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About Us

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 known for its forward-looking philosophy: Think and Do.

With more than 34,000 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 Princeton Review/USA Today and Kiplinger as a national top-20 best value in 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 130 corporate and government research partners, incubator companies and NC State research units.

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 strengths 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.

Campus

NC State University is located west of downtown Raleigh on 2,090 acres. The campus acreage includes Centennial Campus on 1,075 acres and Centennial Biomedical Campus on 152 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 8,971 employees, including 2,323 faculty. Among the many honors and recognitions received by members of the faculty are 10 memberships in the National Academy of Sciences, 14 memberships in the National Academy of Engineering, one membership in the Institute of Medicine, and 635 members of NC State’s Academy of Outstanding Teachers.

Outreach and Extension Program

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.

Students

In the 2014 Fall Semester, the university’s head count enrollment totaled 33,989. Included in this number were 23,019 students in undergraduate degree programs, 8,492 in graduate degree programs, 445 First Professional and 2,033 non degree-seeking students. The total enrollments by college were:

- Agriculture and Life Sciences - 3,452
- Design - 827
- Education - 1,634
- Engineering - 9,258
- Natural Resources - 1,791
- Humanities and Social Sciences - 4,257
- Management - 3,269
- Sciences - 3,767
- Textiles - 1,197
- Veterinary Medicine - 422
- Division of Academic and Student Affairs - 1,577

The student population included 2,212 African American students, 4,185 other non-white students, 15,044 female students. Students at the university come from 52 states and territories, and 117 foreign countries.
The international enrollment is a distinctive feature of the institution as 3,724 international students give the campus a cosmopolitan atmosphere.

**Associations, 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 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, and the Cooperating Raleigh Colleges.

**Accreditation**

NC State University is accredited by the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC) to award associate’s, baccalaureate, master’s and doctoral degrees. Contact SACSCOC at 1866 Southern Lane, Decatur, Georgia 30033-4097 or call (404) 679-4500 for questions about the accreditation of NC 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, (3) to file a complaint against the institution for alleged non-compliance with a standard or requirement. Normal inquiries about NC State, such as admissions requirements, financial aid, educational programs, etc., should be addressed directly to the university and not the SACSCOC's office.

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

Specialized Academic Program Accreditation [http://upa.ncsu.edu/univ/accr/specialized-program-accreditation](http://upa.ncsu.edu/univ/accr/specialized-program-accreditation)

**College of Agriculture & Life Sciences**

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<th>Accrediting Body</th>
<th>Last Yr Accred</th>
<th>Next Yr Accred</th>
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<tr>
<td>Agricultural Education (BS)*</td>
<td>Council for the Accreditation of Educator Preparation (CAEP)</td>
<td>2009</td>
<td>2015</td>
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<tr>
<td>Biological Engineering (BS)**</td>
<td>ABET</td>
<td>2011</td>
<td>2017</td>
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* Accredited through the College of Education  
** Accredited through the College of Engineering

**College of Design** [http://upa.ncsu.edu/univ/accr/specialized-program-accreditation](http://upa.ncsu.edu/univ/accr/specialized-program-accreditation)

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<tr>
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<th>Accrediting Body</th>
<th>Last Yr Accred</th>
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<td>Architecture (B.Arch, M.Arch)</td>
<td>National Architectural Accreditation Board (NAAB)</td>
<td>2012</td>
<td>2018</td>
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<td>Graphic Design (BGD, MGD)</td>
<td>National Association of Schools of Art and Design (NASAD)</td>
<td>2012</td>
<td>2021</td>
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<tr>
<td>Industrial Design (BID, MID)</td>
<td>National Association of Schools of Art and Design (NASAD)</td>
<td>2012</td>
<td>2021</td>
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<tr>
<td>Landscape Architecture (BLA)</td>
<td>Landscape Architectural Accreditation Board (LAAB)</td>
<td>2009</td>
<td>2015</td>
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<td>Landscape Architecture (MLA)</td>
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<td>2016</td>
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**College of Education**

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<tr>
<td>Counselor Education (PhD, MEd, MS)</td>
<td>Council for Accreditation of Counseling and Related Educational Programs (CACREP)</td>
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<td>2020</td>
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<tr>
<td>All teacher education programs, School Counselor (MEd, MS), School Administration (MSA) and School of Social Work (MR) at initial and advanced levels.</td>
<td>Council for the Accreditation of Educator Preparation (CAEP)</td>
<td>2009</td>
<td>2015</td>
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**College of Engineering**

