, Spring, and Summer

TMS 676  Special Projects  (1-3 credit hours)

TMS 685  Master's Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

TMS 690  Master's Exam  (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall and Spring

TMS 693  Master's Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

TMS 695  Master's Thesis Research  (1-9 credit hours)
Thesis research

Prerequisite: Master's student
Typically offered in Fall and Spring

TMS 696  Summer Thesis Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

TMS 699  Master's Thesis Preparation  (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall and Spring

TMS 761  Mechanical and Rheological Properties Of Fibrous Material  (3 credit hours)
In-depth study of the stress-strain, bending, torsional, dynamic and rheological behavior of natural and man-made fibers. Presentation and discussion of theoretical relations and advanced techniques.

Prerequisite: MA 301
Typically offered in Spring only

TMS 762  Physical Properties Of Fiber Forming Polymers, Fibers and Fibrous Structures  (3 credit hours)
Experimental results and theoretical considerations of physical properties of fibers and fiber-forming polymers. Electrical, thermal, optical, frictional and moisture properties of these materials. Influence of chemical and molecular fine structure on these properties.

Prerequisite: PY 208
Typically offered in Spring only

TMS 763/MSE 763  Characterization Of Structure Of Fiber Forming Polymers  (3 credit hours)
Theories, experimental evidence and characterization methods of the molecular fine structure of fiber forming polymers in the solid state. Characterization methods include X-ray diffraction, microscopy, infrared, thermal and magnetic resonance.

Prerequisite: Graduate standing
Typically offered in Fall only

Textile Technology (TT)

TT 105  Introduction to Textile Technology  (3 credit hours)
Introduction to Textile and Apparel, Technology and Management. Structures and production methods for fabrics, yarn, and fibers. Introduction to the nature of polymers and the characteristics of polymers which make them useful for producing fibers that are practically and aesthetically desirable. Design of end products as well as fundamental economic and supply chain issues.

Typically offered in Fall, Spring, and Summer

TT 221  Yarn Production and Properties I  (2 credit hours)
The techniques available for manufacturing yarns from staple fibers. A review of yarn numbering and fiber properties. The principles involved in opening, cleaning, blending, drafting, twisting and winding. Short and long staple spinning systems including a review of opening and cleaning lines, carding, draw frames, roving frames and different spinning machines. Filament yarn processing.

Prerequisite: TT 105 or MT 105; Corequisite: MA 131 or MA 141
Typically offered in Fall, Spring, and Summer

TT 252  Formation and Structure of Textile Fabrics  (4 credit hours)

Prerequisite: TT 221 or TTM 106
Typically offered in Fall, Spring, and Summer

TT 305  Introduction to Nonwoven Products and Processes  (3 credit hours)
Fiber web/nonwoven fabrics produced directly from fibers or their precursors. Physical and chemical nature of local bonding and fiber entanglement. Viable processes for producing these fabrics. Economic justification for process and production. Product/
TT 327  Yarn Production and Properties  (4 credit hours)
The processing of natural and synthetic, fibers and filaments into yarns. The impact of fiber selection and processing parameters on the quality of the yarn and subsequent products. Major processing routes for staple fibers and filaments together with recent developments in applicable technologies.
Prerequisite: TMS 211 and (MA 231 or MA 241) and PY 211 or (PY 205 and PY 206)
Typically offered in Fall only

TT 331  Performance Evaluation of Textile Materials  (4 credit hours)
Standards, principles and effects of test conditions in measuring basic physical and mechanical properties of textile materials. Design of test and interpretation of test results in relation to end-use performance, product development, process control, research and development and other requirements.
Prerequisite: ST 311 or ST 370; and TT 305 or TT 404
Typically offered in Fall and Spring

TT 341  Knitted Fabric Technology  (3 credit hours)
Prerequisite: TT 221 or TT 327
Typically offered in Spring only

TT 351  Woven Products and Processes  (3 credit hours)
Design and development of various woven textile products including their component properties, performance, requirements, structures, and methods of production. The primary objective of the course is to introduce students to various woven textile products, including those used in automotives, agriculture, construction, ETC. and stimulate understanding of their structure, performance requirements, and relevant manufacturing principles including braiding.
Prerequisite: (TT 221 or TT 327) and (PY 211 or (PY 205 and PY 206))
Typically offered in Spring only

TT 380/FTM 380  Management and Control of Textile and Apparel Systems  (3 credit hours)
Management approaches, practices and basic economic considerations in the development, production and distribution of industrial and consumer textile and apparel products.
Prerequisite: FTM 217
Typically offered in Fall only

TT 401  Textile Technology Senior Design I  (4 credit hours)
This is Part 1 of 2 for the Senior Capstone Design Course. Students work in cross-functional teams to research and solve real-world problems in fibers, polymers, and textile science utilizing their foundation skills in Textile Technology. TT 401 and TT 402 must be taken in the same academic year as the class is project and team dependent. Students will be required to meet outside the normal class times as well as expected to participate in various off-campus field trips and activities for successful completion of the project. Project sponsors will cover any transportation costs that are incurred. TT majors only.
Prerequisite: TT 331, Senior standing
Typically offered in Fall only

TT 402  Textile Technology Senior Design II  (4 credit hours)
This is Part 2 of 2 for the Senior Capstone Design Course. Students work in cross-functional teams to research and solve real-world problems in fibers, polymers, and textile science utilizing their foundation skills in Textile Technology. TT 401 and TT 402 must be taken in the same academic year as the class is project and team dependent. Students will be required to meet outside the normal class times as well as expected to participate in various off-campus field trips and activities for successful completion of the project. Project sponsors will cover any transportation costs that are incurred. TT majors only.
Prerequisite: TT 401
Typically offered in Spring only

TT 404/TT 504/NW 504/NW 404  Introduction to Nonwovens Products and Processes  (3 credit hours)
This course introduces the fundamentals of nonwoven structures, process, and products. It provides performance criteria, raw materials, manufacturing methods, and market outlooks of major nonwoven application segments including hygiene, wipes, filters, medical, automotive, and geotextile. Emphasis is placed on building basic understandings of process/structure/property relationship in nonwoven product and the economic justification for process and production.
Prerequisite: (MA 131 or 141), PY 205; Corequisite: TT 503
Typically offered in Fall only

TT 405/TT 505/NW 505/NW 405  Advanced Nonwovens Processing  (3 credit hours)
Mechanisms used in the production of nonwoven materials. Design and operation of these mechanisms. Process flow, optimization of process parameters, influence of process parameters on product properties.
Prerequisite: MA 231 or MA 241, PY 211 or (PY 205 and PY 206), TT 305 or TT 404
Typically offered in Spring only

TT 407  Characterization Methods in Nonwovens  (3 credit hours)
Prerequisite: ST 311 or ST 370; and TT 305 or TT 404
Typically offered in Spring only
TT 408/TT 508/NW 508/NW 408 Nonwoven Product Development (3 credit hours)
Prerequisites: TT 405 and TT 407
Typically offered in Spring only

TT 431 Quality Management and Control In Textile Manufacturing (3 credit hours)
Principles of quality and process management and control in textile/apparel manufacturing with emphases in quality management systems, quality costs, statistical control chart procedures, process capability, acceptance sampling, and optimal process and product design and improvement methods.
Prerequisite: TT 331
Typically offered in Spring only

TT 451/TT 551 Advanced Woven Fabric Design (3 credit hours)
Design and production requirements for highly specialized woven fabric structures. The laboratory activities will include a project on design from concept to final production and finishing.
Prerequisite: (TT 252 or TT 351) and Senior Standing
Typically offered in Fall only

TT 470 Jacquard Woven Fabric Design (3 credit hours)
This course is dedicated to the study of Jacquard woven fabric design and structural technology through the use of CAD as both an aesthetic and technical tool, and will culminate in each student producing a unique fabric collection based upon his/her developed area of interest. Jacquard design for many different end uses is addressed, from art fabrics to unique specialty products. A field trip in this course will require personal transportation.
Prerequisite: TT 252, TT 371
Typically offered in Fall only

TT 480/FTM 480 Operations Management Decisions for Textiles (3 credit hours)
Quantitative techniques for decision making and management in the textile complex. Applications include vendor selection, plant location, retail inventory management, forecasting demand, project management, and logistics planning. Techniques covered include simulation, PERT/CPM, mathematical modeling.
Prerequisite: TT/FTM 380 and ACC 210 and ST 311 or ST 370 and ((MA 131 and 132) or MA 141)
Typically offered in Fall only

TT 481 Design and Technology of Technical Textiles (3 credit hours)
Performance requirements of various technical textiles. Underlying principles of design, application, manufacture, and evaluation of fibrous structures intended to meet specific end-use requirement.
Prerequisite: TT 305, TT 341 and TT 351
Typically offered in Fall only

TT 485/FTM 485 Textile Computer Integrated Enterprise (3 credit hours)
Survey of information technology in textile and apparel industries. Topics discussed include: computer aided design (CAD); computer aided manufacturing (CAM); computer aided engineering (CAE); material handling systems; automation and robotics; logistics and warehousing systems; retail product tracking, and Internet resources.
Prerequisite: TT/FTM 380
Typically offered in Fall only

TT 486/FTM 486 Supply Chain Management in the Textile Industry (3 credit hours)
Study of the operations necessary to produce and distribute a product, starting with the procurement of the raw material used in making the goods and ending with the delivery of the finished product. Topics covered include approaches to solving problems in manufacturing, sourcing, transportation logistics, and retail operations within the Integrated Textile Complex. Credit cannot be given for both TAM486 and MT386.
Prerequisite: TT/FTM 380
Typically offered in Fall only

TT 499 Textile Senior Project (4 credit hours)
This is a project based course to be taken in the last semester of the Senior year. In this capstone course the students work in cross-functional teams to research and solve applied problems in textile related fields. The results of the projects will
Prerequisite: Senior standing
Typically offered in Fall and Spring

TT 500 Understanding the Textile Complex (3 credit hours)
This course provides an overview of product development, processing, managing, financing, etc., for the textile industry. It is designed to give new graduate students basic preparations for more advanced, required textile courses. Students will also gain insight into the research being conducted within the College of Textiles.
Prerequisite: Graduate standing
Typically offered in Fall only

TT 503/NW 503 Materials, Polymers, and Fibers used in Nonwovens (3 credit hours)
Fundamentals of raw material used in nonwoven processes. Raw material production, chemical and physical properties of nonwoven raw materials and assessment of material properties. Introduction of structure/property relationships for these materials and how these relationships influence end use applications.
Prerequisite: MA 141, PY 205, PCC 203
Typically offered in Fall and Spring

TT 504/NW 504/NW 404/TT 404 Introduction to Nonwovens Products and Processes (3 credit hours)
This course introduces the fundamentals of nonwoven structures, process, and products. It provides performance criteria, raw materials, manufacturing methods, and market outlooks of major nonwoven application segments including hygiene, wipes, filters, medical, automotive, and geotextile. Emphasis is placed on building basic understandings of process/structure/property relationship in nonwoven product and the economic justification for process and production.
Prerequisite: (MA 131 or 141), PY 205; Corequisite: TT 503
Typically offered in Fall only
TT 505/NW 505/NW 405/TT 405  Advanced Nonwovens Processing  (3 credit hours)
Mechanisms used in the production of nonwoven materials. Design and operation of these mechanisms. Process flow, optimization of process parameters, influence of process parameters on product properties.
Prerequisite: MA 231 or MA 241, PY 211 or (PY 205 and PY 206), TT 305 or TT 404
Typically offered in Spring only

TT 507/NW 507  Nonwoven Characterization Methods  (3 credit hours)
Prerequisite: ST 361, Corequisite: TT/NW 505
Typically offered in Spring only

TT 508/NW 508/NW 408/TT 408  Nonwoven Product Development  (3 credit hours)
Prerequisites: TT 405 and TT 407
Typically offered in Spring only

TT 520  Yarn Processing Dynamics  (3 credit hours)
Principles and practice involved in modern yarn and manufacture; including machine-fiber interactions occurring during different processing stages. Not normally for credit for undergraduate textile majors.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Spring

TT 521/TMS 521  Filament Yarn Production Processing and Properties  (3 credit hours)
Structure, properties and processes for manufacturing and treating continuous filament yarns. Response of fibers to elevated temperatures, twist, false twist and various bulkings processes. Yarn structure and properties required for stretch and molded fabrics. Independent laboratory and critical literature review in general area of filament yarn processing, properties and test methods. credit not allowed for both TT 521 and TT 425
Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TT 530/TTM 530  Textile Quality and Process Control  (3 credit hours)
Quality control and improvement methods for textile processes and products including quality systems, statistical control chart procedures, process capabilities, acceptance sampling plans, textiles process and product designs, on-line and off-line control systems and specific quality factors governing textile products and processes and their variabilities.
Prerequisite: TT 420, Corequisite: ST 511 or ST 515
Typically offered in Spring only

TT 532  Evaluation of Biotextiles  (3 credit hours)
Evaluation of the performance of biotextiles and medical polymers in biological and microbiological environments, with an emphasis on “in vitro” and “in vivo” techniques for testing the biocompatibility and biostability of implantable biomedical products. Related issues will deal with quality assurance systems, inspection and sampling plans, ISO certification, GMP’s, reference materials and organisms, and the use of accelerated tests as animal trials so as to meet regulatory requirements.
Prerequisite: ZO 160, TC 203, TMS 211, CH 220
Typically offered in Fall only

TT 533/TTM 533/TE 533  Lean Six Sigma Quality  (3 credit hours)
Systematic approach (Lean Six Sigma philosophy) for improving products and processes. Defining the improvement opportunity, measurement system analysis, data collection, statistical analysis, design of experiment (DOE) methods, and statistical process control (SPC) methods. Application of Lean Six sigma methods to improve product or process.
Prerequisite: ST 361 and ST 371, or equivalent
Typically offered in Spring only

TT 535/TTM 535  Research Methods and Management  (3 credit hours)
Basic principles and methods of academic and industrial research, research ethics, search of knowledge bases, research hypothesis, scientific paradigm, theory development, optimal research design and execution of scientific experiments, regression methods, survey design, use of variance components for sampling scheme, model building and validation, principles of industrial R&D, project design and management, intellectual property rights, and maximization of research output.
Prerequisite: ST 361, Graduate standing
Typically offered in Spring only

TT 549  Warp Knit Engineering and Structural Design  (3 credit hours)
Prerequisite: TT 443
Typically offered in Spring only

TT 550  Production Mechanics and Properties of Woven Fabrics  (3 credit hours)
Interrelation between mechanics of production and mechanical properties of woven fabric; unit operations required to prepare yarns for weaving and the mechanism employed in weaving; fabric structure, geometry and mechanical properties; designing for specific fabrics properties. Not normally for credit for undergraduate textiles majors.
Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

TT 551/TT 451  Advanced Woven Fabric Design  (3 credit hours)
Design and production requirements for highly specialized woven fabric structures. The laboratory activities will include a project on design from concept to final production and finishing.
Prerequisite: (TT 252 or TT 351) and Senior Standing
Typically offered in Fall only
TT 553  Formation and Structure of Woven and Knitted Fabrics  (3 credit hours)
The interrelation between the mechanics of production and mechanical properties of woven and knitted fabrics; unit operations required to prepare yams for weaving and knitting and mechanisms employed in weaving and knitting; fabric structure, geometry and mechanical properties; designing for specific fabric properties. Students will not be allowed credit for TT 553 and (TT 541, TT 549, and TT 550).

Typically offered in Spring only

TT 570  Textile Digital Design and Technology  (3 credit hours)
This course focuses on design of textile products balancing industry and creative foci. Students will study a range of industry focused technologies and techniques essential to creation of textile products in a technology intensive environment. Basics of textile product design and relevant technologies will be covered along with methods and techniques to improve commercial textile product design process. Students will research in-depth a topic related to textile product design, and present their research in an oral format.

Prerequisite: Graduate standing
Typically offered in Fall only

TT 571  Professional Practices in Textile Design and Technology  (3 credit hours)
This course builds on the concepts introduced in TT 570 with increased focus on professional practice and methods. Focus on advanced textile product design topics incorporating an industry focus and utilizing commercial technologies. Students will investigate in depth a textile product design industry application, technique or method of interest using individual and team based strategies. Topics include advanced study of textile product design concepts, techniques and preparation for professional competitions, displays and conferences.

Prerequisite: TT 570
Typically offered in Spring only

TT 581  Technical Textiles  (3 credit hours)
Performance requirements of various technical textiles. Underlying principles of design and manufacturing of fibrous structures to meet specific needs in mechanical and other behaviors.

Prerequisite: TT 520 or TT 521, and TT 550
Typically offered in Fall only

TT 591  Special Studies in Textile Technology  (1-4 credit hours)
Special Studies in Textile Technology to fulfill needs not covered by current offering. Student and faculty required to submit topics to be covered to director of graduate programs within first week of semester.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TT 601  Seminar  (1 credit hours)
Discussion of scientific articles of interest to the textile industry; review and discussion of student papers and research problems.

Typically offered in Fall and Spring

TT 630  Independent Study in Textile Technology  (1-3 credit hours)
Problems of specific interest in textile technology. Preparation of report, in format suitable for publication required. One-page outline signed by advisor must be submitted to director of graduate programs within first week of semester. A maximum of 3 credit hours will be allowed towards Master of Textiles Degree. No credit is allowed towards MS (Textiles).