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<tbody>
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<td>2017</td>
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<tr>
<td>Biological Engineering (BS)</td>
<td>ABET</td>
<td>2011</td>
<td>2017</td>
</tr>
<tr>
<td>Biomedical Engineering (BS)</td>
<td>ABET</td>
<td>2011</td>
<td>2017</td>
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<tr>
<td>Program Name</td>
<td>Accrediting Body</td>
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<td>Chemical Engineering (BS)</td>
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<td>Civil Engineering (BS)</td>
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<td>2017</td>
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<tr>
<td>Computer Engineering (BS)</td>
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<td>2017</td>
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<tr>
<td>Computer Science (BS)</td>
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<td>2017</td>
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<tr>
<td>Construction Engineering and Management (BS)</td>
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<td>2017</td>
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<td>Electrical Engineering (BS)</td>
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<td>2017</td>
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<td>Engineering - Mechatronics Concentration (BS)</td>
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<td>2017</td>
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<tr>
<td>Environmental Engineering (BS)</td>
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<td>2017</td>
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<td>2017</td>
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<td>2017</td>
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<td>2017</td>
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<tr>
<td>Nuclear Engineering (BS)</td>
<td>ABET</td>
<td>2011</td>
<td>2017</td>
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<tr>
<td>Paper Science and Engineering (BS)</td>
<td>ABET</td>
<td>2011</td>
<td>2017</td>
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<td>ABET</td>
<td>2011</td>
<td>2017</td>
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<td>(<a href="http://upa.ncsu.edu/univ/accr/specialized-program-accreditation">http://upa.ncsu.edu/univ/accr/specialized-program-accreditation</a>)</td>
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<td>Program Name</td>
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<td>Human Factors/Ergonomics Psychology (PhD)</td>
<td>Human Factors and Ergonomics Society (HFES)</td>
<td>2012</td>
<td>2018</td>
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<td>Public Administration (MPA)</td>
<td>National Association of Schools of Public Affairs and Administration (NASPAA)</td>
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<td>2021</td>
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<td>School Psychology (PhD)</td>
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<td>2021</td>
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<td><strong>Poole College of Management</strong></td>
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<td>Accounting (BS, MAC)</td>
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<td>Business Administration (BS, MBA)</td>
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<td>Master of Global Innovation Management (MGIM)</td>
<td>Association to Advance Collegiate Schools of Business (AACSB International)</td>
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<tr>
<td>Forest Management (BS)</td>
<td>Society of American Foresters</td>
<td>2006</td>
<td>2015</td>
</tr>
<tr>
<td>Paper Science &amp; Engineering (PSE)</td>
<td>ABET</td>
<td>2011</td>
<td>2017</td>
</tr>
<tr>
<td>Parks, Recreation &amp; Tourism Management (BS)</td>
<td>Council on Accreditation of Parks, Recreation, Tourism &amp; Related Professions</td>
<td>2012</td>
<td>2017</td>
</tr>
<tr>
<td>Professional Golf Management (BS)</td>
<td>Professional Golf Association of America</td>
<td>2010</td>
<td>2015</td>
</tr>
<tr>
<td>Wood Products (BS)</td>
<td>Society of Wood Science &amp; Technology</td>
<td>2005</td>
<td>2015</td>
</tr>
<tr>
<td><strong>College of Sciences</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program Name</td>
<td>Accrediting Body</td>
<td>Last Yr Accred</td>
<td>Next Yr Accred</td>
</tr>
</tbody>
</table>
Chemistry (BA, BS) American Chemical Society (ACS) 2012 2017

College of Textiles

<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>Fashion Development and Product Management</td>
<td>American Apparel &amp; Footwear Association</td>
<td>2014</td>
<td>2019</td>
</tr>
<tr>
<td>Textile Engineering (BS)</td>
<td>ABET</td>
<td>2011</td>
<td>2017</td>
</tr>
</tbody>
</table>

College of Veterinary Medicine

<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>Veterinary Medicine (DVM)</td>
<td>American Veterinary Medical Association Council on Education (AVMA COE)</td>
<td>2014</td>
<td>2021</td>
</tr>
</tbody>
</table>

Administrative Program Accreditation and Certification (http://upa.ncsu.edu/univ/accr/specialized-program-accreditation)

http://upa.ncsu.edu/univ/accr/specialized-program-accreditation

Division of Academic & Student Affairs

<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>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>2014</td>
<td>2019</td>
</tr>
<tr>
<td>Cooperative Education (On-the-job experience in chosen field)</td>
<td>Council for Cooperative Education</td>
<td>2009</td>
<td>2015</td>
</tr>
<tr>
<td>Counseling Center</td>
<td>International Association of Counseling Services, Inc. (IACS)</td>
<td>2014*</td>
<td>2015</td>
</tr>
<tr>
<td>Student Health Services</td>
<td>Accreditation Association for Ambulatory Health Care (AAAHC)</td>
<td>2013</td>
<td>2016</td>
</tr>
</tbody>
</table>

Student Health Services Commission on Office Laboratory Assessment (COLA) 2014 2016

*Paperwork submitted in 2014; site visit in June 2015 - waiting for re-certification for 4 years.

Environmental Health & Public Safety

<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>Campus Police</td>
<td>Commission on the Accreditation of Law Enforcement Agencies</td>
<td>2013</td>
<td>2016</td>
</tr>
<tr>
<td>Campus Police</td>
<td>International Association of Campus Law Enforcement Administrators (IACLEA)</td>
<td>2013</td>
<td>2016</td>
</tr>
</tbody>
</table>

College of Veterinary Medicine

<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>Veterinary Health Complex</td>
<td>American Animal Hospital Association (AAHA) Performs accreditation inspections</td>
<td>Inspection 2012</td>
<td>Inspection 2015</td>
</tr>
<tr>
<td>Lab Animal Facilities</td>
<td>Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) Performs accreditation inspections</td>
<td>Inspection 2012</td>
<td>Inspection 2015</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. Accordingly, North Carolina State University (“NC State”) does not practice or condone unlawful discrimination in any form, as defined by this policy.*

NC State hereby affirms its desire to maintain a work environment for all employees and an academic environment for all faculty and students that is free from all forms of prohibited discrimination. NC State strives to build and maintain an environment that supports and rewards individuals on the basis of such relevant factors as ability, merit and performance; the prohibited behaviors of discrimination, harassment and retaliation are incompatible with the values and goals of NC State.
Discrimination is unfavorable treatment with regard to a term or condition of employment, or participation in an academic program or activity based upon age (40 or older), color, disability, gender identity, genetic information, national origin, race, religion, sex (including pregnancy), sexual orientation, or veteran status. Discrimination includes the denial of a request for a reasonable accommodation based upon disability or religion. Harassment is any unwelcome conduct based upon age (40 or older), color, disability, gender identity, genetic information, national origin, race, religion, sex (including pregnancy), sexual orientation, or veteran status that either creates a quid pro quo situation or a hostile environment. Retaliation is an adverse action against a covered individual because that individual engaged in a protected activity.

NC State will respond promptly to all complaints of discrimination, harassment and retaliation. Violation of this policy can result in serious disciplinary action up to and including expulsion for students or discharge for employees.