Typically offered in Fall, Spring, and Summer

TT 676  Special Projects Textile Technology  (1-3 credit hours)
Typically offered in Fall and Spring

TT 685  Master's Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall only

TT 690  Master's Examination  (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall and Spring

TT 693  Master's Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

TT 695  Master's Thesis Research  (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Spring only

TT 696  Summer Thesis Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

TT 699  Master's Thesis Preparation  (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Spring only

TT 896  Summer Dissert Res  (1 credit hours)
Textile Technology Management (TTM)

TTM 106 Yarn Formation, Classification and Numbering Systems (1 credit hours)
The course addresses techniques available for manufacturing staple and filament yarns, classification of yarn types, and processes involved in manufacturing staple and filament yarns. The course covers hands-on calculations and measurements of yarn numbering systems including direct and indirect systems.
Prerequisite: TT 105; Corequisite: MA 131 or MA 141 (Calculus I)
Typically offered in Fall and Spring

TTM 501 Textile Enterprise Integration (3 credit hours)
Discussion of philosophy, strategy and technology of enterprise integration for textile manufacturing. Survey of enabling technologies such as computer-aided design; computer-aided manufacturing; material handling systems; information systems for control, supervision and planning; and internet resources.
Prerequisite: Graduate standing, Background in textile manufacturing.
Typically offered in Fall only

TTM 510 Apparel Technology Management (3 credit hours)
Role of the apparel complex in manufacturing and supplying products on demand to meet the quality and performance of the global customer. The critical juxtaposition of the textile supply together with retail demand studied to understand constraints on apparel products.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

TTM 515 Apparel Production (3 credit hours)
Concepts and practices for the production of apparel items, beginning with development of basic fit blocks and extending through the reaction of stylized garments using pattern engineering techniques, supported by computerized pattern development.
Typically offered in Fall only

TTM 517 Advanced Computer-Aided-Design for Fashion (3 credit hours)
Exploration of industry design software for apparel and other sewn products. U4ia visual design software, Gerber Accumark or Lectra pattern design programs, Adobe Illustrator and Photoshop, and other programs used by the industry to create, market and/or visualize products will be taught. Peripheral equipment essential to the design and visualization process will be included.
Typically offered in Spring only

TTM 530/TT 530 Textile Quality and Process Control (3 credit hours)
Quality control and improvement methods for textile processes and products including quality systems, statistical control chart procedures, process capabilities, acceptance sampling plans, textiles process and product designs, on-line and off-line control systems and specific quality factors governing textile products and processes and their variabilities.
Prerequisite: TT 420, Corequisite: ST 511 or ST 515
Typically offered in Spring only

TTM 533/TE 533/TT 533 Lean Six Sigma Quality (3 credit hours)
Systematic approach (Lean Six Sigma philosophy) for improving products and processes. Defining the improvement opportunity, measurement system analysis, data collection, statistical analysis, design of experiment (DOE) methods, and statistical process control (SPC) methods. Application of Lean Six sigma methods to improve product or process.
Prerequisite: ST 361 and ST 371, or equivalent
Typically offered in Spring only

TTM 535/TT 535 Research Methods and Management (3 credit hours)
Basic principles and methods of academic and industrial research, research ethics, search of knowledge bases, research hypothesis, scientific paradigm, theory development, optimal research design and execution of scientific experiments, regression methods, survey design, use of variance components for sampling scheme, model building and validation, principles of industrial R&D, project design and management, intellectual property rights, and maximization of research output.
Prerequisite: ST 361, Graduate standing
Typically offered in Spring only

TTM 545 Weft and Warp Knit Engineering and Structural Design (3 credit hours)
This class is for both designers, engineers, and technicians for garment applications and machine technologies, to design and create a wide range of products using non-traditional materials and techniques, with the options of knitting in both two and three dimensions. Applications can be but are not limited to sports, medicine, Industrial, electronic and entertainment, transportation, interior design, and furniture.
Typically offered in Fall only

TTM 561 Strategic Technology Management in the Textile Complex (3 credit hours)
Management approaches and strategies for forecasting, planning, creating, and implementing technology changes in textile industry complex undergoing rapid market place and global competitive changes.
Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

TTM 573 Management of Textile Product Development (3 credit hours)
The course focuses on an integrated approach to new product design, development and marketing of textile products. This integrated approach includes a) innovation strategy and opportunity identification, b) the design process for textile products, c) market launch, and d) managing innovation. The course include diverse textile end-uses, including apparel, home textiles, transportation textiles, and medical textiles. Trends in textile product development are reviewed. The dynamics of business analysis and strategy, design prototypes, and product analysis and recommendation are analyzed.
Prerequisite: Graduate standing
Typically offered in Spring only
TTM 579 Textile Design Collection Studio (6 credit hours)
Execution of creative projects addressing textile design problems through synthesis of background research and investigation, and knowledge from previous courses; preparation of work for portfolio, juried exhibition and participation in industry based competitions. Professional textile design practices including advanced portfolio development concepts and presentation, development of textile collections for specified end uses with emphasis on ideation, refinement and design development, and visual communication. FTD-TD ABM and TATM graduate students only.
Prerequisite: FTD 374, FTD 475, FTD 476
Typically offered in Spring only

TTM 580 Consumer Perspectives in Fashion (3 credit hours)
Introduction of concepts and theories related to consumer behavior. Analysis of apparel and textile consumers and their decision making processes as well as internal and external influencing factors. Application of consumer behavior models to investiga
Typically offered in Spring only

TTM 581 Global Textile and Apparel Business Dynamics (3 credit hours)
An overview of the economic, competitive, technological and market dynamics of the international textile and apparel industries. Trends in demand, output and trade are reviewed. The dynamic forces shaping and transforming the industry internationally are analyzed. Patterns of change at the global, regional, national and company level are explained and the outlook for the industries is considered.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Summer

TTM 582 Global Textile Brand Management and Marketing (3 credit hours)
The course provides an understanding of the global textile brand management and marketing environments, global markets, and marketing programs and organizations. Specific topics include a) the economic, social, political/legal, and cultural environments; b) global textile market opportunities and challenges; c) global textile and apparel marketing strategies, and d) creation and management of global textile and apparel marketing programs. Credit will not be allowed for both TAM 482 and TAM 582. Graduate standing.
Typically offered in Fall only

TTM 583 Strategic Planning for Textile Firms (3 credit hours)
Elements of competitive strategy and planning methods within the textile complex with emphasis on the concepts of strategy in a mature industry, defining business in a global industry, resource allocation through strategic planning methods and implementing strategy in a single business and multi-business firms.
Prerequisite: Graduate standing
Typically offered in Fall only

TTM 585/BUS 585 Market Research in Textiles (3 credit hours)
A study and analysis of quantitative methods employed in market research in the textile industry. Function of market research and its proper orientation to management and decision making.
Prerequisite: TAM (EC) 482
Typically offered in Spring only

TTM 587 Advanced Fashion Collection Studio (6 credit hours)
Graduate level fashion product design. Design and production of a "collection" using various methods of generating patterns for garments, such as flat pattern, draping CAD design techniques. Relationship of body configuration and fabrication to garment design. Emphasis on ideation, creativity, communication, fit quality and exhibition of a fashion collection. Work culminates in a fashion show or static exhibition. Restricted to TATM majors.
P: FTM 315,317, and 318 or FTD215, 216, and 321
Typically offered in Fall and Spring

TTM 588 Global Perspectives in Textiles Supply Chain Management (3 credit hours)
Study and analysis of global textile supply chains. Field trips to textile related companies and organizations are required. Students will conduct a research project on global supply chain issues. Course taught off campus for non US global perspectiv

TTM 591 Special Studies in Textile Technology Management (1-4 credit hours)
Special Studies in Textile and Apparel, Technology and Management to fulfill needs not covered by current offerings. Student and faculty required to submit topics to be covered to director of graduate programs within first week of semester.
Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TTM 601 Seminar (1 credit hours)
Discussion of scientific articles of interest to the textile industry; review and discussion of student papers and research problems.
Typically offered in Fall and Spring

TTM 630 Independent Study in Textile Technology Management (1-3 credit hours)
Problems of specific interest in textile and apparel technology. Preparation of report, in a format suitable for publication required. One-page outline signed by advisor must be submitted within first week of semester.
Typically offered in Fall, Spring, and Summer

TTM 632 Special Studies in Textile Product Development (1-6 credit hours)
Preq: Graduate standing or PBS student. This course is an Independent Study in Textile Product Development to fulfill needs not covered by current course offerings. Student and faculty are required to submit the topic to be covered to the graduate admin
Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TTM 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student
Typically offered in Fall and Spring

TTM 695 Master's Thesis Research (1-9 credit hours)
Thesis research.
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer
TTM 696  Summer Thesis Research  (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

TTM 710  Textile Technology Management  (3 credit hours)
The course will discuss economic and technical aspects of managing technology in the textile complex. It will explain how technological change can be planned and thus managed, and it will address the required framework for forecasting, planning, creating, and implementing technological change. Cases of technological change in the textile complex will be discussed.

Requirement: 18TTMPHD
Typically offered in Fall only

TTM 731  Decision Models and Applications in Textile and Apparel Management  (3 credit hours)
This course provides students with an overview of data decision models used in the textile and apparel industry, along with skills to apply them in real-world decision processes. Published academic papers and case studies will augment the teaching and learning in international trade, supply chains, manufacturing processes, quality, marketing, retail and distribution.

Restriction: TTM PhD
Typically offered in Spring only

TTM 750/FPS 750  Advances in Fabric Formation, Structure, and Properties  (3 credit hours)
The course covers different aspects of the processing of yarns to products (braided, knit, woven, and their composites) and the interrelation between the production mechanics and structure, geometry and properties of fiber assembly. Topics in the field are assigned and each student is expected to thoroughly study the topics and write critical papers based on structured assignments and specific questions. Conduct projects from concept to fabric formation, analyses, and evaluation.

Prerequisite: TT 550 or TT 551 (or TT 451) or equivalent
Typically offered in Spring only

TTM 761  Supply Chain Management and Information Technology  (3 credit hours)
Working knowledge of management concepts and information technologies to design and manage supply chain operations in textile complex. Deals with markets and operations distributed geographically and institutionally.

R: Graduate Students Only
Typically offered in Spring only

TTM 785  Doctoral Research Methods  (3 credit hours)
The course in research methods examines contributions to knowledge among the interdisciplinary streams of inquiry that inform global management in textiles and apparel. The course requires active discourse among students regarding: philosophy of science, dominant research paradigms, assumptions of quantitative and qualitative research methods, application of qualitative and quantitative research methods to areas including but not limited to: product development, technology management, supply chain management, textile economics & trade, marketing strategy and consumer behavior. Students are expected to develop particular understanding of the methods commonly applied in their area of interest.

Requirement: 18TTMPHD
Typically offered in Fall only

TTM 791  Advanced Special Studies in Textile Technology Management  (1-4 credit hours)
Advanced Special Studies in Textile Technology Management to fulfill needs not covered by current offerings. Students and faculty are required to submit topics to be covered to the graduate administrator before the start of semester.

Prerequisite: Doctoral Student
Typically offered in Fall, Spring, and Summer

TTM 801  Seminar  (1 credit hours)
Typically offered in Fall and Spring

TTM 830  Independent Study  (1-3 credit hours)
Typically offered in Fall and Spring

TTM 876  Special Project TTM  (1-3 credit hours)
Typically offered in Fall only

TTM 885  Doctoral Supervised Teaching  (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall only

TTM 890  Doctoral Preliminary Examination  (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

TTM 893  Doctoral Supervised Research  (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

TTM 895  Doctoral Dissertation Research  (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer
TTM 896  Summer Dissertation Research  (1 credit hours)
For graduate students whose programs of work specify no formal course
work during a summer session and who will be devoting full time to thesis
research.
Prerequisite: Doctoral student
Typically offered in Summer only

TTM 899  Doctoral Dissertation Preparation  (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment,
preliminary examination, and residency requirements for the doctoral
degree and are writing and defending their dissertations.
Prerequisite: Doctoral student
Typically offered in Fall and Spring

Textiles (T)

T 101  Introduction to the College of Textiles  (1 credit hours)
Introduction topics related to the College of Textiles, the textile industry,
at all textile curricula, advising, academic skills, team work, research and
personnel involved in the college. Students will not receive credit for both
USC 301 and T 101.
Typically offered in Fall and Spring

T 102  Introduction to Product Evolution  (2 credit hours)
Students explore the new product development (NPD) process through
analysis of case studies of how textile products are designed and
developed for a variety of sectors of our economy, including automotive,
medical, industrial, furniture, and clothing. Students develop critical
thinking skills as they read a variety of texts and respond using several
forms of writing techniques.
Typically offered in Fall and Spring

T 104  Fabric of Success and Career Readiness  (1 credit hours)
This course will provide students with the knowledge and resources
needed to effectively identify, plan, and achieve their career interests and
goals. Participants will develop the career-readiness skills that employers
seek in new hires, thus allowing them to be better prepared for and
successful in their future internship and job searches.
Restriction: Wilson College of Textiles Students with 15+ hours
completed at NC State
Typically offered in Fall and Spring

T 200  Introduction to Textiles  (3 credit hours)
Survey of textiles including technical and economic history of the industry;
physical and chemical processes involved in producing textile products
from raw materials; unique aesthetic, physical and chemical properties of
textiles and how these properties are determined by raw materials and
production processes; and influence of properties of textile materials on
their utilization and performance. Not open to students required to take
TT 105; open to transfer students
Typically offered in Fall, Spring, and Summer

T 491  Honors Seminar in Textiles  (1 credit hours)
A seminar on current university and industrial research in the field of
textiles.
Prerequisite: By invitation into Honors Program in Textiles
Typically offered in Spring only

T 493  Industrial Internship in Textiles  (3 credit hours)
Paid professional-level work experience in textiles, relating academic
training in science and technology to industrial practice under
professional guidance. Written and final oral presentation used for
grading. Limited to three hours per student. Individualized/Independent
Study and Research courses require a Course Agreement for Students
Enrolled in Non-Standard Courses be completed by the student and
faculty member prior to registration by the department.
Prerequisite: Textile core courses
Typically offered in Summer only

T 495  International Collaboration in Textiles Research  (1-6 credit hours)
Directed undergraduate research in Textiles and/or Apparel related
areas that requires collaboration with students at an institution abroad.
The research project is structured as an international team project in an
applied field that allows students in
Prerequisite: GPA of 2.75 or better and JR standing
Typically offered in Fall, Spring, and Summer

T 497  Independent Research in Textile Engineering, Chemistry and
Materials Science I  (1-3 credit hours)
Independent research in Textile Engineering, Chemistry and Materials
Science topics through experimental, theoretical and literature studies.
Written and oral reports required. Individualized/Independent Study and
Research courses require a Course Agreement for Students Enrolled in
Non-Standard Courses be completed by the student and faculty member
prior to registration by the department.
Prerequisite: Junior standing in TECS; 2.8 GPA
Typically offered in Fall, Spring, and Summer

T 498  Independent Research in Textile Engineering, Chemistry and
Materials Science II  (1-3 credit hours)
Independent research in Textile Engineering, Chemistry and Materials
Science topics through experimental, theoretical and literature studies.
Written and oral reports required. Individualized/Independent Study and
Research courses require a Course Agreement for Students Enrolled in
Non-Standard Courses be completed by the student and faculty member
prior to registration by the department.
Prerequisite: T 497
Typically offered in Fall, Spring, and Summer

Theatre (THE)

THE 103  Introduction to the Theater  (3 credit hours)
Artistic, technical, historical, and literary areas of theater, including acting,
directing, design, stagecraft, lighting, costuming, makeup, and criticism.

GEP Visual and Performing Arts
Typically offered in Fall and Spring

THE 203  Theory and Practice of Acting  (3 credit hours)
Basic contemporary theories on acting, with practical application through
classroom exercises. Role analysis, adaptation of voice and body to
performance demands, and role development through various rehearsal
activities.

GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer
THE 223 Stagecraft (3 credit hours)
Fundamentals of scenery design, set construction, and related technical activities. Practical applications with use of design media and shop facilities. Required production participation in University Theater presentations.

Typically offered in Fall only

THE 293 Theater Practicum (1-6 credit hours)
Practical experience in one or more of the various areas of artistic and technical theater through active participation in Thompson Theater's play production program.

Typically offered in Fall, Spring, and Summer

THE 303 Stage Directing (3 credit hours)
Basic theory of directing and its application to theatrical production. Play reading, evaluation, casting procedure, staff organization, and rehearsal planning and practices. Laboratory productions of short plays.

Typically offered in Spring only

THE 334 Advanced Acting (3 credit hours)
Advanced methods in role preparation through exercises in concentration, imagination, sensory and emotional recall, and other Stanislavskian techniques. Analyses and critiques of plays and in-class performances.

Prerequisite: THE 203 or demonstrated competence in acting

Typically offered in Spring only

THE 340 African American Theatre (3 credit hours)
This course examines African American dramaturgy and its impact on American theatre. We will study plays from the early period, 1847-1938, and from the recent period, 1935-present. This course will investigate the thematic structure of each section of plays including family life, social protest, and religion. The course will also help students to better understand the social milieu that shaped the content of each play.

Typically offered in Fall only

THE 353 Fundamentals of Theatre Design (3 credit hours)
Fundamentals of Theatre Design provides a framework for the designer's artistic process and practical foundation for scenic, costume, and lighting design for the theatre. Students will learn design terminology, text and performance analysis, design development and presentation, design and production communication and collaboration. Recommended completion of THE 223 Stagecraft. Students may be required to provide their own transportation to and cover the cost of on- or off-campus performance events not to exceed $20.

Typically offered in Spring only

THE 398 Special Topics in University Theatre (1-3 credit hours)
Presentation of material normally not available in regular course offerings, or offerings of a new course on a trial basis.

Typically offered in Fall, Spring, and Summer

THE 433 Period Styles in Acting (3 credit hours)
Interpreting daily lives in earlier eras through reading, discussion, research, and performance. Plays of complex heightened language, in verse and prose, studied from perspective of character's daily lives and their relevance to contemporary performance skills. Scenes, monologues, and soliloquies rehearsed and performed.

Prerequisite: THE 203

Typically offered in Fall and Spring

Toxicology (TOX)

TOX 201 Poisons, People and the Environment (3 credit hours)
TOX 201 serves as an introduction to the fascinating world of chemical poisons and covers their numerous and varied effects on human health and the environment. We will learn how and why poisons have played an important history, how to critically evaluate the chemical risk information reported in the media, in addition to the underlying principles of the basic science of poisons.

GEP Natural Sciences

Typically offered in Fall, Spring, and Summer

TOX 401/TOX 501 Principles of Toxicology (4 credit hours)
Introduce students to the basic principles of toxicology. Will cover the history and scope of the field; absorption, distribution, metabolism and elimination of toxicants; types and mechanisms of toxic action; carcinogenesis; environmental toxicology as well as human and ecological risk assessment.

Prerequisite: CH 220 or CH 221 or CH 225; BIO 181 or ZO 160

Typically offered in Spring only

TOX 415 Environmental Toxicology and Chemistry (4 credit hours)
Environmental toxicology and chemistry including the sources, fate, and effects of chemicals in the environment. Emphasis on contemporary problems in human health and the environment.

Prerequisite: CH 220 or CH 221 or CH 225; BIO 181 or ZO 160 recommended

Typically offered in Fall and Spring

TOX 501/TOX 401 Principles of Toxicology (4 credit hours)
Introduce students to the basic principles of toxicology. Will cover the history and scope of the field; absorption, distribution, metabolism and elimination of toxicants; types and mechanisms of toxic action; carcinogenesis; environmental toxicology as well as human and ecological risk assessment.

Prerequisite: CH 220 or CH 221 or CH 225; BIO 181 or ZO 160

Typically offered in Spring only

TOX 515 Environmental Toxicology (4 credit hours)
Evaluation of the nature, distribution and significance of microchemical contamination. Emphasis on current, relevant problems.

Prerequisite: Two years of biology

TOX 595 Special Topics (1-6 credit hours)

TOX 601 Toxicology Seminar (1 credit hours)
Prerequisite: Graduate standing

Typically offered in Fall and Spring
**TOX 620 Special Problems** (1-6 credit hours)
Topics include responsibility in science, environmental fate of chemicals, developmental toxicology, lab rotations, journal club and wildlife toxicology.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

**TOX 660 Free Radicals In Toxicology** (1 credit hours)
Introduction to the field of free radicals and their role in toxicology and health; chemical and physical properties of partially reduced oxygen intermediates and the natural biological defense mechanisms.

Prerequisite: BCH 451 and TOX 710
Typically offered in Spring only

**TOX 688 Non-Thesis Masters Continuous Registration - Half Time Registration** (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Spring only

**TOX 689 Non-Thesis Master Continuous Registration - Full Time Registration** (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Spring only

**TOX 690 Summer Thesis Research** (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

**TOX 699 Master's Thesis Preparation** (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

**TOX 701 Fundamentals of Toxicology** (3 credit hours)
The basis of toxic action at cellular and molecular levels covering the absorption, distribution, elimination and metabolism of toxicants; toxic action (acute toxicity, carcinogenesis, mutagenesis, organ toxicity, etc.); chemical classes of toxicants; and toxicity testing.

Prerequisite: BCH 451, Senior standing or Graduate standing
Typically offered in Fall only

**TOX 704 Chemical Risk Assessment** (1 credit hours)

Prerequisite: TOX 701, a ST course

**TOX 707 Molecular and Biochemical Toxicology** (3 credit hours)
Fundamental understanding of biochemical, molecular and cellular mechanisms through which xenobiotics alter cellular homeostasis, produce toxicity and alter organ function. Current biochemical, molecular and cellular experimental approaches for study of biochemical mechanisms of toxicity.

Prerequisite: BCH 451; TOX 701
Typically offered in Spring only

**TOX 710 Environmental Toxicology** (3 credit hours)
Evaluation of fundamental processes relating fate and effects of chemicals in the environment. Emphasis on effects of pollutants on non-human species, environmental risk assessment and historically relevant incidents of environmental contaminants.

Prerequisite: Two years of biology
Typically offered in Fall only

**TOX 725/CS 725/HS 725/SSC 725 Pesticide Chemistry** (1 credit hours)
Chemical properties of pesticides including hydration and solvation, ionization, volatilization, lipophilicity, molecular structure and size, and reactivity and classification according to chemical description, mode of action or ionizability. Taught during the first 5 weeks of semester. Drop date is last day of 3rd week of the minicourse.

Prerequisite: (CH 201 or CH 203) and (CH 221 or CH 225)
Typically offered in Spring only

**TOX 727/CS 727/HS 727/SSC 727 Pesticide Behavior and Fate in the Environment** (2 credit hours)
Sorption/desorption, soil reactivity, movement, volatilization, bioavailability, degradation and stability of pesticides in the environment. Taught during the last 10 weeks of semester. Drop date is last day of 3rd week of the minicourse.

Prerequisite: CS(HS,SSC,TOX) 725, SSC 200
Typically offered in Spring only
TOX 771/CBS 771 Cancer Biology (4 credit hours)
A comprehensive graduate course focusing on the molecular and cellular bases of cancer. Targets of oncogenic mutations will be discussed as well as their impact on cell proliferation, cell survival, and the invasion of normal tissues by tumorigenic cells. State-of-the-art technologies to detect oncogenic mutations and characterize transformed cells will be discussed as well as therapeutic strategies for the rational treatment of cancer.

Prerequisite: CBS 770
Typically offered in Fall only

TOX 795 Special Topics in Toxicology (1-6 credit hours)
Typically offered in Fall and Spring

TOX 801 Toxicology Seminar (1 credit hours)
Prerequisite: Graduate standing
Typically offered in Fall and Spring

TOX 820 Special Problems In Toxicology (1-6 credit hours)
Topics include responsibility in science, environmental fate of chemicals, developmental toxicology, lab rotations, Journal Club, and wildlife toxicology.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

TOX 860 Free Radicals in Toxicology (1 credit hours)
Introduction to the field of free radicals and their role in toxicology and health; chemical and physical properties of partially reduced oxygen intermediates and the natural biological defense mechanisms.

Prerequisite: BCH 451 and TOX 710
Typically offered in Fall only

TOX 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

TOX 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

TOX 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

TOX 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

TOX 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

U.S. Diversity (USD)

USD 295 U.S. Diversity Special Topics (1-3 credit hours)
Special topics course offering for the general education U.S. Diversity category.

GEP U.S. Diversity
Typically offered in Fall and Spring

University Scholars Program (USP)

USP 110 Humanities and Social Sciences Scholars Forum (0 credit hours)
Interdisciplinary seminar series with presentations by distinguished faculty members and experts drawn from technical, academic, business and government communities. Discussions of major public issues and topics of contemporary concern.

Prerequisite: Enrollment limited to participants in the University Scholars Program
Typically offered in Fall only

USP 111 Humanities and Social Sciences Scholars Forum (0 credit hours)
Interdisciplinary seminar series with presentations by distinguished faculty members and experts drawn from technical, academic, business and government communities. Discussions of major public issues and topics of contemporary concern.

Prerequisite: Enrollment limited to participants in the University Scholars Program
Typically offered in Spring only

USP 201 Great Decisions (1 credit hours)
Discussion and investigation of major issues in contemporary American foreign policy selected annually by the Foreign Policy Association through its Great Decisions Program. Must be participants in the University Scholars Program. Must have completed th

Prerequisite: 3 semesters of USP 110/111; R: RS/CS students
Typically offered in Fall and Spring

USP 204 Readings Inspired By the Scholars Forum (1 credit hours)
Seminar course for upper class University Scholars who have completed three semesters of the Scholars Forum, with readings drawn from upcoming Scholars Forum themes.

Prerequisite: 3 semesters of USP 110/111; R: RS/CS students
Typically offered in Fall and Spring
University Studies Course (USC)

**USC 100 Transition into a Diverse Community** (1 credit hours)
USC 100 is required for all Summer Start students. It is designed to assist freshmen in making an effective transition to the rigors of a large diverse research-focused university. The course is designed to provide students with the support and knowledge needed to address the academic and personal challenges as well as other transitional issues. This course will also help students understand how culture shapes identity. Classroom discussions, small group work, completion of StrengthsQuest, and an introduction to technological and other resources are all vital components of this course. Topics include: diversity, cultural awareness, StrengthsQuest, academic adjustment, college success, social adjustment, campus resources, and health.

**GEP U.S. Diversity**
Typically offered in Summer only

**USC 101 Introduction to University Education I** (1 credit hours)
Developmental and academic topics to assist students as they make well-informed decisions about majors. Topics include: transition issues between high school and college; community and diversity; major and career decision making; assessment of interests, skills, and values; university resources; overview of university majors and minors as well as policies and procedures. Exploratory Studies students only. Student cannot get credit for both USC 101 and USC 103.

**GEP U.S. Diversity**
Typically offered in Fall only

**USC 102 Introduction to University Education II** (1 credit hours)
Continuation of USC 101. Developmental and academic topics to assist students as they make well-informed decisions about majors and careers. Topics include: career readiness, preparation, and exploration; community and diversity; major and career decision making; assessment of interests, skills, and values; university resources; exploration of university majors and minors. Exploratory Studies students only. Credit cannot be received for both USC 102 and USC 104.

Prerequisite: USC 101
Typically offered in Spring only

**USC 103 Introduction to University Education for Varsity Student Athletes I** (1 credit hours)
Introduction to University Education for Varsity Student Athletes I provides success strategies for first year student athletes at North Carolina State University. The course is designed to assist student-athletes with the skills and knowledge needed to meet the academic and personal challenges of university life and the increased responsibilities of adulthood, with special attention to the unique challenges and opportunities of student-athletes. Topics include: goal setting, time management, study skills, critical thinking, interaction with the faculty, NCAA and NCSU continuing eligibility, academic integrity, nutrition, and diversity.

Typically offered in Fall and Spring

**USC 104 Introduction to University Education for Varsity Student Athletes II** (1 credit hours)
Introduction to University Education for Varsity Student-Athletes II will provide student-athletes with the skills necessary to promote informed decision making in choosing an appropriate major and exploring possible careers. Additional areas of career development, academic success, and personal development will also be addressed as they relate to the day-to-day responsibilities and challenges that student-athletes face, as well as a review of NCAA and NCSU continuing eligibility.

Prerequisite: USC 103
Typically offered in Spring only

**USC 107 College Success for the Pre-College Student** (1 credit hour)
USC 107 is designed to assist first-generation pre-college students in making an effective transition to post-secondary education. The course is designed to provide pre-college students with the skills and knowledge needed to address the academic and personal challenges that may impact their progress to degree. Classroom discussions, small group work, guided tours, near-peer mentoring, and access to resources are all vital components of this course. Topics will include campus resources, policies, procedures; study skills; and life management concerns such as health, self-esteem, motivation, goal setting, diversity, and communication. Upon completion, students should be able to function effectively within the college environment to meet their educational goals.

Typically offered in Summer only

**USC 110 Freshman Advancement Seminar** (1 credit hours)
USC 110 provides an opportunity for a diverse student population to explore the question of race and cultural differences in a global society. This course requires that participants actively explore their biases and cultural prejudices for greater enlightenment. This course challenges sources of conventional information such as media outlets, empirical data and prevailing folklore. The course represents an opportunity to have a positive impact on the matriculation and graduation rate of diverse student populations through positive reinforcement, affirmation of cultural heritage and background. Freshman First Year Entering Students Only.

**GEP U.S. Diversity**
Typically offered in Fall only

**USC 111 Strategies for College Success** (1 credit hours)
This course is intended for students who need to improve their academic standing, with enrollment priority given to students readmitted on academic probation. Students will acquire policy and resource knowledge, practical skills, and strategies to improve their academic standing at NC State University. Students will address the academic and personal challenges that may have impacted progress towards their chosen degree. Department Consent Required

Typically offered in Fall, Spring, and Summer
**USC 116 Introduction to Sustainability for EcoVillage** (1 credit hours)
This course serves as an orientation for students participating in the EcoVillage Living-Learning Village and provides an introduction to the topic of “sustainability.” Students have the opportunity to network with their fellow Village residents, campus partners, and guest faculty while performing service learning and during class group activities and discussions. Students will assess their personal definitions, connections to, and impacts on sustainability. This course is required for all first-year EcoVillage residents. This course meets the requirements for the Interdisciplinary Perspectives GEP Category.

Restricted to students participating in the EcoVillage Living-Learning Village

**GEP Interdisciplinary Perspectives**

**Typically offered in Fall and Spring**

**USC 120 SERV- Seminar Education for Military Veterans/Service Members** (1 credit hours)
The USC 120 class will help military veteran/service members transition into the academic environment and campus community. Topics include academic success skills, academic culture, campus resources and student services. Military Veterans (Active and Veteran)

**Typically offered in Fall and Spring**

**USC 202 Career Exploration and Development** (2 credit hours)
This course is intended for students who are considering changing their college major and/or are interested in exploring academic major opportunities. Career exploration and development provides students across campus a focused classroom setting to receive career exploration and academic major decision-making assistance. Students will learn about their personal strengths, values, skills, and personality and understand how these self-assessments will affect their major/career decisions. Students will explore the concept of career resiliency while developing professional skills that will be transferable into any college major.

**Typically offered in Fall and Spring**

**USC 203 Professional Development For Career Ambassadors** (2 credit hours)
The course is for Career Ambassadors only. This course will offer learning opportunities that will provide class members with the knowledge, skills and attitude necessary to become effective Career Ambassadors. The top seven career readiness competencies will be explained. Guest speakers, class discussions, group activities, reflections and out of class team building experiences will be utilized to facilitate learning. Restricted to students who are chosen to be Career Ambassadors after the interview process. (Department Approval Required).

**Typically offered in Fall and Spring**

**USC 210 Introduction to College Tutoring** (1 credit hours)
GPA 3.25 or higher. All enrolled students must be employed as UTC tutors. The purpose of the course is threefold: to introduce tutors to effective tutoring techniques based on educational research, to help tutors implement a variety of tutoring methods depending on the students’ specific needs, and to guide tutors in self-evaluating their individual tutoring progress and goals. Departmental Approval Required.

Prerequisite: Cumulative GPA greater than or equal to 3.25

**Typically offered in Fall, Spring, and Summer**

**USC 220 Leadership and the Resident Mentor** (3 credit hours)
Course will provide the student basic concepts of involvement theory, group development theory and community development relevant to residence hall living as a paraprofessional leader on the campus; the basic principles related to leadership with emphasis on how one develops and leads with their values, beliefs and attitudes and develop skills involving active listening, communication, conflict management and mediation techniques; basic program development and presentation skills; teaching pedagogy; and diversity issues. Some out of classroom activities are required. Departmental approval required.

**Typically offered in Fall only**

**USC 223 NSP Student Leader Development** (2 credit hours)
For New Student Programs Student Leaders only. Relevant research, student development theory, and shared professional experiences are presented. This course will offer learning opportunities that will provide class members with knowledge, attitude, and skills necessary to become effective NSP Student Leaders. Class discussion, small groups activities, simulations, and writing employed. Individual projects and out-of-class team building experiences are required, including Saturday activities. Departmental Approval Required.

**Typically offered in Spring only**

**USC 225 Leadership Development for University Ambassadors** (2 credit hours)
Course provides University Ambassadors with the knowledge, mindset, and skills necessary to effectively represent the University in a variety of settings to a variety of constituents. Course prepares students to emerge as leaders within the Ambassador program and throughout their University experience. Restricted to University Ambassadors only.

Requisite: University Ambassadors Only

**Typically offered in Fall and Spring**

**USC 240 Leadership and Coalition Building in Diverse Communities** (3 credit hours)
Exploration of US diversity and effective leadership practices using the National Coalition Building Institute (NCBI) model. NCBI is an international non-profit leadership development network dedicated to elimination of racism and other forms of oppression. Students will be introduced to the NCBI model which involves significant self-discovery, active listening and dialogue, and participate in activities that establish leadership strategies applied in various contexts. Each practical learning tool is grounded in principles that will be explored through group discussions and reflective journaling. Specific skill training will focus on conflict resolution, creating inclusive environments, strategies for effective listening/communication, personal growth and development. This course is intended for undergraduates, sophomores and above.

Prerequisite: Class Level = Sophomore, Junior, or Senior

**GEP U.S. Diversity**

**Typically offered in Fall and Spring**

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*University Studies Course (USC)*
USC 291 Research as a Profession (2 credit hours)
Broadly defined, research is an interconnected and global process that adds new knowledge, creativity, and innovation to any discipline, from the sciences to the arts to the humanities and in between. During the first half of this course, students will build a foundation of knowledge in the research enterprise including inquiry, research methods, and research governance in a cross-cultural, multi-disciplinary context. Through the use of site-specific case studies, students will analyze past discoveries and innovations that have shaped our current world. This analysis will then become the basis for a research project during the study abroad component of the course. Upon their return, students will learn to synthesize their findings, draw conclusions, and present their research in a cross-disciplinary manner, developing strong oral and written communication skills. To enroll, students must be accepted to the associated study abroad program. All majors are encouraged.

GEP Interdisciplinary Perspectives
Typically offered in Spring and Summer

USC 292 Service Learning Program Leader Development I (1 credit hours)
The purpose of the course is to prepare students for their role as Alternative Service Break Team Leaders. The course will incorporate the larger issues of citizenship, social justice, and positive change and will include the logistics, risk-management, and leadership skills needed when leading a service trip. This course will require students to think critically about their role as a leader. Students will participate in a weekend overnight retreat. Transportation for the retreat will be provided by University Van rental. Expenses for the weekend retreat are covered in the ASB administrative charge paid by participants.

Typically offered in Fall only

USC 293 Service Learning Program Leader Development II (2 credit hours)
The purpose of the course is to prepare students for their role as Alternative Service Break Team Leaders. Part II of the Service Learning Program Leader Development will build upon what students learned in Part I and they will be able to put into prac

Prerequisite: AEE 291
Typically offered in Spring only

USC 298 Special Topics in University Studies (1-6 credit hours)
Special Topics in University Studies at the Undergraduate level for offering of courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

USC 301 Transfer Student Success (1 credit hours)
USC 301 is designed to assist new transfer students in making an effective transition to the rigors of a large research university. The course is designed to provide students with the skills and knowledge needed to address the academic and personal challenges as well as other transitional issues that may impact their progress toward their degree. Classroom discussions, small group work, guided tours, faculty mentors and introduction to resources, services and opportunities are all vital components of this course. Topics include: academic adjustment, social adjustment, campus resources, major and career exploration, policies and procedures, financial aid, and technology. COURSE IS RESTRICTED TO FIRST OR SECOND SEMESTER TRANSFER STUDENTS. Students will not receive credit for both USC 301 and ALS 303 or T 101.

Typically offered in Fall and Spring

USC 401 Transitions for the College Graduate (3 credit hours)
Focus on the unique transitions the student will face upon leaving college. Through a variety of formats, students will have the opportunity to explore several aspects of their post-baccalaureate lives and ways in coping with emerging careers, money management, extracurricular retirement, transitional issues, civic engagement, and continuing education opportunities. Explorations of these areas include specific emphasis on developing and refining interviewing skills, professional and personal networks, financial endeavors, and job application and selection.

Typically offered in Fall and Spring

Veterinary Medicine-Companion Animal & Sp Species (VMC)

VMC 900 Advanced Equine Medicine (1 credit hours)
This course will build upon topics covered in VMC 952 Equine Medicine and Surgery. Lectures will cover equine medical problems in more depth than in the previous course. Additional topics will also be included. This course is designed for students who p

Prerequisite: 3rd year DVM student
Typically offered in Fall only

VMC 901 Advanced Small Animal Medicine (2 credit hours)
This course provides more advanced instruction on medical and surgical diseases of dogs and cats. Pathophysiology, diagnostic evaluation and medical and surgical management of diseases in nephrology, urology, oncology, respiratory medicine, infectious diseases, gastroenterology, cardiology and endocrinology are contained within this course. This advanced content of this course is designed to run alongside the content in VMC 951.

Prerequisite: 3rd year DVM student
Typically offered in Fall only

VMC 902 Small Animal Rounds (1 credit hours)
Course incorporates weekly rounds on actual cases in the NCSU-CVM. Students will practice clinical reasoning, test interpretation and oral and written case presentations in a low stakes, safe environment. Real cases will provide a comprehensive application of the pre-clinical courses. Weekly repetition of these skills will prepare students for clinical practice.

Typically offered in Fall and Spring
VMC 903  Advanced Equine Surgery and Lameness  (1 credit hours)
Course will augment areas noted by the syllabus of core equine surgery and lameness presented in VMC952. In the course surgical alternatives, techniques and outcomes will be presented at a level that a student graduating with an equine or mixed focus could describe and discuss treatments with clients or comfortably function in an internship environment
Prerequisite: 3rd year DVM student
Typically offered in Fall only

VMC 904  Advanced Equine Theriogenology  (1 credit hours)
This course provides more advanced instruction in equine Theriogenology (mare and stallion). Diagnostic evaluation and techniques, with expansion on basic core concepts introduced in previous course content are contained within this course.
Prerequisite: 3rd year DVM student
Typically offered in Spring only

VMC 905  Advanced Topics in Small Animal Dermatology  (1 credit hours)
This course will provide broad understanding of small animal dermatology by building upon the basic foundation principles covered in VMC 951. Students will learn to recognize, diagnose and treat both common and uncommon skin diseases of small animals.