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

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
Website: www.ncsu.edu/oied

* This policy reflects federal and state civil rights such as: Title VII of the Civil Rights Act, Title IX of the Education Amendments, the American with Disabilities Act, and the Age Discrimination in Employment Act, among others.
Admission

All undergraduate applicants apply by creating a wolfPAW (https://wolfpaw.ncsu.edu/Default.asp) account, NC State's Personal Admissions Website. Undergraduate Admissions implements a notification date system for both domestic freshman and transfer applicants and international applicants are notified as decisions are made. Freshmen are strongly encouraged to apply during the fall of their senior year in high school.

The final freshman application deadline for the fall semester and summer sessions is January 15; the final transfer application deadline is March 15. Applicants for the College of Design and Fashion and Textile Design program must submit complete applications by November 1 and list it as their first choice major. Freshman applications that are submitted and have all required materials received by November 1 will be automatically considered for campus merit-based scholarships.

All applications for the spring semester should be submitted prior to October 1. The College of Design, College of Engineering and First Year College do not admit students for the spring semester.

Freshman Application Deadlines

• Deadline 1: October 15
  Notification Date: December 15
• Deadline 2: November 1
  Notification Date: January 30
• Final Review Deadline: January 15
  Notification Date: March 30

Transfer Application Deadlines

• Deadline 1: January 15
  Notification Date: March 30
• Final Deadline: March 15
  Notification Date: May 15

International Application Deadlines

• Deadline 1: November 1
• Final Deadline: January 15

Students are notified of their decision on their wolfPAW account and admitted students (http://admissions.ncsu.edu/admitted-students) must confirm their enrollment by May 1.

The Undergraduate Admissions website (http://admissions.ncsu.edu) provides more information on the application review process and procedure.

New Student Orientation

106 Peele Hall
NC State Box 7525
Raleigh, NC 27695-7525
Phone: (919) 515-1234 Fax: (919) 515-5844
Michael Coombes, Director

New Student Orientation provides newly admitted first-year and transfer undergraduate students introductory assistance and continuing services that will aid in their transition to NC State. Our programs expose students to broad educational opportunities, academic expectations and resources, as well as social and developmental opportunities. Most importantly, we begin the process of integrating students into the life of the institution.

Freshman Admission

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 First Year College. 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.

In addition, 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 in 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

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

NC State does not conduct individual interviews with applicants; however, a prospective student is always welcome to visit the Office of Undergraduate Admissions. Freshman information sessions and student led campus tours are available Monday through Friday at the Joyner Visitor Center (http://admissions.ncsu.edu/visit/schedule-your-visit). Prospective students should register for the information session and tour via their wolfPAW (https://wolfpaw.ncsu.edu) account.

College of Design and Fashion and Textile Design

If you are interested in a College of Design major or Fashion and Textile Design, it should be listed as your first choice major and your application should be submitted and complete (along with a separate essay and online portfolio) by November 1. If you are a domestic freshman applying
for the Design Studies major, the final deadline is January 15. The College of Design will not consider second choices for Design majors. Design applications are reviewed by the Office of Undergraduate Admissions and, if found to be academically competitive, are forwarded to the College of Design for review. To assess creative potential, candidates must present a portfolio of works created inside and/or outside school. High school art classes are not required for acceptance, but they are encouraged. For more information regarding the portfolio, contact the College of Design. Design applicants will be notified on January 15 whether their application is under review by the College of Design for their first choice, or whether it is being considered for second choice of major in a different college at NC State. Notification of admission decisions will be at the end of March.

Professional Golf Management (PGM)

Along with completing the undergraduate admissions application, students must provide a copy of their GHIN scores from their local facility documenting a handicap of 12 or below. Students may provide documentation of successfully passing the PGA Playing Ability Test (PAT) but GHIN scores with handicap verification must be submitted along with the PAT documentation. A letter of recommendation from the student’s golf coach or a PGA professional must also be sent. Handicap verification and the letter of recommendation must be submitted directly to the PGM office when the application is submitted to Undergraduate Admissions. Documentation and questions should be directed to the PGM office: Tel. 919-515-8792, email: susan_colby@ncsu.edu.

Two-Year Agricultural Institute

Requirements for admission to the Agricultural Institute (http://harvest.cals.ncsu.edu/aginstitute), a two-year terminal program, include graduation from high school with a 2.0 minimum grade point average or successful completion of the high school equivalency examination administered by the State Department of Public Instruction, and one letter of recommendation. SAT scores are not required. Coursework is not transferable to the four-year degree programs. Completion of course work in the Agricultural Institute leads to an Associate of Applied Science (A.A.S.) degree.

Standardized Test Scores

Freshman applicants must submit scores from the SAT or the ACT Assessment. The ACT Assessment must include the Writing Test. Applicants’ scores must be sent directly from the testing agency to NC State (SAT Code #5496, ACT code #3164). Prospective students may find more information and applications for the tests online: www.collegeboard.com (http://www.collegeboard.com) or www.act.org (http://www.act.org).

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) or International Baccalaureate (IB) examinations; 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/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.

Transfer Students

NC State welcomes transfer applicants, and in recent years, more than 20 percent of our graduates started their college programs at other institutions. A transfer student should present at least 30 semester hours (or 45 quarter hours) of “C” or better college level work, including an English class and a college level math class applicable to the requested degree program. Additional specific course work is required for most programs. Transfer admission is highly competitive, and the grade point average required for consideration varies depending on the requested program of study. Transfer students must be eligible to return to the last institution previously attended and must submit individual transcripts from each institution.

Students who graduated from high school since 1990 must submit a high school record to verify that they have met UNC-system Minimum Course Requirements (MCR) for course work as outlined in the Freshman Admissions section of this catalog. Exceptions to this requirement are students who will have earned an A.A., A.S., or A.F.A. degree before enrolling at NC State. Individuals who do not have the minimum admissions requirements at the high school level must complete at the college level six semester hours or nine quarter hours each of English, foreign language, mathematics, science, and social science to be eligible to transfer.