"Corequisite: Enrollment in a 3rd year DVM program"
Typically offered in Spring only

VMC 906  Equine Field Skills Elective  (2 credit hours)
This course will provide practical instruction in commonly used skills and techniques necessary for equine primary care practice. It is an intensive, team taught series of individual laboratories that provide students with experience in the varied skill set required of an equine general practitioner. This course is designed for students that are in the third year of the DVM curriculum, have good horse handling skills and a desire to practice equine veterinary medicine upon graduation. Registration for this course is by instructor permission only.
Prerequisite: 3rd year DVM student
Typically offered in Spring only

VMC 908  Advanced Small Animal Neurology, Ophthalmology, and Orthopedics  (2 credit hours)
This course will provide a more advanced approach to the medical and surgical management of selected metabolic, neoplastic, nutritional, immune mediated, developmental and degenerative diseases and traumatic injury of the ophthalmologic, neurologic, and musculoskeletal systems of small animals. It is a companion course to material given in VMC961. Concurrent enrollment in third year of DVM curriculum.
Typically offered in Spring only

VMC 909  Feline Medicine  (1 credit hours)
This course will equip students for success in feline practice or in small animal or mixed practice with a feline component. The course will address the basic behavioral and nutritional needs of cats, and students will learn how the unique physiology of this species affects feline health and feline disease management.
Prerequisite: 3rd year DVM student
Typically offered in Spring only

VMC 910  Careers in Veterinary Medicine  (1 credit hours)
Specialists and invited speakers from multiple areas of veterinary medicine will present information about career opportunities.
Typically offered in Fall only

VMC 911  Advanced Topics in Equine Medicine and Surgery  (1 credit hours)
The major objectives are to expose students to additional in-depth information related to equine medicine and surgery. This course will build on information covered in equine portions of the veterinary curriculum. Students must have a degree in veterinary medicine, enrollment in the veterinary curriculum, or approval of the course coordinator.
Prerequisite: VMB 921
Typically offered in Spring only

VMC 912  Group Communication in Veterinary Medicine  (1 credit hours)
This course explores how to effectively communicate in small groups in a professional veterinary context. Students will develop verbal and nonverbal communication skills, an understanding of task/process balance, meeting management and facilitation techniques, and communication styles and strategies for dealing with challenging group situations and conflict management. Examples and cases from veterinary medicine will guide application of group communication in context.
Course limited to students enrolled in the DVM curriculum.
Typically offered in Fall only

VMC 914  Ethic Jurispru  (2 credit hours)

VMC 917  Pre Hlth & Mgmt I  (1 credit hours)

VMC 919  Clinical Behavior and Welfare for Dogs and Cats Elective  (1 credit hours)
This is a one-credit course in clinical veterinary behavioral medicine and welfare, with an emphasis on diagnosis and treatment of behavior problems of dogs and cats. The course will build upon the foundation of normal versus abnormal behavior and learning theory of VMC 927. This course will focus on the recognition of common problem behaviors in dogs and cats and how to approach a behavior problem with a systematic Problem Oriented Approach (POVMR). The presentation, proposed etiology and pathogenesis, differential diagnosis, and plan formulation-including diagnostic, treatment, and education plans, will be discussed for common problems. Behavioral medication and complementary products will be included when discussing treatment plans. Additionally, the impact on animal welfare and the human-animal bond will be discussed. Problems to be reviewed include noise aversion, separation anxiety, compulsive disorders, housesoiling, fear and anxiety related problems, problems presenting with aggression, cognitive dysfunction, and some nuisance behaviors.
Typically offered in Fall only

VMC 920  Subtropical Zoology and Medicine in Bermuda  (1 credit hours)
This unique opportunity will allow DVM students to experience a subtropical island and much of its natural history offerings. The internationally renowned Bermuda Institute of Ocean Science (BIOS) will serve as the base of operations where students will be housed, fed, and taught. Lectures, laboratory sessions, and field trips will cover a wide variety of zoological and medical topics.
Requisite: Currently enrolled DVM student
Typically offered in Spring only
VMC 921 Special Topics in Zoological Medicine (1-3 credit hours)
This elective course allows students to participate in customized laboratory and field experiences in zoological medicine (avian, aquatic, reptile, amphibian, invertebrate, and mammalian species). This course is designed to be adapted to the needs of students in the DVM program who desire practical experiences in the discipline. Specific details of individual projects are developed by the course coordinator and participating faculty. This elective course can provide partial fulfillment for elective credit for Zoo Focus Area.
Prerequisite: 1st, 2nd, or 3rd year DVM student
Typically offered in Fall and Spring

VMC 922 Veterinary Acupuncture in China (2 credit hours)
This elective course is a two week international experience in China that will introduce DVM students to Traditional Chinese Veterinary Medicine (TCVM), including acupuncture, moxibustion, and related therapies. The course will include an overview of TCVM history, terminology, theory, and practical applications using equine (horse or donkey) and canine species. In addition, the course will include elective opportunities to meet and interact with Chinese veterinary students, and opportunities to explore the many cultural options available in China.
Prerequisite: VMB 911 and VMB 921; Corequisite: Current enrollment in the DVM program
Typically offered in Spring only

VMC 923 Research in Zoological Health (1-4 credit hours)
This course provides an opportunity to pursue mentored research projects relevant to zoological health while in the DVM curriculum. Projects may be but are not limited to those related to the zoological health focus thesis option.
Restriciton: DVM student status. By Instructor Permission only.
Typically offered in Fall and Spring

VMC 924 Equatorial Zoology and Medicine In Gal pagos (1 credit hours)
This unique opportunity will allow DVM students to experience a unique, equatorial archipelago and much of its natural history offerings. The Gal pagos Science Center (GSC) will serve as the base of operations. Dr. Gregory Lewbart, who has worked at the facility four separate times, will be the local program leader and guide. He will be assisted by local and visiting scientists. Lectures, laboratory sessions, and field trips will cover a wide variety of zoological and medical topics dealing with native invertebrates, fishes, reptiles, birds, and mammals. There will be an emphasis on aquatic species and a paper is required.
Requisite: Currently enrolled DVM student
Typically offered in Spring only

VMC 927 Introduction to Companion Animal Behavior (2 credit hours)
This course explores the behavior of companion animals from a veterinary perspective. An emphasis is placed on behavior as an indicator of welfare and health, humane handling of animals, prevention of behavior problems, and treatment of common behavior problems. In addition the nature of human-animal bond and ethical issues relating to human-animal interactions will be discussed. Students will learn how to diagnose and treat common behavior problems on the basis of video-rich case presentations, lecture material, and class discussion. This course is restricted to students enrolled in the DVM Curriculum.
Doctor of Veterinary Medicine Majors Only
Typically offered in Spring only

VMC 926 Topics in Wild Reptile Medicine (1 credit hours)
The NCSU-CVM Turtle Rescue Team treats sick and injured wild reptiles (mostly turtles) belonging to over a dozen different species. First, second, and third year veterinary students taking this course will be responsible for case management, coordinating consultations, diagnostic testing within the hospital, and placing recuperating animals with local wildlife rehabilitators. Students are also required to attend periodic rounds and attend eight lectures about amphibians and/or reptiles, separate from the core and Selective curriculum.
Typically offered in Spring only

VMC 930 Rehabilitation and Mobility Clinical Rotation (2 credit hours)
In this course, students will gain a general understanding of veterinary rehabilitation therapy, including principles and protocols of assessment and treatment, tissue healing, the theory and application of treatment modalities and the common conditions treated.
Requisite: Currently enrolled DVM student
Typically offered in Fall and Spring

VMC 932 Principles of Surgery (3 credit hours)
This course covers the science, art and craft of surgery, as a foundation for clinical applications. The principles you learn will give you a foundation for performing surgery on all species, even though the examples in this course are centered on the dog and cat.
Prerequisite: 2nd year DVM student
Typically offered in Fall only

VMC 933 Theriogenology (2 credit hours)
The physiology, endocrinology, and pathology of the reproductive system are presented. Emphasis includes genital anatomy and function, endocrine interrelationships, and methods for examination of mammary gland and reproductive tract function, including diagnosis and treatment of clinical disorders.
Prerequisite: Successful completion of the second year of the DVM program
Typically offered in Fall only

VMC 937 Introduction to Physical Examination Skills- Small Animal (1 credit hours)
Introduction to physical examination, laboratory sample collection, and medication administration skills in dogs and cats. Students will also be taught how to understand and use the problem oriented approach for patient management. Students must be enrolled in the Doctor of Veterinary Medicine program. Enrollment in year 2 of Doctor of Veterinary Medicine Program.
Typically offered in Spring only

VMC 947 General Limited Small Animal Practice (2 credit hours)
Will expose clinical year veterinary students to a general small animal veterinary practice. There will be several areas of focus: learning clinical skills relevant to a general veterinary practitioner; developing strong problem solving abilities; developing the strong communication skills necessary to interact effectively with client, colleagues and staff, incorporating and conducting behavioral evaluations of pets during wellness examinations. Enrollment in this course is limited to students in the DVM professional program.
Typically offered in Fall and Spring
VMC 940  Clinical Theriogenology  (2 credit hours)
This course is designed to instruct veterinary students to make clinical diagnoses and problems of the reproduction system of domestic animals. Instruction is provided on medical and surgical correction of clinical reproductive system problems, such as infertility, obstetrical procedures, assisted reproductive techniques, and traumatic injuries. Must be enrolled in fourth year clinical rotations.
Typically offered in Fall and Spring

VMC 941  Special Topics in Theriogenology  (2 credit hours)
The primary objective of this course is to provide additional information and training to veterinary students that have taken the VMP 980 (VMC 940 new course #) clinical theriogenology senior clinical rotation. Emphasis will be directed to acquaint students with modern and current practices of clinical Theriogenology. It is expected that the majority of the information and activities offered in this course will involve equine species (80%) and, to a lesser extent, canine (10%) and bovine species (10%). Requires satisfactory completion of 3rd year of professional program and clinical theriogenology senior rotations.
Typically offered in Fall and Spring

VMC 942  Principles of Medicine  (2 credit hours)
This cross-species course provides an introduction to the principles of disease and injury state common to all species. Content in this course is intended to prepare the students for third year DVM medicine and surgery courses.
Prerequisite: 2nd year DVM student
Typically offered in Spring only

VMC 943  Laboratory Animal and Zoological Species Health and Disease I  (1 credit hours)
Principles of applied biology, management, physical examination, and medical techniques, health problems and medical treatment of laboratory and companion fishes, amphibians, and reptiles will be presented. Laboratory sessions will include handling of live animals, examination of necropsy specimens, and case discussions. Students must be enrolled in the Doctor of Veterinary Medicine program.
P: Admission to professional veterinary program
Typically offered in Spring only

VMC 944  Introduction to Clinical and Professional Communication  (1 credit hours)
The ability to communicate with clients is important to successful veterinary practice. The focus of this course is to explore how to effectively communicate with clients in a clinical context. Students will develop verbal and nonverbal communication skills, an understanding of relationship-centered care, management of client interactions, getting informed consent, and communicating complex information. Examples and cases from veterinary medicine will guide application of clinical communication in context.
Corequisite: Current enrollment in DVM program
Typically offered in Spring only

VMC 946  Extramural Business Management Experience  (2 credit hours)
This course is designed to offer students additional business experience in the veterinary industry. Through partnership with external organizations, students will gain business experience and explore topics such as emerging business, legal, and ethical issues, practice management, human resource management, employment contracts and negotiations, buy and selling veterinary practices, and practice financing. This opportunity will consist of an evolving list of external partners and could include organizations offering practice management consulting, human resource consulting, business consulting, insurance and financing.
Prerequisite: 4th year DVM student
Typically offered in Fall only

VMC 947  Practice Management: Evaluating the workflow, services, and financial performance of a hospital  (2 credit hours)
The Practice Management rotation is designed for students interested in obtaining a deeper understanding of how to manage a successful veterinary practice. This experience will give students the opportunity to apply business principles learned in the classroom to real world practices. Students will use assessment tools provided to analyze veterinary practices and provide constructive feedback to practice owners. Students will be expected to interview practice owners and staff, observe practice flow and patient care, and perform an in depth financial analysis. Students will then prepare a written summary and present their findings and appropriate recommendations to the practice owner(s).
Prerequisite: 4th year DVM student
Typically offered in Fall only

VMC 948  Clinical Rotation in Veterinary Radiation Oncology  (2 credit hours)
This is an elective rotation during the 4th year of CVM professional studies providing an introduction to veterinary radiation oncology. Basic information about radiation therapy equipment, treatment planning and delivery, and outcome of patients treated for various cancers with radiation therapy will be emphasized. Students will be assigned cases being seen by the radiation oncology service as inpatients, outpatients, and new referral appointments.
Prerequisite: VMB 960
Typically offered in Fall and Spring

VMC 949  Equine Primary Care  (4 credit hours)
This 4 week course will provide students with an initial one week of intensive clinical experience in equine primary care and three weeks with a NCSU CVM approved equine primary care practice. Students will be seeing a variety of primary care cases from CVM staff and faculty owned horses, state owned horses, and horses from non-profit organizations during the first week at Southern Pines; including vaccinations, dentistry, lameness, imaging, nasogastric intubation, and field surgery. This course is not an externship and students will have outcome assessments from the instructor as well as the veterinarian at the equine primary care practice. During the final three weeks, students will be exposed to a general equine primary care practice. Students will be expected to examine cases, discuss differentials, provide a treatment plan, perform treatments, and provide client communication. Instructor approval for enrollment required.
Prerequisite: 4th year DVM student
Typically offered in Fall and Spring
VMC 950 Sea Turtle Medicine and Rehabilitation (2 credit hours)
This course provides practical experience in husbandry and disease diagnosis and treatment in rehabilitating sea turtles at the Karen Beasley Sea Turtle Rescue and Rehabilitation Center (KBSRRC) in Topsail Beach, NC. Skills to be acquired in clinical and didactic setting include sea turtle husbandry and rehabilitation techniques, diagnostic sample collection and interpretation, physical examination and safe handling, medication delivery, wound treatment, and necropsy protocols.
Prerequisite: 4th year DVM student
Typically offered in Fall only

VMC 951 Companion Animal Medicine and Surgery I (4 credit hours)
Overview of medical and surgical management of selective metabolic, neoplastic, nutritional, immune-mediated, developmental and degenerative diseases of companion animals.
Prerequisite: Successful completion of the 2nd year of the professional curriculum
Typically offered in Fall only

VMC 952 Equine Medicine and Surgery (3 credit hours)
Medical conditions in large domesticated animals are presented in this course. Discussions involve the agents causing diseases and the therapeutic methods used to correct. 3 semester hours.
Typically offered in Fall only

VMC 953 Laboratory Animal and Zoological Species Health and Disease II (3 credit hours)
Principles of applied biology, management, physical examination and medical techniques, health problems and medical treatment of laboratory animals, small companion mammals and zoological species will be presented. Laboratory sessions may include handling of live animals, examination of necropsy specimens, and case discussions. Laboratory Animal and Zoological Species Health and Disease II will focus on avian and mammalian species. Students must be enrolled in the Doctor of Veterinary Medicine program.
Typically offered in Fall only

VMC 954 Companion Animal Medicine for Food Animal Students (2 credit hours)
Small animal medicine clinical rotation emphasizing the disciplined detection, prioritizing and planning for therapy of medical diseases in small companion animals. Development of medical judgment and the use of the problem oriented medical record is stressed. This course is intended for DVM students in the food animal focus area.
Prerequisite: Senior DVM student
Typically offered in Fall and Spring

VMC 955 Extramural Experiences in Lab An Med (2 credit hours)
DVM students will have the opportunity to undertake a two-week rotation in an approved laboratory animal facility under the supervision of a laboratory animal veterinarian. This opportunity will meet the need to increase "hands-on" experience as part of the curriculum.
Corequisite: Current enrollment in DVM program.
Typically offered in Fall and Spring

VMC 956 Advanced Clinical and Professional Communication (1 credit hours)
The ability to communicate with clients is important to successful veterinary practice. This course explores how to effectively communicate with clients in both clinical and non-clinical settings. The course will develop verbal and nonverbal communication skills and an understanding of how to manage difficult client interactions, including communicating about money, communicating during adverse events, and communicating during euthanasia. Examples and cases from veterinary medicine and simulated client interactions will guide application of clinical communication in context.
Prerequisite: 3rd year DVM student
Typically offered in Fall only

VMC 957 Introduction to Clinical Practice (1 credit hour)
This course has 4 components: a surgery laboratory, a clinical skills laboratory, a communication and wellness case-based facilitated session and community-based experiences. Taken together, these experiences are designed to give students practice and confidence in skills related to small animal general practice.
Typically offered in Fall only

VMC 958 Advanced Prosimian Medicine (2 credit hours)
This course is designed to provide senior veterinary students with clinical experience in prosimian medicine. Students will gain practical experience in the diagnosis, treatment, and prevention of disease in captive prosimians maintained in research facilities. Students participate in formal rounds, autodidactic exercises, and case management at the Duke Lemur Center. Limited to 4th Year DVM curriculum students. Additional travel is required.
Prerequisite: VMC 991, restricted to 4th year DVM students
Typically offered in Fall and Spring

VMC 959 Advanced Primate Medicine (2-4 credit hours)
The delivery of health care and management to captive and free-ranging primates is a component of zoological, wildlife, and laboratory animal medicine. There is a distinct body of information and techniques for the practice and an increasing demand and opportunity for veterinary graduates with this knowledge. Practical application of techniques and methods for diagnosing disease, delivering health care, and devising preventative medical programs in a research primate facility environment will enable students to evaluate their potential role in the field and equip them to evaluate and responsibly deal with medical issues involving primates.
Typically offered in Fall only

VMC 960 Small Animal Emergency Service (2 credit hours)
Assessment, triage, and management of canine and feline patients admitted to the small animal emergency service after hours.
Prerequisite: fourth year clinics student, DVM student
Typically offered in Fall and Spring

VMC 961 Companion Animal Medicine and Surgery II (3 credit hours)
This course is an overview of medical and surgical management of selected metabolic, neoplastic, nutritional, immune-mediated, developmental, and degenerative diseases of companion animals.
Requisite: Currently enrolled DVM student
Typically offered in Spring only
VMC 963 Extramural Experience in Zoological Medicine (2 credit hours)
This elective senior year rotation allows students to obtain clinical, laboratory, field, and research experiences in zoological medicine that augment the basic rotations in the zoological medicine focus area. Students can customize their training through participation in a variety of opportunities including epidemiology projects, other basic or clinical research projects, and externships involving captive and free-ranging wildlife & zoo species. does not fulfill senior year requirement for elective credit in Zoo Focus Area

Requisite: Currently enrolled DVM student
Typically offered in Fall and Spring

VMC 964 Zoological Husbandry and Nutrition (2 credit hours)
This course is designed to provide senior veterinary students with husbandry and background experience in a zoo setting as a foundation for health management. Students will gain practical experience in the husbandry and nutrition of zoo animals while learning the importance of prevention of disease in captive wildlife. Students participate in formal rounds, autodidactic exercises, and hands on animal care delivery.

Requisite: Successful completion of 3 Zoological Medicine Selectives or course coordinator permission
Typically offered in Fall and Spring

VMC 965 Advanced Principles of Surgery (1 credit hours)
This laboratory includes induction and maintenance of anesthesia in representative companion animal, food animal, and equine species; the practice of surgery on anesthetized animals and cadaver specimens; and experience with diagnostic and therapeutic techniques. Students examine, assess, and provide preoperative, intraoperative, and postoperative management of their patients.

Requisite: DVM student, Completion of fall semester, VM3 students
Typically offered in Spring only

VMC 966 Equine Emergency and Critical Care (2 credit hours)
An intensive course in the assessment and management of equine emergencies. This would include evaluation of patients, surgical and medical treatment of in house and emergency critical care patients, and post-operative assessment and management. Students will gain valuable practical experience of critically ill patients and rounds will be held daily to ensure a high level of learning.

Requisite: 4th year DVM student, Third year veterinary curriculum
Typically offered in Fall and Spring

VMC 967 Clinical Veterinary Dentistry (2 credit hours)
Will participate in examination, admission, diagnosis treatment, discharge, and follow-up of patients in dentistry service. Take a clinical history, perform a physical examination, develop appropriate diagnostic plan, discuss the plan with the service's clinicians, and participate in formulation of treatment protocol. Service treats patients Monday-Thursday. Friday reserved for overflow, emergencies, research and teaching. Students given prepared lectures on dental procedures and diseases, and will be allowed to perform supervised procedures on cadavers. (No animals euthanized for this purpose.)

Typically offered in Fall and Spring

VMC 968 Equine Orthopedic Surgery and Lameness (2 credit hours)
Application of problem solving skills and the art, science, and practice of equine orthopedic surgery and lameness in the veterinary teaching hospital setting.

Prerequisite: DVM student, Completion of 3rd year veterinary curriculum
Typically offered in Fall and Spring

VMC 969 Equine Podiatry (2 credit hours)
Two-week clinical block in equine podiatry clinic Tuesday, Wednesday, and Thursday, with guided independent clinically applied study Monday and Friday.

Prerequisite: 4th yr. standing in the veterinary curriculum at the CVM, Successful completion of 3rd yr. of Veterinary Curriculum
Typically offered in Fall and Spring

VMC 970 Companion Animal and Special Species (2 credit hours)
Students on this rotation will have the opportunity for more direct animal experience than they have previously had. They will be exposed to the needs of shelter animals and the care of large populations of dogs and cats. The mobile unit will be used for the provision of off-site medical and surgical care, but will be staffed with student volunteers. The Wake County Animal Shelter is serving as the intake facility for all relinquished animals in Wake County.

Prerequisite: Fourth year student in the professional curriculum at The College of Veterinary Medicine
Typically offered in Fall, Spring, and Summer

VMC 971 Comp Animal Med II (4 credit hours)
1. Obtain a thorough history and perform a complete physical examination. 2. Identifying, defining, and prioritizing problems. 3. Developing and initiating rational diagnostic and therapeutic plans. 4. Performing certain diagnostic and therapeutic procedures. 5. Interpreting results of diagnostic tests, and determining their importance to the patient. 6. Verbal and written communication with clinicians, clients, veterinary techniques, fellow student veterinarians, and referring veterinarians. 7. Determining the point at which it is time to refer a case to a colleague for "another look", or to a referral center for specialized diagnostic testing or treatment. 8. Understanding how cases management in private practice compares with referral practice. 9. Approaching issues regarding euthanasia; your decision-making, assisting the owner.

Typically offered in Fall and Spring

VMC 972 Clinical Small Animal Veterinary Cardiology (2 credit hours)
Two-week clinical rotation to provide senior veterinary student training in diagnostic and therapeutic aspects of veterinary small animal cardiology. Clinical experience with patients and clients of Veterinary Teaching Hospital and topic and case review

Prerequisite: 4th yr. standing in the veterinary curriculum at the CVM, Successful completion of 3rd yr. of Veterinary Curriculum
Typically offered in Fall and Spring
VMC 973  Small Animal Surgery  (2 credit hours)
Clinical rotation on the small animal surgery services. Students will be assigned to one of two services, general surgery or orthopedic surgery. Students see cases and assist with care of small animal surgical patients. Students will be on-call to assist with emergency surgery cases.
Prerequisite: Completion of third year veterinary curriculum
Typically offered in Fall, Spring, and Summer

VMC 974  Equine Dentistry and Podiatry  (2 credit hours)
This course will provide practical instruction in commonly used skills and techniques necessary for equine dentistry and equine podiatry. It is an intensive, team taught series of didactic lectures, individual laboratories, and clinical case experiences with practitioners that provide students with a high level of experience in equine dentistry and equine podiatry. This course is designed for students in the fourth year of the DVM curriculum, with good horse handling skills and a desire to practice equine veterinary medicine upon graduation. This course is strongly recommended for students with an equine focus or mixed animal focus with an equine concentration. Students must have basic equine handling experience and/or have taken the Equine Behavior Selective. Equine, mixed animal, food animal, and exotics focus students will be given preference.
Typically offered in Fall and Spring

VMC 975  Equine General Surgery  (2 credit hours)
Application of problem solving skills and the art, science, and practice of equine general surgery in the veterinary teaching hospital setting.
Prerequisite: DVM student, Completion of 3rd year veterinary curriculum
Typically offered in Fall and Spring

VMC 976  Veterinary Critical Care  (2 credit hours)
Assessment and management of companion animal emergency and critical care patients, including several 'hands on' laboratories using cadavers to learn and practice emergency and critical care techniques. Principles of emergency and critical patient evaluation, stabilization, and organ system support are the focus of the course. Out-rotations at area emergency clinics are required. Open only to 4th year students in the small animal focus area.
Prerequisite: 4th year DVM student
Typically offered in Spring only

VMC 977  Equine Preventative Health Care  (2 credit hours)
Perform routine preventative health care procedures for the horse in a field setting.
Prerequisite: Completion of 3rd year in veterinary curriculum
Typically offered in Fall, Spring, and Summer

VMC 978  Equine Lameness and Imaging  (2 credit hours)
Development and use of problem solving skills and techniques for diagnosis, treatment, and management of lameness in horses.
Prerequisite: DVM student, Completion of the third year of the veterinary curriculum
Typically offered in Spring only

VMC 979  Equine Medicine  (2 credit hours)
Students are responsible for all aspects of patient care and are expected to be dedicated to their patients. Frequent and careful observation of the patients, attention to detail, diligent record keeping, accuracy in formulating and carrying out a treatment plan, and use of common sense are expected. The earlier you note potential problems, the earlier and easier they can be resolved. Irresponsibility, carelessness, lack of accuracy, untruthfulness, or a poor attitude will not be tolerated.
Typically offered in Fall and Spring

VMC 980  Vet Clini Oncology  (2 credit hours)
This is a two-week, two credit elective rotation during the 4th year of CVM professional studies providing experience in the diagnosis and treatment of cancer in animals. Emphasis is on development of comprehensive cancer management strategies including ethical considerations, diagnostic techniques, treatment options, and client communication skills. Students will be assigned cases being seen by the oncology service as inpatients, outpatients, and new referral appointments.
Typically offered in Fall and Spring

VMC 981  Lab Animal Medicine  (2 credit hours)
The block will provide practical experience in the diagnosis, treatment and prevention of diseases of laboratory animals. It will include special study of diseases of laboratory animals and the management of laboratory animal facilities. Opportunity to perform surgical procedures on common laboratory animals will be provided in a series of surgical labs. There will be field trips to other laboratory animal resource facilities within the Research Triangle Park and surrounding areas. The student will present a seminar on a selected topic for critical appraisal by students and faculty.
Typically offered in Fall and Spring

VMC 982  Ophthalmology  (2 credit hours)
The purpose of the ophthalmology course is to acquaint the student with examinations, diagnostics and therapeutic practices, and principles of clinical veterinary medicine. There will be direct supervision by faculty and house officers. Attendances required at weekly clinical rounds, general medicine rounds, and the patient rounds and mini-seminars conducted within the service. Irregular and/or long hours may be required. Students will be expected to be neatly dressed, well groomed, and conduct themselves in a professional manner at all times.
VMC 983 Dermatology (2 credit hours)
Dermatological disease will represent a significant proportion of your case load, particularly in companion animal practice. Most of the patients that you will see have chronic relapsing disease that can be frustrating, and often costly for the owner. Therefore, whilst an accurate diagnosis represents the first step in dealing with a case, the challenge in this field of medicine is to successfully manage cases in the long term. This requires good and open communication with the client as well as regular patient evaluation. Most of the diagnostic techniques employed in dermatology are very simple and do not require expensive equipment or excessive amounts of time. The key to successful dermatological practice is to use these tools appropriately to recognize conditions such as parasitic infestations and bacterial or yeast infections for which there is a specific course of treatment. It specializes in the diagnosis and management of chronic ear disease and immunological dermatoses such as autoimmune skin diseases, food reactions and atopic dermatitis. The good practitioner however, recognizes that cutaneous manifestations may be a reflection of internal disease and a thorough systemic evaluation is also required. When studying the skin there is one big advantage, it is on the outside.

Typically offered in Fall and Spring

VMC 984 Intro Clin Neuro (2 credit hours)
This service provides diagnosis and management of nervous system disorders in animals, including nuclear imaging, myelography, CT scans, electromyography, neurosurgery, and postoperative patient rehabilitation including hydrotherapy and treadmill training. Attendance is required at weekly clinical rounds, general medicine rounds, and the patient rounds and mini-seminars conducted within the service. Irregular and/or long hours may be required. Students will be expected to be neatly dressed, well groomed, and conduct themselves in a professional manner at all times.

Typically offered in Fall and Spring

VMC 985 Avian and Reptile Medicine (2 credit hours)
The medicine of companion and wild birds and reptiles (turtles, lizards & snakes) will be taught using clinical cases in the Veterinary Teaching Hospital and field service visits to avicultural and herpetological collections. Emphasis will be on proper restraint and handling, physical examination, diagnostic sample collection and routine treatment procedures. A problem orientated approach will be used for all clinical cases.

Prerequisite: 4th year standing in the veterinary curriculum at the CVM, VMC 953, VMF 964
Typically offered in Fall, Spring, and Summer

VMC 986 Adv Com An Int Med (2 credit hours)
This course provides a higher level experience to diagnosis and management of companion animals with complex medical problems. Students may choose to concentrate on particular aspects of internal medicine. Students are not required to participate in e

Typically offered in Fall and Spring

VMC 987 Aquatic Medicine (2 credit hours)
This course is designed as an elective clinical block rotation in field services, in the final year of the professional DVM curriculum. Students electing the course would have successfully completed the two theoretical/laboratory courses in special species medicine providing the foundation for participation in this course. It is the only clinical course offering hands on experience with medical care delivery to aquatic species.

Typically offered in Fall and Spring

VMC 988 Exotic Animal Medicine (2 credit hours)
This clinical rotation provides practical experience in the diagnosis, treatment and prevention of disease in privately owned small mammals, birds, reptiles, fish, and amphibians. In addition to assisting with the management of clinical cases, students will participate in daily teaching rounds, laboratory activities to increase their technical proficiency, and field visits to various exotic animal collections in NC. Presentation of a short seminar on a clinically relevant topic is required. Irregular and/or long hours, including on-call duty for after-hours emergencies, may be required.

Typically offered in Fall and Spring

VMC 989 Zoological Medicine (4 credit hours)
This course is designed to introduce the senior veterinary students to clinical zoological medicine. Students will gain practical experience in the diagnosis, treatment, and prevention of disease in captive zoological specimens maintained in zoos. Students participate in formal rounds, autodidactic exercises, and case management at the N.C. Zoological Park.

Prerequisite: VMC 964 or successful completion of 3 Zoological Medicine Focus Selectives; and Course Coordinator’s Permission
Typically offered in Fall and Spring

VMC 990 Musculoskeletal Ultrasound in the Horse (2 credit hours)
Develop and use problem solving skills during management of clinical cases incorporating diagnostic ultrasound in a number of different clinical situations. Physics of ultrasound and the resultant sound beam-tissue interactions, mainly musculoskeletal diagnostic ultrasound.

Prerequisite: VMC 975
Typically offered in Spring only

VMC 991 SP Top in DOCS (1 credit hours)
One week special topic course in the Department of Clinical Sciences
Corequisite: Current enrollment in DVM program

VMC 992 SP Top in DOCS (1-4 credit hours)
Two week special topic course in the Department of Clinical Sciences.

VMC 993 Equine Special Topics (2 credit hours)
This course is offered to students that have already signed up to take any two of the following courses: Preventative Health Care, Equine Medicine, Equine Surgery, or Equine Theriogenology. The course is designed to give additional experience in equine-oriented clinical services at NCSU. Students will not be able to participate in this block off campus, unless working directly with a NCSU faculty member. A faculty mentor must be identified within one month of signing up for this course and a written proposal of activities planned submitted to Dr. Gardner.

Typically offered in Fall and Spring
VMC 994  Small Animal 4th Year Extramural Studies  (1-6 credit hours)
This course is a recommended rotation designed to expand opportunities for senior veterinary students to participate in small animal private practice a) enhance and learn clinical and technical skills, b) develop effective client communication skills and time management, and c) observe elements of small business management, including personnel involved and professional financial interactions with private clients. Students will work at a private or corporate veterinary practice under the direct supervision of a licensed veterinarian engaged in small animal practice. Must be senior student in the DVM program.

Typically offered in Fall and Spring

VMC 995  Clinical Conference  (1 credit hours)
This weekly seminar course will incorporate a range of topics relevant to success in the clinical year and beyond, including preparation for the NAVLE exam, integration of themes and topics presented elsewhere in the DVM curriculum, job search strategies, employment contracts, financial literacy and loan repayment, critical reflection, and others. The course calendar is based on relevant topics to members of the senior class as they pass through the academic year. Topics will be addressed in an interactive and discussion-based manner and will be selected with input from the student body.

Restriction: Active DVM student in year 4 of the curriculum (successful completion of years 1-3)

Typically offered in Fall, Spring, and Summer

VMC 996  Advanced Avian Clinical Medicine  (2 credit hours)
Students will work with teaching birds to develop skills in avian handling, diagnostic sample collection, anesthesia and radiology. Cadavers will be used to teach orthopedic and soft tissue surgical procedures. Students and faculty will spend approximately 5 days in the field, working with psittacine birds, waterfowl and raptors at Sylvan Heights Waterfowl park in Scotland Neck, NC and at the Carlina Raptor Center in Charlotte, NC. Restricted to senior DVM students.

P: VMC 988

Typically offered in Fall and Spring

VMC 997  Raptor Medicine and Rehabilitation  (2 credit hours)
This elective senior year rotation allows students to obtain clinical experience in raptor medicine and rehabilitation at Carolina Raptor Center in Charlotte, N.C. Students will develop skills with species identification, capture and handling, physical examination, bandaging, diagnostic sample collection and interpretation, emergency stabilization and treatment techniques, necropsy, anesthesia and surgery assistance, and captive management and husbandry issues. A maximum of 2 students will be permitted in each 2-week clinical rotation. For students enrolled in DVM Curriculum. Will partially fulfill senior year requirement for elective clinical rotation credit in Zoo Focus Area.

Typically offered in Fall and Spring

VMC 998  Basic Wildlife Rehabilitation Medicine  (2 credit hours)
Wildlife rehabilitation medicine, the delivery of health care and management to free-ranging native wildlife with the goal of re-release is an important component of clinical veterinary medicine. Students in this basic course will work with instructors to learn to apply practical medical and surgical techniques and methods for diagnosing disease, delivering health care, and implementing appropriate triage for injured and ill North Carolina native wildlife. Restricted to DVM Curriculum 4th year students.

Prerequisite: VMC 964 or successful completion of 3 Zoological Medicine Focus Selectives, VMC 989, and Course Coordinator's Permission

Typically offered in Fall and Spring

VMC 999  Advanced Wildlife Rehabilitation Medicine  (2 credit hours)
Wildlife rehabilitation medicine, the delivery of health care and management to free-ranging native wildlife with the goal of re-release is an important component of clinical veterinary medicine. Students in this advanced course will apply practical medical and surgical techniques and methods learned in the basic course for diagnosing disease, delivering health care, and implementing appropriate triage for injured and ill North Carolina native wildlife. They will assist staff and faculty in managing cases native to North Carolina.

Prerequisite: VMC 964 or VMC 998

Typically offered in Fall and Spring

Veterinary Science - VMB (VMB)

VMB 900  Veterinary Pain: Physiology and Clinical Problem Solving  (1 credit hours)
Course will review the neuroscience and physiology of pain with emphasis on veterinary species. The course will also cover clinical treatment options and ethical discussions.

Typically offered in Fall only

VMB 901  Molecular Medicine  (1 credit hours)
This elective is designed for all DVM students to augment their training in clinical and basic sciences. Modern medicine is making increasing use of molecular approaches for advancing diagnostic and prognostic modalities, and for developing more effective therapeutic strategies for cancer, metabolic disorders and infectious diseases. This class will outline the concepts underlying current and emerging technologies in molecular medicine, and investigate their utility in a clinical setting. The goal is to equip students with a basic understanding of the appropriate and effective use of molecular strategies, whether directly for patient care, or within academic, industry or government research.

Typically offered in Spring only

VMB 909  Case Based Radiographic Interpretation  (1 credit hours)
Using an entirely case based approach, disorders that are commonly diagnosed radiographically in both small and large animals will be discussed. The emphasis will be on radiographic interpretation. Important concepts in radiographic interpretation and how imaging can affect patient management will be discussed.

"Corequisite: Concurrent enrollment in third year of DVM curriculum"

Typically offered in Spring only
VMB 911 Veterinary Anatomy I (5 credit hours)
Gross anatomy of the dog and cat. Neuroanatomy of the dog and cat. Dissection of embalmed (dog/cat) cadavers, study of prosections, slides, models, and imaging modalities.

P: Admission to professional veterinary program
Typically offered in Fall only

VMB 912 Introduction to Clinical Problem Solving in Veterinary Practice (2 credit hours)
A combination of lectures and in-class activities will be used to explore the clinical reasoning process and steps used in “working up” a veterinary clinical case. Specific topics include: patient signalment, chief complaint, history, physical exam, problem list, differential diagnosis. Also covered: introductory clinical skills, medical records (SOAP). Course limited to students enrolled in the DVM curriculum.

Requisite: Currently enrolled DVM student
Typically offered in Fall only

VMB 913 Veterinary Physiology I (4 credit hours)
A course in comparative physiology with special attention to domestic mammalian and avian species. Emphasis is placed on cellular and metabolic physiology and the physiology of the nervous and cardiovascular systems.