College transcripts are required from each institution attended and are evaluated for credit that is transferable to the university as part of the admission application review. A grade of “C-” or better is required before a course may be considered for credit. The college to which the application is made will determine the exact amount of credit applicable toward a degree at NC State.

International Students

NC State welcomes international student applications and has a long history of enrolling outstanding international students. International students must apply online: admissions.ncsu.edu. International applicants must demonstrate competitive academic credential, evidence of English language proficiency, and adequate financial resources before a visa certificate can be issued.

English Proficiency

English proficiency can be demonstrated by meeting these requirements:

Options for Meeting Requirements -

- TOEFL IBT (code: 5496)
  - Scores required for full undergraduate admission: 85 or higher (minimum of 18 in each sub score)
  - Scores required for conditional admission: 60 or higher
- TOEFL Paper Based (code: 5496)
  - Scores required for full undergraduate admission: 563 or higher
  - Scores required for conditional admission: 500 or higher
- IELTS Academic
• Scores required for full undergraduate admission: 6.5 or higher (minimum of 6.5 in each sub score)
• Scores required for conditional admission: 6.0

• Pearson Test of English (PTE) Academic
  • Scores required for full undergraduate admission: 62 or higher (minimum of 53 in each sub score)
  • Scores required for conditional admission: 45

• Intensive English Program (http://iep.oia.ncsu.edu)
  • Completion of Level 6 with a grade of B or higher and meet all other exit criteria

• English Composition I and II from an accredited U.S. College or university
  • Grade of C or higher

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 (e.g.: H-4, L-2, DACA, E-2, Pending Permanent resident etc.). They 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 WolfPAW account.

Once the applicant is considered admitted (fully or conditionally), 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 via FedEx. Newly 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.

New international students must check-in with 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. http://asap.dasa.ncsu.edu/summer-start.

For more information regarding the CFR and VCF please contact:

Pascale Toussaint
North Carolina State University
International Admissions

Tel: 919-513-3446
Pascale_toussaint@ncsu.edu

Administration and Offices

Office of the Chancellor

W. Randolph Woodson, Chancellor
PJ Teal, Assistant to the Chancellor and Secretary of the University
Kevin Howell, Assistant to the Chancellor for External Affairs
Frances Milks, Assistant to the Chancellor
Stephanie Parker, Assistant to the Chancellor for Communication
Kathy Moritz, Administrative Officer
Mary Catherine Cole, Administrative Support Specialist.

Office of the Provost and Executive Vice Chancellor

Warwick A. Arden, Provost and Executive Vice Chancellor
Betsy E. Brown, Vice Provost for Faculty Affairs
Louis D. Hunt, Jr., Vice Provost for Enrollment Management and Services and University Registrar
Duane Larick, Senior Vice Provost for Strategic Initiatives and Dean of the Graduate School
Bailian Li, Vice Provost for International Affairs
Thomas K. Miller, Senior Vice Provost for Academic Outreach and Entrepreneurship and Distance Education and Learning Technology Applications
Susan K. Nutter, Vice Provost and Director, NCSU Libraries
Alice S. Warren, Vice Provost for Continuing Education
Joanne G. Woodard, Vice Provost for Equal Opportunity and Equity
John T. Ambrose, Dean Emeritus

College of Agriculture and Life Sciences

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Lisa Guion Jones, Assistant Dean for Diversity, Outreach and Engagement
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Keith Oakley, Executive Director, College Advancement
Sam L. Pardue, Associate Dean and Director for Academic Programs
John Sabella, Assistant Dean for International Programs
Steve Lommel, Associate Dean for Research and Director, NC Agricultural Research Service
Joe Zublena, Associate Dean, Cooperative Extension Service

College of Design

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Hernán Marchant, Associate Dean for Undergraduate Studies and Academic Support
Art Rice, Associate Dean for Graduate Studies, Research and Extension
Tameka Whitaker, Assistant Dean for Student and Academic Services
Dottie Haynes, Assistant Dean for Budget and Administration
Carla Abramczyk, Assistant Dean of External Relations

College of Education

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Ellen McIntyre, Interim Associate Dean, Academic Affairs
Samuel S. Snyder, Associate Dean, Research and Administration
Anona Smith Williams, Assistant Dean, Student Engagement
Michael J. Maher, Assistant Dean, Professional Education

College of Engineering
Louis Martin-Vega, Dean
J.G. Gilligan, Senior Advisor Research and Graduate Programs
Jerome P. Lavelle, Associate Dean, Academic Affairs
Thomas K. Miller, Associate Dean, Distance Education and Information Technology
Christine Grant, Associate Dean, Faculty Development and Special Initiatives
David W. Parish, Assistant Dean, Academic Affairs
Angelitha L. Daniel, Interim Director, Minority Engineering Programs

College of Humanities and Social Sciences
Jeffery Braden, Dean
Victoria J. Gallagher, Associate Dean for Academic Affairs and Graduate Studies
Thomas A. Birkland, Associate Dean for Research, Engagement, Extension and Development
Karen R. Young, Assistant Dean for Academic Affairs and Director of Undergraduate Programs
Helga G. Braunbeck, Assistant Dean for Interdisciplinary Studies, International Programs, and Diversity
Betty A Byrum, Assistant Dean for Finance and Administration
Clifford Griffin, Director of International Programs
Lauren R. Kirkpatrick, Director of Communication
Justin Daves, Director of CHASS IT
Dara Leeder, Director of Student Recruitment and Retention

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Steve Allen, Associate Dean, Graduate Programs and Research

College of Natural Resources
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Marian McCord, Associate Dean, Research
Sandy Jones, Assistant Dean, Finance and Business

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Jacqueline Krim, Interim Associate Dean, Research
Jamila S. Simpson, Director of Multicultural Affairs and Student Services
Michael C. Smith, Director of Undergraduate Enrollment
Jacqueline Hawkins-Morton, Director of Advising