P: Admission to professional veterinary program
Typically offered in Fall only

VMB 914 Histology and Cytology (2 credit hours)
This course focuses on the study of cells, basic tissues, and selected organs of domestic animals. The primary emphasis is on the molecular and structural basis for cell function, tissue organization, and organ systems.

P: Admission to professional veterinary program
Typically offered in Fall only

VMB 920 Small Group Problem Solving in Veterinary Medicine (1 credit hours)
Students will work in small groups with a faculty facilitator to examine case scenarios, and apply the problem-solving process discussed in VMB 912 to a variety of clinical and research problems. This course will provide a venue for integration of content presented in other courses, as well as application of small-group communication skills. Course limited to students enrolled in the DVM curriculum.

Typically offered in Spring only

VMB 921 Veterinary Comparative Anatomy (4 credit hours)
Gross anatomy of domestic ungulates (horse, ox, goat, pig). Involves dissection of embalmed specimens and study of prosections, models, and radiographs.

Typically offered in Spring only

VMB 922 Veterinary Physiology II (4 credit hours)
A continuation course in comparative physiology with special attention to domestic and avian species. Emphasis is placed upon water and electrolyte metabolism and the physiology of respiratory, renal, gastrointestinal, endocrine, and reproductive systems.

Typically offered in Spring only

VMB 923 Veterinary Physiology II (4 credit hours)
A continuation course in comparative physiology with special attention to domestic and avian species. Emphasis is placed upon water and electrolyte metabolism and the physiology of respiratory, renal, gastrointestinal, endocrine, and reproductive systems.

Typically offered in Spring only

VMB 930 Anesthesiology (2 credit hours)
Anesthetic principles, agents, and techniques of mammalian, avian, and rodent species.

Typically offered in Fall only

VMB 931 Veterinary Ethics and Animal Welfare (2 credit hours)
This course will explore the major ethical issues confronting the practices of veterinary medicine, biomedical science, and animal welfare. Students will become familiar with legal and institutional positions, consider and debate opposing arguments on the various topics, and examine relevant case studies. Provides the basic leadership and operational training necessary to become a Certified Responder for the State of North Carolina. Limited to DVM students or by permission of instructor.

Requisite: Currently enrolled DVM student
Typically offered in Fall only

VMB 932 Veterinary Medical Decision Making (1 credit hours)
A combination of lectures and Moodle activities will be used to explore the medical decision-making process in veterinary medicine and error prevention strategies. Main course themes are errors in: knowledge acquisition, data gathering, data processing and metacognition. Discussion of generation, refinement and testing of diagnostic hypotheses. Course limited to students enrolled in the DVM curriculum.

Typically offered in Fall only

VMB 933 Veterinary Pharmacology I (3 credit hours)
This course focuses on the action of drugs in animals and basic principles of drug disposition and pharmacokinetics. The course will provide presentations on the principles of pharmacology of medications used in animals. Principles of autonomic pharmacology will form a foundation that is important to other drug groups. Important drug groups discussed during the course will be sympathomimetic and parasympathetic agonists and antagonists, anesthetic, sedative, and tranquilizer drugs. During the chemotherapy portion of the course, anti-infective agent chemotherapy will be discussed, which includes antibacterial, antiparasitic, antifungal, and antiviral drugs. Anticancer agents also will be considered in the chemotherapy portion of the course.

Restriction: Acceptance and good standing in a veterinary professional curriculum.
Typically offered in Fall only

VMB 936 Introduction to Radiology (1 credit hours)
This course describes and explains the principles of physics of diagnostic radiology and ultrasound, and the basics of image interpretation. Principles of thoracic radiography and radiographic anatomy will be covered. Radiographic interpretation of the cardiovascular system, lungs and airways, and pleural space will be discussed and related to the physiology of the different organ systems. Principles of abdominal radiography and radiographic anatomy will be covered as well and the concepts of peritoneal detail, abdominal mass effect and intestinal ileus will be introduced.

Typically offered in Fall only
VMB 943 Veterinary Pharmacology II (3 credit hours)
A course in veterinary pharmacology with emphasis on the pharmacology of drugs affecting various body systems including digestive, endocrine, ocular, respiratory, central nervous, cardiovascular, or musculoskeletal. Drugs that produce analgesic and anti-inflammatory properties also are included.

Corequisite: Current enrollment in DVM program
Typically offered in Spring only

VMB 944 Veterinary Toxicology and Poisonous Plants (2 credit hours)
Toxicological basis and pathological features of diseases of animals and birds caused by common toxic chemicals and plants with emphasis on clinical manifestations, diagnosis, prevention, and treatment.

Corequisite: Current enrollment in DVM program
Typically offered in Spring only

VMB 952 Specialized Problem Solving in Veterinary Medicine (1 credit hours)
Specialized Problem-Solving is the fourth in a series of courses focusing on Clinical Reasoning and Problem Solving. In this class, you will build upon the skills developed in earlier courses, and work to diagnose, treat and trouble-shoot more complex cases. These cases may have external constraints that will limit your ability to order diagnostic tests, and/or may require identification and correction of medical errors. You will work in unsupervised teams, and then present the results of your decision-making processes to a facilitator for discussion, review and critique.
Course limited to students enrolled in the DVM curriculum.

Typically offered in Spring only

VMB 960 Veterinary Radiology and Radiobiology (2 credit hours)
Fundamentals of radiographic diagnosis. The VMB 960 course is focused on the diagnostic imaging appearance of small and large animal thoracic, abdominal, musculoskeletal and neurologic disease. The main imaging modality that will be covered is diagnostic radiology and some diagnostic ultrasound but Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) will be introduced as well. The principles of image interpretation will be revisited and the imaging appearance of important and common diseases will be presented and discussed. Case examples will be shown and students may be asked to provide case interpretation in class.

Requisite: Currently enrolled DVM student
Typically offered in Spring and Summer

VMB 961 Success in the Clinics and Beyond (1 credit hours)
This course provides an opportunity for students to integrate and synthesize professional skills in preparation for clinical rotations and veterinary practice. An introduction to the current VH electronic medical record system will be provided. Students will apply their knowledge of clinical communication, teamwork, clinical reasoning, and ethics to a variety of case scenarios.

Typically offered in Spring only

VMB 962 Clinician Scientist Research Experience (1-10 credit hours)
This course is designed to give students an opportunity to take part in research in the laboratory of their chosen mentor(s), resulting in a greater understanding of the research process. Students will be specifically required to complete at least three 2-week blocks, and to have at least two of these blocks scheduled consecutively (i.e., a 1-month time period in the laboratory). This course is restricted to students enrolled in the Clinician Scientist Focus Area of the DVM curriculum and requires approval by the student's CSFA mentor.

Prerequisite: All freshman-junior DVM courses allowing the student to enroll in senior DVM courses.
Typically offered in Fall and Spring

VMB 965 Veterinary Nutritional Health (2 credit hours)
The role of nutrition in veterinary medicine. Development, diagnosis and prevention of nutritional problems in a variety of species will be discussed, frequently employing a comparative approach.

Typically offered in Spring only

VMB 975 Radiology (2 credit hours)

VMB 976 Radiology Rotation (2 credit hours)
This rotation will provide practical training in the production of quality radiographic examinations and will help develop interpretation skills in diagnostic radiology. Students are expected to be familiar with material covered in the junior radiology course (VMB 960) as it will be incorporated into this rotation. Review of the auto-tutorial teaching cases, located in the “Star Wars” room. The radiology rotation is oriented toward teaching and service. Learning experiences result from a combination of direct contact with the faculty, residents, technicians, and classmates. You will make diagnostic quality radiographs, participate in morning rounds and review didactic material, VMB 960 teaching files and ask questions.

VMB 977 Clinical Anesthesia Rotation (2 credit hours)
Students engage in the daily clinical service responsibilities of the CVM-VTH Anesthesia Section in the role of anesthetists assigned to the care of client-owned animals. The objective of this clinical course is to enable each student to achieve their maximum potential as neophyte anesthetists having limited experience. Student activities are supervised and conducted by CVM faculty anesthesiologists, and VTH staff anesthesia technicians. Supporting activities related to delivering clinical service include attending clinical rounds and case discussions, and oral presentation of a critical review of a recently published research paper relevant to anesthesia and it's supporting basic sciences.

Typically offered in Fall and Spring

VMB 978 Clinical Behavior & Nutrition (2 credit hours)
This 4th year clinical rotation will provide interested students with the opportunity to gain experience in both behavior and nutrition. During the week spent at the Animal Behavior Service, students will participate in the diagnosis and treatment of behavior problems in companion animals. During the week spent at the Nutrition Service, students will develop and initiate Nutrition Support plans for hospitalized and health companion animals. Relevant nutrition support skills will be practiced. This course is restricted to students in the DVM curriculum.

Prerequisite: VMC 927 or equivalent, DVM Curriculum Student Status
Typically offered in Fall and Spring
VMB 991 SP Top in MBS (1-2 credit hours)
One week special topic course in the Department of Molecular Biomedical Sciences.

VMB 992 SP Top in MBS (2 credit hours)
Two week special topic course in the Department of Molecular Biomedical Sciences.

Veterinary Science - VMP (VMP)

VMP 162/PO 162 Livestock and Poultry Disease Management (3 credit hours)
Basic principles of disease and disease management in livestock and poultry. Disease prevention through sanitation and vaccination. Diseases of horses, pigs, ruminants, poultry, and disease prevention programs for each species.

Requisite: Agricultural Institute Only

VMP 401 Poultry Diseases (4 credit hours)
Concepts of factors contributing to or causing disease, disease cycle, host responses, and general approaches to prevention and control including management and biosecurity methods, immunization, and medication. Recognition, diagnosis, prevention, control, and treatment of economically significant infectious and noninfectious diseases affecting poultry.

Typically offered in Spring only

VMP 420 Disease of Farm Animals (3 credit hours)
Pathology of bacterial, viral, parasitic, nutritional, thermal and mechanical disease processes for farm animals. This emphasis practices for prevention and control of each disease.

Prerequisite: Junior standing.

Typically offered in Spring only

VMP 900 Global Health Research Project (5 credit hours)
This international elective (Global Health Research Project) will allow students to develop an understanding of methodological approaches and techniques used in global health research, including qualitative field work, quantitative surveys, experimental designs, intervention trials, and program evaluation. This elective will highlight the importance of understanding and addressing global health through multidisciplinary frameworks and collaborations. This elective is a required component of the Certificate in Global Health. Course Coordinator Permission required.

Typically offered in Summer only

VMP 901 Small Ruminant Medicine (1 credit hours)
This course will present the key principles involved with management, reproduction and diseases of sheep, goats and camels. This will include basic information such as recommended nutrition programs to more advanced material such as diagnostic, therapeutic and prophylactic measures necessary to correct, reduce or prevent common diseases. Course restricted to 3rd year veterinary students, unless special permission is granted by course coordinator.

Typically offered in Fall only

VMP 902 SP Top in MBS (2 credit hours)
Two week special topic course in the Department of Molecular Biomedical Sciences.

VMP 903 Dissection of the Horse and Horse Diseases (2 credit hours)
This course will enable the student to describe the steps that lead from a normal cell to a fully malignant neoplasm, understand underlying molecular mechanisms, and correlate these mechanisms to relevant treatment options. Students will be able to classify different tumor types and deduce the impact of the neoplasm on the host and host responses. Students will also learn how to set up clinical trials, to analyze and understand production records, understand regulations and economic analysis. Students will also learn how to set up clinical trials, to interpret serological and virological results, to perform necropsy and to understand swine reproductive management.

Restriction: Third Year DVM Students

Typically offered in Spring only

VMP 904 Swine Industry (1 credit hours)
This course will provide veterinary students with expertise to approach a clinical swine problem and also to understand and analyze different parameters from a swine problem. Students will evaluate clinical signs, analyze and understand production records, understand regulations and economic analysis. Students will also learn how to set up clinical trials, to interpret serological and virological results, to perform necropsy and to understand swine reproductive management.

Typically offered in Spring only

VMP 906 Bovine Assisted Reproduction Techniques (1 credit hours)
Students will gain hands-on experience with bovine rectal palpation, rectal ultrasonography, trans-cervical catheterization, and embryo flushing. Course will provide didactic instruction on assisted reproduction techniques followed by lab time to practice discussed topics. Students will be required to travel to lab locations.

Typically offered in Summer only

VMP 907 Cancer Pathogenesis and Diagnosis (1 credit hours)
This course will enable the student to describe the steps that lead from a normal cell to a fully malignant neoplasm, understand underlying molecular mechanisms, and correlate these mechanisms to relevant treatment options. Students will be able to classify different tumor types and deduce the impact of the neoplasm on the host and host responses. Students will also learn how to set up clinical trials, to analyze and understand production records, understand regulations and economic analysis. Students will also learn how to set up clinical trials, to interpret serological and virological results, to perform necropsy and to understand swine reproductive management.

Typically offered in Spring only

VMP 908 Advanced Ruminant Medicine and Surgery (2 credit hours)
This elective course will be a weekly lecture and lab that covers routine ruminant surgical procedures and advanced medicine techniques to supplement VMP 962 Ruminant Medicine and Surgery.

Prerequisite: 3rd year DVM student

Typically offered in Spring only

VMP 909 Veterinary International Elective Experience (1-2 credit hours)
This course will provide students with practical experience in a foreign country working on a veterinary medicine related project being conducted in that country. Projects may focus on production medicine, occupational, zoological medicine, or basic research. Travel restricted to sites not included on the State Department alert/warning list. See http://travel.state.gov/content/passports/english/alertswarnings.html for details.

Corequisite: Current enrollment in DVM program

Typically offered in Fall and Summer

VMP 962 Ruminant Medicine and Surgery (3 credit hours)
Disease of Farm Animals

VMP 963 Cancer Research and Technology (1 credit hours)
This elective course will be a weekly lecture and lab that covers routine ruminant surgical procedures and advanced medicine techniques to supplement VMP 962 Ruminant Medicine and Surgery.

Prerequisite: 3rd year DVM student

Typically offered in Spring only

VMP 964 Swine Industry (1 credit hours)
This course will provide veterinary students with expertise to approach a clinical swine problem and also to understand and analyze different parameters from a swine problem. Students will evaluate clinical signs, analyze and understand production records, understand regulations and economic analysis. Students will also learn how to set up clinical trials, to interpret serological and virological results, to perform necropsy and to understand swine reproductive management.

Restriction: Third Year DVM Students

Typically offered in Spring only
VMP 910 Infection and Immunity 1 (3 credit hours)
This course is intended to familiarize the student with the pathogenic bacteria and fungi of veterinary importance. The student will learn the properties and cultivation of these microorganisms and receive a general introduction to the diseases they can cause. Primary emphasis will be placed on how the biology of the pathogen influences disease pathogenesis, and microbiological identification of infectious agents. The laboratory exercises will complement the lectures and focus on standard procedures for microbial cultivation and identification.

Prerequisite: Admission to the DVM Curriculum
Typically offered in Fall only

VMP 916 Health Maintenance and Animal Production I (1 credit hour)
This course is part I of a series with VMP 936 and 956 designed to introduce students to procedures for health maintenance and care of horses and food-producing animals. Students learn how to prevent diseases and promote animal health in laboratories.

Typically offered in Fall and Spring

VMP 920 Infection and Immunity 2 (4 credit hours)
This course is intended to continue the topics introduced in Infection and Immunity 1. Specific bacterial, fungal and viral pathogens will be covered including pathogenesis and strategies used to control infection and/or development of disease. The course will also cover more advanced topics in immunology including the types of hypersensitivities, autoimmunity, immunity in the newborn and fetus, immune deficiencies and vaccination.

Prerequisite: Admission to the DVM Curriculum
Typically offered in Spring only

VMP 921 Problem Solving for Cases in Infectious Diseases and Immunity 1 (2 credit hours)
This course is intended to challenge first-year veterinary students to reach a diagnosis of realistic cases involving either infectious diseases or immune pathology. The first part of the course is an introduction to diagnostic laboratory procedures. The second portion of the course requires the students to develop a list of differential causes to assigned clinical cases, choose a presumptive diagnosis based on available data and ordering of diagnostic tests to confirm the presumptive diagnosis. The individual cases are discussed in a small group format with a faculty facilitator.

Prerequisite: Admission to the DVM Curriculum
Typically offered in Fall only

VMP 930 Infection and Immunity 3 (3 credit hours)
Infection and Immunity 3, VMP93X, is designed to serve as a continuation of Infection and Immunity 1 & 2 (first-year curriculum) for the second-year veterinary student. This course is designed to reinforce principles if infectious disease and immunity introduced in the first year of the DVM curriculum and expand upon specific groups of parasites. This course will cover the diagnosis, treatment and control of major endo and ecto parasites of domesticated animals.

Prerequisite: Admission to the DVM Curriculum
Typically offered in Fall only

VMP 931 Veterinary Pathology I (3 credit hours)
Introduction to the basic pathologic changes which occur in animal tissues. Developmental processes and resulting morphology observed at gross, cellular, and subcellular level emphasized.

Typically offered in Fall only

VMP 934 Problem Solving for Cases in Infectious Diseases & Immunity 2 (2 credit hours)
This course is intended to challenge first-year veterinary students to reach a diagnosis of realistic cases involving either infectious diseases or immune pathology. The first part of the course is an introduction to diagnostic laboratory procedures. The second portion of the course requires the students to develop a list of differential causes to assigned clinical cases, choose a presumptive diagnosis based on available data and ordering of diagnostic tests to confirm the presumptive diagnosis. The individual cases are discussed in a small group format with a faculty facilitator.

Prerequisite: Admission to the DVM Curriculum
Typically offered in Fall only

VMP 936 Health Maintenance and Animal Production II (1 credit hour)
This course is part II of a series with VMP 916 and 956 designed to introduce students to procedures for health maintenance and care of horses and food-producing animals. Students learn how to care for animals, prevent diseases, and milk cows in laboratories.

Prerequisite: VMP 916
Typically offered in Fall and Spring

VMP 941 Veterinary Pathology II (4 credit hours)
Systemic Pathology - A study of specific responses of organ systems to pathogenic influences in animals with emphasis on the effects on the body as a whole.

Corequisite: Current enrollment in DVM program
Typically offered in Spring only

VMP 942 Veterinary Clinical Pathology (3 credit hours)
Introduction to the mechanisms which produce abnormal physiologic parameters within the animal during illness, with emphasis on the techniques for determining those abnormalities in the living animal.

Typically offered in Spring only

VMP 945 Epidemiology & Public Health (3 credit hours)
The focus of this course is to construct a foundation for clinical medicine by acquiring a holistic view of disease, exploring optimal preventive medicine strategies while developing a critical thinking skills and quantitative reasoning techniques. The teaching/learning format of the course will include lecture, in-class exercises, discussions and case studies.

Prerequisite: VMP 912, DVM student
Typically offered in Spring only

VMP 956 Health Maintenance and Animal Production III (1 credit hour)
This course is part III of a series designed to instruct students in procedures for maintaining the health and well-being of horses and food-producing animals. Students learn how to prevent diseases and promote animal production, including production of safe meat and milk.

Typically offered in Fall only
VMP 962 Ruminant Medicine  (3 credit hours)
The principles of medical disorders of ruminants are presented. This includes the cause of the disorders and the diagnostic, therapeutic and prophylactic measures necessary to correct, reduce or prevent these problems.

Typically offered in Spring only

VMP 964 Swine and Poultry Medicine  (2 credit hours)
Lecture series supplemented with projected illustration on the most economically important diseases of poultry and swine. Emphasis is placed on definition of diseases, etiology, characteristics of the disease, and diagnosis. The economics related to occurrence, prevention, treatment, and control are presented.

Typically offered in Spring only

VMP 970 Ruminant Health Management I  (2 credit hours)
This is a two-week block considering health management of ruminant species. During the two-week period, students accompany faculty on visits to farms to deliver health management programs, to investigate health problems, or to consider approaches to enhance productivity. A portion of the course also involves experience in providing individual animal health management and addressing medical/surgical disorders. Available to senior veterinary students.

Prerequisite: VMP 956 or VMP 974 or consent of the instructor
Typically offered in Fall and Spring

VMP 971 Food Animal Diagnostics for Disease Diagnosis, Control, and Population Surveillance  (2 credit hours)
This course is intended to instruct food animal veterinary students in: 1) underlying principles of veterinary diagnostic assays, 2) proper collection of samples, 3) effective testing approaches for diagnosis and management of disease, 4) strategies for efficient monitoring of food animal population for infection by specific agent(s), and 5) analysis of data from veterinary diagnostic laboratory tests and optimal use of the results for making production management decisions. Priority given to students in Food Animal Focus area. Students in Mixed Animal Focus Area or special-case Epidemiology Focus Area students can enroll (if space remains) with the approval of Course Coordinator if they meet the criteria states in the above requisites.

Prerequisite: Prior undergraduate coursework, summer work experiences, and/or consistent enrollment and good performance in food animal selectives.
Typically offered in Fall only

VMP 972 Ruminant Health Management II  (2 credit hours)
Senior veterinary students will experience advanced training in ruminant clinical medicine.

Prerequisite: VMP 970
Typically offered in Fall and Spring

VMP 973 Special Topics in Epidemiology  (2 credit hours)
The main goal of this course is to provide senior veterinary students with the opportunity for pursuing a focused research topic in the area of veterinary epidemiology and population medicine under the direction of consenting faculty. The exact direction and scope of the topic is agreed upon between the instructor, the student and the course coordinator. The course is offered only by the permission of the participating instructor(s) and the course coordinator. The instructor and the student will work out the type of project, what exact objectives are to be met and how the success of obtaining those objectives will be evaluated. The objectives and methods of evaluation of performance will be negotiated between the veterinary student and the instructor and put into writing in the form of a Plan of Action PRIOR to course permission being granted by the course coordinator.

Typically offered in Fall and Spring

VMP 974 Food Supply Veterinary Medicine  (2 credit hours)
This 2-week course provides exposure to the clinical principles of food supply veterinary medicine. It is primarily intended for individuals who are not in the NCSU-CVM Food Animal Focus Area. Ruminant, swine and poultry faculty provide an overview of the animal industries and production practices, as well as exposure to basic veterinary knowledge and clinical skills. Prerequisites may include consent of instructor.

Prerequisite: Completion of first 3 years of veterinary curriculum; consent of instructor for any enrollment >8.
Typically offered in Fall and Spring

VMP 975 Advanced Topics in Veterinary Anatomic Pathology  (1-6 credit hours)
This is a two-week senior veterinary clinical rotation that provides students with additional, focused experience in veterinary anatomic pathology. Students have the option of rotating through necropsy service and surgical biopsy service for two weeks to gain additional experience in pathology similar to VMP 977, the prerequisite for this course. Students have the option of designing a specialized pathology experience with the guidance of an approved pathology faculty member. Enrollment requires pre-approval by faculty assigned to the course.

Prerequisite: VMP 977
Typically offered in Fall and Spring

VMP 976 Food Animal Pharmacology  (2 credit hours)
This course will outline the basic principles of pharmacology and therapy of the major diseases of ruminants, swine and poultry. Students will be expected to develop a thorough understanding of how properly to use drugs in food animal species and should be able to develop a treatment program for most major livestock diseases. The course will be restricted to students in the food animal and mixed animal focus areas.

Prerequisite: VMB 943; VMP 962; VMP 964
Typically offered in Fall only

VMP 977 Autopsy/ Clinical Pharmacology  (2 credit hours)
Two clinical disciplines are completed during this clinical block - Autopsy Pathology and Clinical Pharmacology. The autopsy clinical rotation provides exposure to pathology techniques, observation skills and medical reasoning used to obtain and interpret autopsy and laboratory data in order to develop diagnoses, understand disease processes and address clinical and/or farm problems. The clinical pharmacology portion of the rotation will expose the students to current veterinary clinical pharmacology and therapeutics.

Typically offered in Fall and Spring
VMP 978 Clinical Pathology and Laboratory Medicine (2 credit hours)
This course provides veterinary students with a practical case-based approach to learning all majors aspects of veterinary clinical pathology and laboratory medicine (parasitology, immunology, bacteriology) in a clinical setting. It is restricted to students enrolled in the fourth year of the DVM curriculum.

Typically offered in Fall and Spring

VMP 979 Epidemiology (2 credit hours)
The main goal is to provide senior veterinary students with the opportunity for pursuing a focused research topic in the area of veterinary epidemiology and population medicine under the direction of consenting faculty. The exact direction and scope of the topic is agreed upon between the instructor, the student and the course coordinator. This course is offered only by the permission of the participating instructor(s) and the course coordinator. The instructor and the student will work out the type of project, what exact objectives are to be met and how the success of obtaining those objectives will be evaluated. The objectives and methods of evaluation of performance will be negotiated between the veterinary student and the instructor and put into writing in the form of a Plan of Action PRIOR to course permission being granted by the course coordinator. No one textbook is required for this course.

Typically offered in Fall and Spring

VMP 980 Theriogenology I (2 credit hours)
This course is designed to instruct students in clinical Theriogenology. It will be primarily oriented toward equine and canine species, however, cases and problems from other species will be seen and included as teaching materials. The students will improve upon the skills learned in VMF 951 and will be expected to use these skills in dealing with clinical cases and laboratory type situations. Transabdominal, vaginal, and rectal examination of the reproductive tract, semen collection, and evaluation will be taught during this course. This course may be repeated as many times as a student wishes during their senior year.

Prerequisite: Enrolled in fourth year clinical rotations.
Typically offered in Fall, Spring, and Summer

VMP 981 Special Topics in Theriogenology (2 credit hours)
The primary objective of this course is to provide additional information and training to veterinary students that had taken the VMF 980 Clinical Theriogenology senior clinical rotation. Specifically, emphasis is directed to acquaint students with modern and current practices of clinical Theriogenology. Various aspects of assisted reproductive technology available to domestic animals will be discussed. It is expected that the majority of the information and activities offered in this course will involve equine species (80%) and, to a lesser extent, canine (10%) and bovine species (10%). Teaching and client-owned animals are available for the rotation. Although emphasis is given on hands-on activities, didactic instruction of selected topics in clinical Theriogenology will be discussed.

VMP 982 Poultry Health Management I (2 credit hours)
Poultry Health Management I is a clinical rotation elective for 4 th year veterinary students with an interest in poultry health management or food animal production. This two-week course is offered 4 times each year. Diseases of turkeys and chickens will be discussed. Basic concepts in poultry disease diagnosis, prevention and treatment will be emphasized. The course will consist of lectures, laboratory and field experiences.

Typically offered in Fall and Spring

VMP 983 Poultry Health Management II (2 credit hours)
Poultry Health Management II is a clinical rotation elective for 4 th year veterinary students with a commitment to pursue a career in poultry health management or food animal production. This two-week course is offered throughout the year and may be repeated with permission of the instructor. The course will consist of laboratory and/or field experiences designed to meet the student's career goals. A list of available externships in poultry health management, which may be applicable for this course can be found on the Association of Avian Pathologists web site: http://www.aaap.info/index.html, under Educational Opportunities, Senior Veterinary Student Externships approved by the Kenneth Eskelund Preceptorship Committee. Funds to help pay for travel expenses may be available through the Kenneth Eskelund Preceptorship, see information at the web site listed above.

Typically offered in Fall and Spring

VMP 984 Swine Health Management I (2 credit hours)
This course will provide senior veterinary students with techniques and expertise to approach a clinical swine problem. Students will evaluate clinical signs, analyze production records, assess facilities and management, institute a diagnostic plan and establish an economically feasible solution to the clinical problem. The outline for this course may vary slightly from year to year but the following topics will be covered: Necropsy procedures/sample techniques; Interpreting serologic/virologic results; Farm visits - review building/equipment designs; Practical swine reproductive management; Practical bacteriology; Practical swine nutrition/rations; Swine record systems/Pig Champ.

Typically offered in Fall and Spring

VMP 985 Swine Medicine & Production II (2 credit hours)
This course will provide senior veterinary students with the opportunity to utilize the techniques and expertise gained in VMF 984. Students will evaluate clinical and production problems on a variety of swine farms. Practicum/field work and independent study will be conducted on commercial swine farms, usually with a veterinary practitioner or faculty member.

Typically offered in Fall and Spring

VMP 986 One Health: From Philosophy to Practice (2 credit hours)
Graduate/professional seminar (with team project) addressing intersections of veterinary medicine, human medicine, and environmental health. Co-listed at UNC CH Gillings School of Global Public Health and Duke University School of Medicine. Includes participants from these three institutions, plus related private-sector members, non-governmental organizations, and governmental professionals. Its purpose is to facilitate understanding of one health as a system of systems, and promote cross-campus and cross-discipline interactions. Weekly evening course held at NC Biotechnology Center, RTP. Limit: 15 students per university. Requires current graduate standing at NCSU or professional student standing within the College of Veterinary Medicine.

Typically offered in Fall only

VMP 987 Ruminant Topics (2 credit hours)
This two-week elective allows goal-directed educational enrichment in Ruminant Practice under the direction of consenting faculty. Formats include clinical experiences, clinical and applied investigations, etc. Topics and times are arranged by the student and consenting faculty. Available to 3 rd and 4 th year veterinary students only upon consent of faculty. VMF 970 may be a required prerequisite.

Typically offered in Fall and Spring
VMP 998 Advanced Topics in Clinical Pathology  (2 credit hours)
The goal of the Advanced Topics in Clinical Pathology is to gain further experience in clinical pathology beyond the required prerequisite laboratory medicine rotation VMP978. This senior clinical rotation is designed around the interests and career goals of students. Typically offered in Fall, Spring, and Summer.

Prerequisite: VMP 978 (Clinical Pathology, Laboratory Medicine and Nutrition) is a prerequisite course although under special circumstances instructor could permit to take prior to VMP 978 based on student background. Instructor permission is required.

Typically offered in Fall, Spring, and Summer

VMP 999 Extramural Experiences - Large Animal  (2 credit hours)
Senior DVM students will have the opportunity to undertake an elective rotation in an approved practice externship in a large animal practice a) food animal/rural or b) equine/mixed animal. The practice opportunity will meet the need recognized by students, CVM faculty and private practice colleagues alike to increase "hands on" experience in a private practice setting. Private practice experiences are available for year 1 - 3 students through the selective offerings. Presently, senior studentshave the opportunity to experience private practice by arranging an externship as an elective. However, initiating an elective course will ensure consistency between experiences, with clear expectations to achieve an approved level of learning/skills objectives with verification from the practice. Practitioners will be valuable partners in the education process in the senior year, providing access to individual animal and herd-related clinical diversity that is increasingly difficult to offer in the academic setting.

Typically offered in Fall and Spring

VMP 991 SP Top in PHP  (1 credit hours)
One week special topic course in the Department of Population Health & Pathobiology Department.

VMP 992 SP Top in PHP  (1-2 credit hours)
One week special topic course in the Department of Population Health & Pathobiology Department.

VMP 993 Extramural in Epidemiology, Public Health, and Public Policy  (2-6 credit hours)
This course is designed to expand opportunities for senior veterinary students to participate in a 2 week practicum in epidemiology, public health, or public policy under mentorship of experienced State, Federal, or private organization professionals. Students select their area or topic of interest and consult with the Focus Area Leader and submit a short proposal for review. Students work under supervision of an approved professional. Focus Area students may repeat the 2 week experience 3 times for a total of 6 weeks.

Typically offered in Fall and Spring

VMP 994 Extramural Experience in Pathology  (1-4 credit hours)
This is a two-week externship experience in pathology. The student will arrange an extramural experience in an academic, diagnostic, government, industrial, or zoological/wildlife laboratory setting under the supervision of a board certified veterinary anatomical or clinical pathologist. Fourth year DVM students only.

Typically offered in Fall and Spring

VMP 995 Clinical Conferenc  (1 credit hours)

VMP 999 Extramural in Vet International Programs  (2 credit hours)
This course will provide students with practical experience in a foreign country working on a veterinary medicine related project being conducted in that country. Projects may focus on production medicine, occupational safety, zoological medicine, or basic research.

Typically offered in Fall and Spring

Visual and Performing Arts (VPGE)

VPGE 295 Visual and Performing Arts Special Topics  (3 credit hours)
Special topics course offering for the general education Visual and Performing Arts category.

GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

Visual and Performing Arts and Glob Know (VPGK)

VPGK 295 Visual and Performing Arts and Global Knowledge Spec Topics  (3 credit hours)
Special topics course offering for the general education Visual and Performing Arts and Global Knowledge categories. This course may be used for the Global Knowledge (GK) co-requisite and/or for the Visual and Performing Arts (VPA) requirement.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

Visual and Performing Arts and U.S. Div (VPUS)

VPUS 295 Visual and Performing Arts and U.S. Diversity Special Topics  (3 credit hours)
Special topics course offering for the general education Visual and Performing Arts and U.S. Diversity categories. This course may be used for the U.S. Diversity (USD) co-requisite and/or for the Visual and Performing Arts (VPA) requirement.

GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

Women's and Gender Studies (WGS)

WGS 200 Introduction to Women's and Gender Studies  (3 credit hours)
Introduction to women's and gender studies as an interdisciplinary field spanning the humanities, social sciences and natural sciences. Study of historical perspectives and contemporary understanding of women and gender. Theory, systematic analysis and experimental accounts used to explore complexities of gender, and other identity determinants, mechanisms of power and privilege, and avenues for social change.

GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer
WGS 204/SOC 204 Sociology of Family (3 credit hours)  
Contemporary American family structures and processes and their development. Focus on socialization, mate selection, marital adjustment and dissolution. Includes core sociological concepts, methods, theories.

GEP Social Sciences, GEP U.S. Diversity  
Typically offered in Fall and Spring

WGS 210/STS 210 Women and Gender in Science and Technology (3 credit hours)  
Interdisciplinary introduction to the reciprocal relationships between scientific/technological research and contemporary understanding of gender. Special emphasis on social factors influencing scientists and engineers in their professions.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity  
Typically offered in Fall, Spring, and Summer

WGS 220 Men and Masculinity (3 credit hours)  
An introduction to the study of men and masculinity as an interdisciplinary field spanning the humanities and social sciences. This course will draw on both historical perspectives and contemporary understanding of men and masculinity, with attention to key domains of men's lives such as the roles of men in fiction and film, race and masculinity, religion and masculinity, fatherhood, masculinity and sports, and male sexuality.

GEP U.S. Diversity  
Typically offered in Fall and Spring

WGS 293 Special Topics in WGS (3 credit hours)  
Examination of varying topics on women and/or gender from an interdisciplinary perspective at an introductory level.

Typically offered in Fall and Spring

WGS 300 Introduction to Feminist Theories (3 credit hours)  
This course provides an overview of primarily US and western feminist theoretical perspectives by focusing on the variety of viewpoints within feminism and their specific historical roots. More than half of the course is devoted to studying specific themes and issues in women's history. The historical background lays the foundation for examining specific feminist theories, including liberal feminism, difference feminism and black feminism/womanism. The course prepares students for further work in Women's and Gender Studies, including WGS 492.

Prerequisite: WGS 200  
Typically offered in Fall only

WGS 304/SOC 304 Gender and Society (3 credit hours)  

P: 3 credits in SOC at the 200-level  
GEP Social Sciences, GEP U.S. Diversity  
Typically offered in Fall and Spring

WGS 305/ENG 305 Women and Literature (3 credit hours)  
Nineteenth through twenty-first century women's literature, as shaped by the intersecting and competing claims of gender, race, sexuality, and culture. Focus on fiction, accompanied by critical readings from American studies, feminist literary criticism, and postmodern theory.

Prerequisite: Sophomore standing and above  
GEP Humanities, GEP U.S. Diversity  
Typically offered in Fall and Spring

WGS 306/PS 306 Gender and Politics in the United States (3 credit hours)  
This course explores the role of gender in contemporary American politics. The course examines the historical course of gender politics to see how we have arrived at the present state. It investigates the activities that women and men play in modern politics-voting, running for office, serving in office, etc., and how women and men perform these activities in different ways. The course also focuses on major areas of public policy that affect women and men in different ways.

Prerequisite: PS 201  
GEP Social Sciences, GEP U.S. Diversity  
Typically offered in Fall only

WGS 308/ENG 308 Contemporary Issues in Ecofeminism (3 credit hours)  
Contemporary issues in ecofeminism provides a historical introduction to and global perspectives on women's sociopolitical, ethical, and economic contributions to the 20th and 21st century environmental movement. Theory and political action as they interweave issues of gender, race, and class in western and non-western contexts will be emphasized. Students will read works by and about female scientists/activists/writers and examine their own communities, analyzing the ways that individuals, community values, and dominant institutions impact women's relationships with the environment. Students will formulate questions, responses, and interpretations through critical reading practices, class discussion groups, self-reflective writing, and comparative analyses. Special attention will be paid to the role of literature--memoir, novel, short story, essay--in the dissemination of ecofeminist ideas.

GEP Humanities, GEP Interdisciplinary Perspectives  
Typically offered in Spring only

WGS 310 Women's and Gender Studies Internship (3 credit hours)  
Internship program. Introduction to careers that deal specifically with women's issues. Ten-hours-per-week work at a nonprofit or governmental organization. Contextualization of that experience through additional academic requirements. Individualized

Typically offered in Fall and Spring

WGS 327/ENG 327 Language and Gender (3 credit hours)  
Introduction to the use of language by men and women. Research in Linguistics and Women's Studies addressing issues such as the acquisition of gender-differentiated language, gender and conversational interaction, sexism in language, gender issues in society, and the relationship between language, gender, and other social constructs (e.g., class, culture, and ethnicity).