College of Textiles
A. Blanton Godfrey, Dean
Harold S. Freeman, Associate Dean for Research
Behnam Pourdeyhimi, Associate Dean for Industry Research and Extension
William Oxenham, Associate Dean for Academic Programs

College of Veterinary Medicine
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David G. Bristol, Senior Associate Dean and Director, Academic Affairs
Kathryn M. Meurs, Associate Dean and Director, Graduate Studies and Research
Michael G. Davidson, Associate Dean and Director, Veterinary Medical Services
Jeffrey Huckel, Director of Student Services

Distance Education and Learning Technology Applications (DELTA)
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Donna Petherbridge, Associate Vice Provost, Instructional Technology Support and Development Services
Rebecca Swanson, Associate Vice Provost for Distance and Distributed Education
Barbara Yde, Business Officer
Kay Zimmerman, Associate Vice Provost for Marketing & Partnership Development

African American Cultural Center
Sheila Smith-McKoy, Director
Darrell Lester, Assistant Director

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Tim R. Luckadoo, Vice Provost, Campus Life
N. Alexander Miller III, Vice Provost, Arts NC State
Jose A. Picart, Vice Provost, Academic Programs and Services
Lisa P. Zapata, Vice Provost, Student Development, Health and Wellness

Campus Life
Tim R. Luckadoo, Vice Provost, Campus Life

ARTS NC STATE
N. Alexander Miller III, Vice Provost, ARTS NC STATE
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George Thomas, Director, Crafts Center
Robin Harris, Director, Dance Program
Roger Manley, Director, Gregg Museum of Art & Design
Dr. Tom Koch, Interim Director, Music Department
John McIlwee, Director, University Theatre
Christina Menges, Director, Arts Development
Jill Powell, Director, Arts Marketing
Amy Savvy, Coordinator, Arts Outreach
Katherine Fuller, Director, Ticket Central

Academic Programs and Services in the Division of Academic and Student Services
Jose Picart, Vice Provost
Barbara M. Kirby, Associate Vice Provost
Roger A. E. Callanan, Assistant Vice Provost
Catherine Freeman, Academic Standards Coordinator
Pat Cellini, Director of Finance and Business
Mark Newmiller, Director of the Disability Services Office
Bill Winner, Director of Environmental Sciences
Carrie McLean, Executive Director of the First Year College and Academic Advising Services
Rich Slatta, Director of the First Year Inquiry Program
Frankye Artis, Director of the Transition Program
Marsha Pharr, Executive Director of the TRIO Programs
Courtney Simpson, Director of Student Support Services
Chris Ashwell, Director of the Office of Undergraduate Research
Barbie Windom, Director of the Undergraduate Tutorial Program
Larry Blanton, Director of the University Honors Program

Student Development, Health, and Wellness
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Monica Osburn, Director, Counseling Center
Leah Amett, Director, Student Health Services
Arnold Bell, Director, Career Development Center
Eric Hawkes, Director, University Recreation
Holly Durham, Director, Business & Planning
Paul Cousins, Director, Student & Community Standards
Tom Roberts, Health & Exercise Studies Department Head
Michael Giancola, Associate Vice Provost, Student Leadership & Engagement
Eileen Coombes, Director, Student Involvement
Amanda Illiong, Director, Center for Student Leadership, & Public Service
Patrick Neal, Director, Student Media
Lt Col Jayson Allen, Air Force ROTC Commander
LTC Randall Wheeler, Army ROTC Commander
CAPT Douglas Wright, Naval ROTC Commander

Division of Enrollment Management and Services
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Angela I. Brockelsby, Director, Communications and Marketing
Krista Domnick, Director of Scholarships and Financial Aid
Thomas H. Griffin, Associate Vice Provost and Director of Undergraduate Admissions
Michelle G. Johnson, Senior Associate Registrar
Shawn P. Smith, Assistant Vice Provost, Financial Operations and Audit
Steven White, Data Analysis and Research

The Graduate School
Michael Carter, Associate Dean
Lis Borbye, Assistant Dean
George Hodge, Assistant Dean
David Shafer, Assistant Dean
Daniel Willits, Assistant Dean

Intercollegiate Athletics
Deborah A. Yow, Director

International Affairs
Balilin Li, Vice Provost for International Affairs
Ingrid R. Schmidt, Associate Vice Provost for International Affairs and Director, Study Abroad Center
Michael J. Bustle, Associate Vice Provost for International Affairs and Director, Global Training Initiative
John Baugh, Director, North Carolina Japan Center
Anna Lamm, Deputy Director, Confucius Institute at NC State University

Karin Sandler, Director, Intensive English Program

McKimmon Center for Extension and Continuing Education
Alice Warren, Vice Provost for Continuing Education
Marilyn Anselmi, Director, The Collaborative at Gateway Technology Center
Yevonne Brannon, Executive Director, Center for Urban Affairs and Community Services
Judson Hair, Executive Director, Continuing and Professional Education
Tricia Inlow-Hatcher, Director, Encore Program for Lifelong Enrichment
Kathy Lawson, Student Success Outreach Specialist, Upper Coastal Plain Learning Council
Cynthia Peck, Community Outreach Specialist - Teacher Education, Upper Coastal Plain Learning Council