Prerequisite: ENG 101  
Typically offered in Fall only
Women's and Gender Studies (WGS)

WGS 330 Women and Health (3 credit hours)
Women and Health utilizes an interdisciplinary approach to explore historical perspectives on health, access to health technologies, health policy research, and emerging topics in women’s health. The humanities, social sciences, and biological sciences inform inquiry into “hot topics” in health policy, ethics, and the medical sciences. The health of women is dissected through a lens of gender equity and domestic and international perspectives are employed. Students are encouraged to identify and study topics of their own interest.

GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

WGS 350 Emerging Issues in Women’s and Gender Studies (3 credit hours)
Exploration of advanced specialized topics in Women’s and Gender Studies, to enhance in-depth undergraduate training in specific applied theories and methods. Seminar content will rotate, with attention to contemporary theoretical currents, and their application and effectiveness in addressing important emerging issues affecting individuals’ well-being in society, particularly those faced by underrepresented groups.

Prerequisites: WGS 200 or WGS 210 or STS 210
Typically offered in Fall, Spring, and Summer

WGS 360/MUS 360 Women In Music (3 credit hours)
The role of women in music as patrons, teachers, composers, and performers, placing them within the social, economic, and political framework to which they belong. Emphasis on Western Art Music and the role of women in popular music. No previous formal training in music is required.

GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Spring only

WGS 362/COM 362 Communication and Gender (3 credit hours)
Effects of gender on the interpersonal communication process. Construction of gendered identities via communication practices. Examination of theories of gender and the role of gender in organizational, institutional, and media communication practices.

Prerequisite: Junior standing, COM 112
Typically offered in Fall only

WGS 370 Advanced Studies of Gender in Science (3 credit hours)
This course is designed to provide students with an in-depth view of recent research about the influence of contemporary gender relations on science and engineering. Readings address feminist theories about sex/gender, race/class/sexualities, the social construction of science, and technological innovation. Discussions will focus on scholarship that explores how, why, and when a "gender lens" brings value to understanding nature and knowledge.

Prerequisites: WGS 200 or (WGS 210 or STS 210)
GEP Interdisciplinary Perspectives
Typically offered in Spring only

WGS 380/AFS 380 Black Feminist Theory (3 credit hours)
Focused examination of Black feminist theory as a significant and distinct body of work. Interdisciplinary exploration of the impact of Black feminist theory on movements for social justice, the development of academic feminism generally, and the lived experience of Black women both in the United States and internationally.

Prerequisite: Any 200-level course in either WGS or AFS
GEP U.S. Diversity
Typically offered in Fall and Spring

WGS 390 Queer Theory (3 credit hours)
Queer Theory provides an overview of the writings, art, identity/ies, work, politics, debates, histories, bodies, intimacies, kinship, and other lived realities of the people and experiences often organized under the LGBTQIA+ umbrella. As a critical theory, queer theory examines how circulations of power, dominance, and oppression constantly re/ vision what it is to be queer, queering, and queerer. The course will focus on how gender, race, class, functional diversity, sexuality, work, documentation status, age, etc. impact and are impacted by queer becoming.

P: Any 3-credit 200-level WGS course.
GEP Humanities
Typically offered in Fall and Summer

WGS 393 Special Topics in Women’s and Gender Studies (3 credit hours)
Special topics in Women’s and Gender Studies at the 300 level for offering courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

WGS 406/PSY 406 Psychology of Gender (3 credit hours)
Current theory and research on perceived and actual biological, social, cognitive, personality and emotional similarities and differences of men and women throughout the lifespan. The construction and consequences of gender in our society and others. Credit will not be given for both PSY/WGS 406 and PSY/WGS 506.

Prerequisite: PSY 200 or WGS 200
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

WGS 407/SOC 407 Sociology of Sexualities (3 credit hours)

Prerequisite: 3 hours SOC 200 level, 300 level
Typically offered in Spring only

WGS 410/ENG 410 Studies in Gender and Genre (3 credit hours)
This course examines the ways in which women writers from diverse backgrounds have revised the literary genres to include the varied experiences of women. It will focus on a different generic area, such as poetry, fiction, drama or autobiography, depending on its instructor.

Requisite: Sophomore Standing or Above
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only
WGS 418/PS 418  Gender Law and Policies  (3 credit hours)
Law and policy pertaining to contemporary gender issues. Examination of agenda setting, policy formation, implementation, judicial interpretation and evaluation of selected issues, such as reproductive policies, equal employment and sexual abuse.

Prerequisite: 3 hours of Political Science
GEP U.S. Diversity
Typically offered in Spring only

WGS 444/ANT 544/WGS 544/ANT 444  Cross-Cultural Perspectives on Women  (3 credit hours)
Comparison of women in a variety of societies: western and non-western; hunting and gathering to industrialized. Cross-cultural perspective on the similarity and diversity of women's statuses and roles. Effect of gender on social position

Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346
Typically offered in Spring only

WGS 447/HI 547/WGS 547/HI 447  Women in America: From Contact to the Civil War  (3 credit hours)
The historical experience of women in America from Native American and European contact through the colonial period to the immediate post-Civil-War years (to 1890). Topics include the history of women's work, education, legal and political status, religious experience, and sex roles, with consideration of age, class, race, sexual preference, and region as significant variables in women's experience in America. Credit will not be given for both HI (WGS) 447 and HI (WGS) 547.

P: 3 Hours of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

WGS 448/HI 548/WGS 548/HI 448  American Women in the Twentieth Century  (3 credit hours)
Women's historical experience in America, 1890-1990. Changes in women's work, education, legal and political status, and sex roles, age, class, race, sexual preference and region as significant variables in women’s experience in America. Credit will not be given for both HI (WGS) 448 and HI (WGS) 548.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

WGS 472/REL 472  Women and Religion  (3 credit hours)
Historical, literary, and theological sources dealing with portrayals of women and women's religious experience in several religious traditions of the world through different historical periods, from ancient to modern. Impact of feminist theory on the academic study of religion; methodological issues surrounding the study of women's religious history; role of religion in shaping attitudes toward women and their status in society. Students cannot receive credit for both REL/WGS 472 and REL/WGS 572.

Prerequisite: one course in religious studies or women's and gender studies
GEP Humanities
Typically offered in Spring only

WGS 473/REL 573/WGS 573/REL 473  Religion, Gender, and Reproductive Technologies  (3 credit hours)
Examines comparative religious ethics concerning gender marriage, parenthood, children, and the relationship of human beings to the "natural". Relates these views to new and emerging reproductive and genetic technologies. Compares the internally diverse perspectives of three major religious traditions with regard to their interpretations of these technologies. Analyzes the impact of particular uses of these technologies on the rights of women and girls. Students cannot earn credit for both REL 473 and REL 573.

Prerequisite: One 3 cr course in Philosophy (PHI) or Religious Studies (REL) or Women's and Gender Studies (WGS)
Typically offered in Fall only

WGS 492  Theoretical Issues in Women's and Gender Studies  (3 credit hours)
Examination of feminist theory. Study of formative texts in modern feminism, drawn from various disciplines within the humanities, social sciences, and natural sciences. In-depth exploration of feminist perspectives on issues of race, class, gender, sexuality, work and mothering, among others. Analysis of local and global cultural practices using feminist theoretical frameworks.

Prerequisite: WGS 200
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

WGS 493  Special Topics in Women's and Gender Studies  (3 credit hours)
Examination of varying topics on women and/or gender from a multidisciplinary perspective.

Typically offered in Fall only

WGS 540/ECD 540  Gender Issues in Counseling  (3 credit hours)
Exploration of gender as primary identity and social construct. Emphasis on gender dynamics in counseling, client empowerment and preventive approaches.

Prerequisite: Graduate standing or Six hrs. in ED or PSY
Typically offered in Spring and Summer

WGS 544/ANT 444/WGS 444/ANT 544  Cross-Cultural Perspectives on Women  (3 credit hours)
Comparison of women in a variety of societies: western and non-western; hunting and gathering to industrialized. Cross-cultural perspective on the similarity and diversity of women’s statuses and roles. Effect of gender on social position

Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346
Typically offered in Spring only

WGS 547/HI 447/WGS 447/HI 547  Women in America: From Contact to the Civil War  (3 credit hours)
The historical experience of women in America from Native American and European contact through the colonial period to the immediate post-Civil-War years (to 1890). Topics include the history of women's work, education, legal and political status, religious experience, and sex roles, with consideration of age, class, race, sexual preference, and region as significant variables in women's experience in America. Credit will not be given for both HI (WGS) 447 and HI (WGS) 547.

P: 3 Hours of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only
Typically offered in Fall only

WGS 548/Hi 448/WGS 448/Hi 548 American Women in the Twentieth Century (3 credit hours)
Women's historical experience in America, 1890-1990. Changes in women's work, education, legal and political status, and sex roles, age, class, race, sexual preference and region as significant variables in women's experience. Credit will not be given for both Hi (WGS) 448 and Hi (WGS) 548.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

WGS 737/SOC 737 Gender in Public and Intimate Relations (3 credit hours)
In contemporary society, gender is a critical social construction on which the relationships and interactions of individuals depend. This course presents a contemporary exploration of gender and gender differences as they affect women and men in our society and others.

Typically offered in Spring only

Prerequisite: Graduate student, SOC 736 or 731

Typically offered in Fall only

WGS 739/SOC 739 Social Psychology Of Inequality (3 credit hours)
The effects of race, class and gender inequality on the formation of group consciousness, self-evaluations, emotions, values, attitudes and beliefs. Attention to interpersonal processes through to reproduction of inequality in everyday life.

Requisite: Admission to SOC Graduate Program
Typically offered in Spring only

Wood and Paper Science (WPS)

WPS 201 Sustainable Materials for Green Housing (2 credit hours)
The overall goal of the class is to make the students more informed and aware consumers of materials used in housing. The class will connect the economic and energy impacts of producing common materials with the environmental impacts, e.g., carbon, water, and pollutants. The concepts of embodied energy, water use, and land impacts will be used to examine common building materials. The concept of Lifecycle Analysis will be introduced and used to evaluate the use and trade-offs for different building materials. The opportunities and trade-offs for reuse and recycling materials at the 'end of life' will also be explored.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

WPS 491 Special Topics in Wood and Paper Science (1-4 credit hours)
Independent study of management or technology problems selected with faculty approval or the offering of experimental courses.

Typically offered in Fall, Spring, and Summer

Zoology (ZO)

ZO 233 Human-Animal Interactions (3 credit hours)
This course is designed to explore the relationship humans share with other animals and nature. We will study the early history of animal domestication and the influence of animals on human culture and religion. We will also explore our relationships to animals as pets, food, research subjects, and wildlife. All subjects will be covered through interaction with guest speaker, assigned readings, case studies, and class discussion.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Summer

ZO 250 Animal Anatomy and Physiology (4 credit hours)
Roles of physical laws, environmental challenges, and evolutionary history in shaping animal structure and function. Selected examples from invertebrates and vertebrates. Laboratory in anatomy and physiology, hypothesis generation and testing and data analysis and presentation.

Prerequisite: C- or better in BIO 183
Typically offered in Fall only
ZO 317 Primate Ecology and Evolution (3 credit hours)
A comprehensive survey of the behavior, evolution, and ecology of nonhuman primates. Special emphasis will be placed in the evolution of cognitive abilities, social systems, and behavioral patterns that are unique to primates, including the evolution of language. Topics include primate taxonomy, evolution of the extant primates, geographic distribution, social behavior, reproductive behavior and strategies, parental behavior, communication, and cognitive. Classes will consist of interactive lectures, films, and class discussions.

Prerequisite: C- or better in BIO 181 & BIO 183, and one of the following courses: ANT 251, BIO 212, BIO 240, BIO 245, BIO 250, BIO/PB 330, BIO 350, BIO/PB 360, BIO 410, BIO 422, BIO 424, or BIO 488
Typically offered in Spring only

ZO 333 Captive Animal Biology (3 credit hours)
This course serves to introduce interested students to historical and current captive animal conservation efforts. We will discuss in detail a variety of issues essential to the management of wild animals in a captive setting including ethics, nutrition, reproduction, behavior, and population management.

Prerequisite: C- or better in BIO 181 and one of the following (BIO 140 or 250 or 260 or 350 or NTR 301 or ANS 150 or 205 or GN 311)
Typically offered in Spring only

ZO 334 Captive Animal Biology Field Laboratory (2 credit hours)
This laboratory course serves to introduce interested students to today’s captive animal conservation efforts from the perspective of NC facilities on the front lines. Through the lens of these nearby institutions, we will investigate in detail a variety of factors essential to the management of wild animals in a captive setting. We will take topics (history, population management, genetics, nutrition, education, conservation) from the lecture course and expand them as we focus on challenges unique to these local captive facilities. While some activities will take place on campus, a number of off-campus field trips are required, including one 3-day laboratory at North Carolina Zoo. We will return to campus most days within the scheduled time frame, however students should plan for the possibility that labs may go overtime on some occasions.

Prerequisite: C- or better in BIO 181; Co-requisite: ZO 333; Sophomore standing and above.
Typically offered in Spring only

ZO 350 Animal Phylogeny and Diversity (4 credit hours)
Phylogenetic history and adaptive radiation of animals; contrast of environmental determinants of biodiversity in tropical and polar regions; modern approaches to phylogeny; role of humans in influencing biodiversity. Students may not receive credit for

Prerequisite: A grade of C- or better in BIO 181 and sophomore standing.
Credit is not allowed for both ZO 350 and ZO 402/
Typically offered in Spring only

ZO 351 Animal Symbiosis (3 credit hours)
Symbiotic associations of animals including mutualism, commensalism and parasitism. The morphological, physiological, behavioral and ecological adaptations of symbionts and the complex interactions between partner species.

Prerequisite: 12 hrs. of biology and zoology
Typically offered in Spring only

ZO 352 Biological Clocks (3 credit hours)
The anatomy, physiology and development of biological clocks in a variety of organisms, including humans. Required readings in primary literature.

Prerequisite: Graduate standing
Typically offered in Spring only

ZO 356 Comparative Physiology (3 credit hours)
Comparative study of the organ systems of vertebrates and physiological processes involved in maintaining homeostatic state. Various compensatory mechanisms employed during environmental stress included.

Prerequisite: ZO 421
Typically offered in Fall only

ZO 374 Applied Ethology (3 credit hours)
An applied approach to the study of avian behavior, with emphasis on ethological principles. Core reading: Bird Behavior and Evolution by Agapow and Arnold. Course will involve field trips on the NC State campus, and several trips to nearby natural areas. Field notes, articles, and discussions will be emphasized.

Prerequisite: ZO 421
Typically offered in Fall only

ZO 402 Invertebrate Biology (4 credit hours)
Over 90% of all animals are invertebrates, and many invertebrate species have proven extremely useful in medical and research applications. This course will survey invertebrate groups or clades (excluding the Protista), and will emphasize their functional biology, phylogeny, ecology, behavior, and use as models in research. Lab will emphasize an experimental approach and will involve work primarily with live material. Students may not receive credit for both ZO 402 and ZO 350.

Prerequisite: A grade of C- or better in BIO 181 and BIO 183. Credit is not allowed for both ZO 402 and ZO 350.
Typically offered in Fall only

ZO 410 Introduction to Animal Behavior (3 credit hours)
Studies in animal behavior in vertebrates and invertebrates, focusing on the mechanisms and evolution of animal behavior. Topics include neural, hormonal, and genetic bases of behavior; foraging; anti-predator defenses; mating systems and sexual selection; social behavior; communication; parental care; territoriality and habitat selection.

Prerequisite: C- or better in BIO 181 and BIO 183
Typically offered in Fall and Summer

ZO 419 Ethology of Nonhuman Primates (4 credit hours)
This course will focus on the natural history and behavior of nonhuman primates with emphasis on the topics that have special relevance to human behavior, such as social organization, communication, cognition, and cooperation. We will have guest lecturers from the zoo and have the opportunity to observe and study captive nonhuman primates.

Prerequisite: Prerequisite: A grade of C- or better in BIO 181 & BIO 183, and one of the following: BIO 350 or BIO 402/403 or GN 311 or ST 311.
Typically offered in Fall only

ZO 420 Comparative Neuroethology (3 credit hours)
Survey of the ethology of nonhuman primates and other vertebrates. Comparative studies of behavior in the context of the phylogenetic history of the species, including human behavior. Course will emphasize the functional biology of behavior. Students may not receive credit for both ZO 420 and ZO 451.

Prerequisite: A grade of C- or better in BIO 181 and one of the following (BIO 140 or 250 or 260 or 350 or NTR 301 or ANS 150 or 205 or GN 311)
Typically offered in Spring only

ZO 512 Animal Symbiosis (3 credit hours)
Symbiotic associations of animals including mutualism, commensalism and parasitism. The morphological, physiological, behavioral and ecological adaptations of symbionts and the complex interactions between partner species.

Prerequisite: 12 hrs. of biology and zoology
Typically offered in Spring only

ZO 513 Comparative Physiology (3 credit hours)
Comparative study of the organ systems of vertebrates and physiological processes involved in maintaining homeostatic state. Various compensatory mechanisms employed during environmental stress included.

Prerequisite: ZO 421
Typically offered in Fall only

ZO 522 Biological Clocks (3 credit hours)
The anatomy, physiology and development of biological clocks in a variety of organisms, including humans. Required readings in primary literature.

Prerequisite: Graduate standing
Typically offered in Spring only
ZO 524/PHY 524/PO 524 Comparative Endocrinology (3 credit hours)
Basic concepts of endocrinology, including functions of major endocrine glands involved in processes of growth, metabolism and reproduction.
Prerequisite: BIO 421 or PO 405
Typically offered in Spring only

ZO 542 Herpetology (3 credit hours)
The biology of the amphibians and reptiles: systematics, life history, anatomy, behavior, physiology and ecology.
Prerequisite: ZO 250 and ZO 421
Typically offered in Spring only

ZO 553/FW 553 Principles Of Wildlife Science (3 credit hours)
The principles of wildlife management and their application studied in the laboratory and in the field.
Prerequisite: BIO 260 or BIO/PB 360
Typically offered in Spring only

ZO 582/ENT 582 Medical and Veterinary Entomology (3 credit hours)
The morphology, taxonomy, biology and control of the arthropod parasites and disease vectors of man and animals. The ecology and behavior of vectors in relation to disease transmission and control.
Prerequisite: ENT 425 and ZO 315
Typically offered in Spring only

ZO 790 Special Topics (1-6 credit hours)

ZO 791 Topics In Animal Behavior (3 credit hours)
Intensive examination of selected aspects of animal behavior and their relationship to physiology, ecology and other biological fields. May be repeated for credit when topic changes.
Prerequisite: Graduate standing
Typically offered in Fall only

ZO 829 Special Topics (1-6 credit hours)
A directed individual investigation of a particular problem in zoology, accompanied by a review of the pertinent literature. A maximum of three hours allowed toward master's degree.
Prerequisite: Twelve hours ZO
Typically offered in Fall and Spring
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