The NCSU Libraries
Susan K. Nutter, Vice Provost and Director of Libraries

Office of Finance and Business
Charles D. Leffler, Vice Chancellor for Finance and Business
Sallie Newton, Assistant to the Vice Chancellor for Finance and Business
Marilyn Stieneke, Director of Planning and Communication
Barbara Carroll, Associate Vice Chancellor for Human Resources
Dan Adams, Associate Vice Chancellor for Campus Enterprises
Michael Harwood, Associate Vice Chancellor for Centennial Campus Development Office
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Steve Keto, Associate Vice Chancellor for Finance and Resource Management
Kevin MacNaughton, Associate Vice Chancellor for Facilities
Mary Peloquin-Dodd, Associate Vice Chancellor for Finance and Business and University Treasurer
David Rainer, Associate Vice Chancellor for Environmental Health and Public Safety
Lisa Johnson, University Architect
Yvette Griffin, Director of Benefits
Pat Hofmeister, Director, University Bookstores
Richard A. Hayes, Sr, Director Financial Services, Campus Enterprises
Cameron Smith, Director of Capital Project Management
Maria Brown, Director of University Cashier and Student Accounts Office
Deborah Wright, Director of Classification and Compensation
Julie Brasfield, Director of Contracts and Grants
Charles Cansier, University Controller
Andy Sneed, Director of Design and Construction Services
Randy Laft, Sr. Director Hospitality Services, Campus Enterprises and Director, University Dining
Marc Okner, Director of Employee Relations
Kathy Lambert, Director of Employment Services
Ken Kretchman, Director Environmental Health & Safety
Jack Colby, Assistant Vice Chancellor for Facilities Operations
Jill Tasaico, Senior Director of Foundations Accounting and Investments
Brian Simet, Director of HR Information Management
Jim Semple, Director of Insurance and Risk Management
Sharon Loosman, Director of Materials Management
Franki Senter, Director of Payroll
Jack Moorman, Chief of Police
Ralph Recchie, Director Real Estate Office
Barbara Moses, Director Office of Resource and Budget Management
Lori Johnson, Director Strategic Debt Management
Enrollment (Registration)

Enrollment is conducted using MyPack Portal, Registration and Records' online student services application. MyPack Portal is available from the Registration and Records' website (http://registrar.ncsu.edu). This website contains 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 using the MyPack Portal system; and
3. Students pay tuition, fees, and all other debts to the university by the established deadlines. Advising and general enrollment start dates and deadlines are published on the web each semester. Students must check the specific day and time they will access Enrollment in the Enrollment Dates menu of MyPack Portal.

For more information, contact:
Department of Registration and Records (http://registrar.ncsu.edu)
1000 Harris Hall
Box 7313,
NC State University
Raleigh, NC 27695
phone: (919) 515-2572
fax: (919) 515-2376
For questions, please visit the Registration and Records FAQ (http://ncsu.parature.com).

Cooperative Registration 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 Registration 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) 515-1496 or crc@ncsu.edu or visit the Inter-Institutional website (http://registrar.ncsu.edu/exchange-programs/inter-institutional).

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) 515-1496 or crc@ncsu.edu or visit the Inter-Institutional website (http://registrar.ncsu.edu/exchange-programs/unconline).

Cooperating Raleigh Colleges
The Cooperating Raleigh Colleges Program (CRC) is a voluntary organization comprised of NC State, Meredith College, Peace College, St. Augustine’s College, and Shaw 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 required but not offered through NC State. Interested students should contact the Inter-Institutional Coordinator at (919) 515-1496 or crc@ncsu.edu or visit the Cooperating Raleigh Colleges website (http://registrar.ncsu.edu/exchange-programs/cooperating-raleigh-colleges).

Veterans Affairs
NC State University is approved to administer veterans benefits to eligible students. The Veterans Affairs Office is located in Registration and Records, 1000 Harris Hall. Students who are eligible to receive veterans benefits should contact the NC State Certifying Official at (919) 515-3048 or veterans_affairs@ncsu.edu. For more information see the NC State Veterans Education website (http://registrar.ncsu.edu/veterans).

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. For specific deadlines, visit the calendar page on the Registration and Records website. (http://www.ncsu.edu/registrar/calendars)

Courses may be dropped without regard to course load during the first two weeks of a regular semester. During weeks three through six of a semester, 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.

Students who wish to drop all courses for which they are enrolled, must withdraw from the university for the remainder of the semester or summer session in which they are enrolled. A degree student who finds it necessary to drop all courses will initiate withdrawal from the university at the Counseling Center, Student Health Center, 2815 Cates Avenue, second floor.

Honors and Scholars Programs

University Honors Program
The University Honors Program (UHP) is a highly selective program academic program. The program exists to encourage and enable outstanding students to engage in research and scholarship in their chosen discipline. The mission of the University Honors Program is to encourage and enable outstanding NC State students to engage in the knowledge-building and creative activities of the NC State faculty. The UHP seeks to cultivate students as public intellectuals interested in and capable of making a meaningful contribution to their discipline, NC state, and society-at-large. It is an opportunity for motivated students to craft for themselves a unique undergraduate education that draws on the full range of opportunities that exist at a major research, land-grant university such as NC State. The UHP is designed to be a transformative experience which is catalyzed through a process of creativity, inquiry, and discovery. Undergraduates can pursue research and scholarship in any discipline. In fact, there are students from every undergraduate college at NC State in the UHP.

University Honors Program Admission
Application to the University Honors Program is by invitation. Incoming freshmen are invited to apply after they have been accepted to the university. All invitations are issued on a rolling basis throughout the university’s admissions process (typically mid-December through February). If you do not receive an invitation, but believe you are a strong candidate for the University Honors Program, you can contact the program and request an invitation to apply. Admission is competitive and based on evidence of motivation to pursue research and scholarship in the discipline, academic achievement, extracurricular activities, and our desire to maintain an Honors community that includes students from a diversity of academic disciplines. Current freshmen may also request an invitation to apply.

University Honors Program Requirements
The curricular core of the UHP is the HON seminars, which are small, thought-intensive, graduate-style, interdisciplinary courses designed to expose students to how multiple disciplines approach and try to solve problems. University Honors Program students are required to take a minimum of 12 credit hours of HON seminars (generally one per semester in their first two years), these seminars are taught by some of the most innovative professors at NC State. The UHP also offers experiential learning courses that enable them to earn credit for activities such as working with a faculty member on a project or with a local museum to create educational materials for a new exhibit. The other major curricular dimension of the UHP is the Capstone project, which is a 6-credit-hour, 2 semester long independent research project, conducted under the guidance of a faculty mentor or other campus or local professionals. The Capstone is the culmination of a student’s NC State and University Honors Program experience, because it is the process through which students truly move from being knowledge consumers to knowledge producers. The Capstone requires that a student articulate a problem or issue of interest and then use the tools and methods of their discipline in order to make a new discovery.

The Honors Village
The Honors Village is a collaborative partnership between the University Honors Program and University Housing. The mission of the Honors Village is to create a community of young scholars which is engaged in
the societal issues, provides opportunities for growth, and is grounded in critical scholarship. It gives students the opportunity to live with a diverse group of highly motivated students and to participate in co-curricular learning through activities such as group discussions, trips, and social events. The Honors Village has Honors Village Fellows (upper class mentors) and a Scholar in Residence Program, which was established to connect NC State faculty members and Honor Village students in non-traditional learning environments. The Honors Village is located in the historic renovated Quad residence halls on East Campus.

In Addition

The Honors experience at NC State includes Honors programs located in the colleges and departments. Students are invited to participate in these programs at various times, depending upon the specific program (generally the second semester of the sophomore year or first semester of the junior year). Many of the students in the University Scholars Program are also participants in one or more of the college or departmental Honors programs.

For more information about the UHP, contact:

University Honors Program, Division of Academic and Student Affairs, Campus Box 8610, Raleigh, NC 27695-8610 Phone: 919-513-4078 Fax: 919-513-4392 Email: university_honors@ncsu.edu or visit http://www.ncsu.edu/honors/

University Scholars Program

“Twenty years from now you will be more disappointed by the things you didn’t do than by the ones you do. So throw off the bowlines, sail away from the safe harbor. Catch the trade winds in your sails. **Explore. Dream. Discover.**” --Mark Twain.

For thirty-five years, the USP has encouraged outstanding students to leave the safe harbor, to pursue their dreams, and to explore the beauty and the challenges of the world around them. How? Through opportunities to participate in the Scholars Forum, to enroll in special courses and to join the community of the Scholars Village.

**SCHOLARS FORUM:** University Scholars enroll in the Scholars Forum (http://scholars.dasa.ncsu.edu/forum) for three semesters. The Forum features musical and theatrical performances, addresses by major public figures, authors and scientists, and debates and discussions of significant public policy issues. Among our recent guests were:

- Grenoldo Frazier, an award-winning musician, actor and composer of the gospel musical *Mama I Want to Sing*.
- David Doubilet, the world’s leading underwater photographer who has published over 70 stories for *National Geographic* magazine.
- Shana Tucker, a “ChamberSoul” cellist, singer and songwriter whose music is a mix of pop, jazz and folk.
- Shane Harris, an award-winning journalist, national security expert and author of the critically-acclaimed book *The Watchers*.
- Lisa Jolley, a teacher of improv and Broadway performer who has starred in *Hairspray*.

The Scholars Forum also offers an extraordinary range of cultural, educational and outdoor opportunities, all provided free through the program. Take part in special tours of NC State’s Nuclear Reactor, the Duke Lemur Center, or Piedmont Biofuels; participate in canoeing and hiking trips; and attend local theatre, music and dance performances and museum exhibitions. Students choose what they wish to do, and the options are amazing!

**SPECIAL COURSES:** University Scholars have the opportunity to enroll in honors sections (http://scholars.dasa.ncsu.edu/current/coursework) of academic courses that are taught by the very best faculty at NC State.

**OUTDOOR & CULTURAL EXPLORATIONS:** With day, weekend and weeklong trips, our Outdoor Explorations (http://scholars.dasa.ncsu.edu/current/ce) program offers University Scholars opportunities to explore the natural world, get to know their peers, and engage in personal reflection. Cultural Explorations (http://scholars.dasa.ncsu.edu/current/ce) include a Fall Break trip to New York City, Spring Break trips overseas, and summer study abroad programs in Florence, Italy and Oxford, England.

**SCHOLARS VILLAGE:** Special activities, outstanding students, and a close-knit community make the Scholars Village (http://scholars.dasa.ncsu.edu/village) a very special place to live. To learn more about the Scholars Village and how to apply, visit University Housing (http://www.ncsu.edu/housing).

For more information concerning the USP, contact:

University Scholars Program
Box 7316, NC State University
Raleigh, NC 27695-7316
phone: (919) 515-2353,
fax: (919) 515-7168;
e-mail: university_scholars@ncsu.edu or visit University Scholars Program website (http://www.ncsu.edu/univ_scholars).

**International Programs and Activities**

**Study Abroad**

Study abroad can be a transformative experience that fosters personal growth along with increased intellectual development. Employers value international experience and look for skills such as intercultural sensitivity, the ability to deal with ambiguity, and adaptation to new surroundings – all developed through study abroad. Approximately 13% of undergraduates nationwide study abroad. Distinguish yourself from your peers by developing skills and engaging in a unique learning environment abroad. By being outside of one’s comfort zone, every new experience can be a challenge and an adventure!

Students can fulfill major, minor, general education program and elective courses abroad. Plus, participation on any study abroad program fulfills the Global Knowledge co-requisite degree requirement for NC State students. Students should discuss a study abroad experience with their academic advisor to identify a time frame and outline a course plan. For all majors, with academic planning, study abroad does not delay graduation at NC State.

**Study Abroad Programs**

NC State offers more than 400 study abroad programs in 60 countries worldwide that meet student academic, personal, and cultural interests. Most programs have no foreign language requirement.

**Group Programs**

Students study abroad with a group of NC State peers. Participants pay a fixed program cost, which includes tuition, housing, insurance and
some cultural activities. Group programs are offered throughout the year, including summer, semester, or short term.

Exchange Programs
Students pay NC State tuition and fees and become a regular student at an overseas institution for either a semester (4-6 months) or full academic year. Class credit earned appears as transfer credit on the NC State transcript.

Direct Enrollment Programs
Some partner universities allow NC State students to enroll directly at the host institution as a visiting student. Participants pay tuition and fees abroad (rather than to NC State). Class credit earned appears as transfer credit on the NC State transcript.

Funding Study Abroad
Even if students operate on a tight budget, study abroad is still an option. Students are eligible to receive financial aid (including loans, grants, and scholarships) for the cost of any study abroad program. 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. The Study Abroad Office also administers more than $250,000 in scholarships annually. In addition to the NC State Scholarships, there are many other financial resources available in support of study abroad.

Applying for Study Abroad
With hundreds of opportunities to choose from—each differing in curriculum, duration, language, degree of cultural immersion, cost, and location—early planning is key to a successful study abroad experience. Students should begin planning up to a year in advance.

Visit http://studyabroad.ncsu.edu to learn more.

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.

International Cultural Leadership Project (ICLP)
The ICLP connects NC State students to international students from the SKEMA Business School in France as well as students from GTI partner schools in Brazil, China, and Taiwan. NC State student volunteers play an important and fun role in helping new and visiting international students integrate into the Wolfpack community.

Two types of ICLP participation are available: Volunteer & Leadership Council

The ICLP is facilitated by the Global Training Initiative (http://www.ncsu.edu/gti) and details can be found on the website (http://ncsu.edu/gti/iclp/iclp.php).

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 3000 international students and 500 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, I-SSERV service learning program, English Conversation Club, International Friendship Program, cultural diversity workshops, and many others. New international students are required to participate in New International Student Orientation and to check-in with OIS upon arrival. 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 orientation, English Conversation Club, International Friendship Program, etc.

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 non-degree study abroad programs that international students may be interested in. These full-time non-degree study abroad 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 International Cultural Leadership Project (ICLP). The ICLP connects NC State’s domestic and international students through joint participation in cultural, volunteer, and academic events and workshops. Visit the ICLP website (http://www.ncsu.edu/gti/iclp/iclp.php) 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 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
International Programs and Activities

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.

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: http://iep.olia.ncsu.edu/

Summer Institute in English for Speakers of Other Languages

The Summer Institute in English for Speakers of Other Languages is a five-week, intensive English language program for students from other countries. It is especially good for students from other countries who intend to pursue university studies or specialized training programs in the United States in the fall. The institute, which is jointly sponsored by the Department of Foreign Languages and Literatures and the Division of Continuing Education, is held from early July to early August each summer. It is designed to provide students with intensive instruction and practice in the use of the English language. Emphasis is on developing integrated oral and written skills in English.

The institute also offers orientation to American life and institutions to give students insight into life in the United States and to help them to adjust to the new environment. Students take part in field trips to places of historic, cultural, and scenic interest. Prospective students have usually studied English and have some experience with spoken English prior to enrolling in the institute. However, all levels from beginners to advanced are welcome. Admission to the institute does not imply admission as a degree candidate at NC State or any other campus of the University of North Carolina System.

Global Village

The world is at your doorstep in the Global Village where residents from around the world live, learn and interact. Students who live in the Global Village experience different cultures and viewpoints while creating a tight-knit community. The Village’s focus is global awareness, understanding and experience.

Global Village is located on Central Campus in Alexander Hall (http://housing.ncsu.edu/alexander-hall).
Village Features

- Pairing of international students and American students as roommates
- Student Ambassadors to assist in acclimating international students to American culture
- A faculty-led programming series on global and cultural issues
- Programs focused on US and international culture
- A place for students to practice their language skills
- Excursions to events/sites within North Carolina, New York City, and Washington DC
- Discussion programs focusing on international issues and global awareness
- A hall primarily for students who are sophomore classification or higher
- Hall-style living environment

Global Village Requirements

Residents who live in Global Village must:

- Attend the Global Village Fall Orientation that occurs before the start of classes
- Participate in five or more Village programs each semester
- Abide by the Student Code of Conduct, University Housing Rules and Community Standards and remain in good academic standing.
- Be an active participant within the Global Village community

Research Centers

In addition to offering more than 110 bachelor and master’s degrees in more than 110 areas of study, doctorate degrees in 61 disciplines, and a Doctorate of Veterinary Medicine, NC State also boasts more than 55 research centers and institutes. In conjunction with the colleges, these research centers support a broad spectrum of more than 3,700 sponsored scholarly endeavors.

The Research Triangle Park

NC State is one of the three Triangle area top-tier research universities 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 The Research Triangle Park, a 7,000-acre research park founded in 1959 by leaders from academia, business and government. Today, The Research Triangle Park is home to some of the most innovative and cutting-edge research based companies in the world.

The unique “Research Triangle” area of North Carolina has captured national and international attention. The “triangle” is formed by the three geographic points of Raleigh, Durham and Chapel Hill that are home to the area’s top-tier research universities: NC State, Duke University and University of North Carolina at Chapel Hill. Because of this wealth of educational and research opportunities, the triangle contains one of the highest concentrations of Ph.D. scientists and engineers per capita, in the nation. The highly educated workforce in the Triangle is extremely attractive to companies, many of which engage in collaborative programs within the area universities.

Since it was established, The Research Triangle Park has witnessed a steady and stable increase in the number of companies and employees. Currently, there more than 170 organizations located in The Research Triangle Park. More than 40,000 people work in the Park, with combined annual salaries of over $2.7 billion. Organizations in the Park include government research laboratories of the National Institute of Environmental Health Sciences, and the U.S. Environmental Protection Agency. Private companies such as IBM, GlaxoSmithKline, Nortel, Cisco, and RTI International are located in the Park. Talented scientists, engineers and managers from RTP companies frequently hold adjunct faculty appointments in one or another of the Triangle universities.

The Analytical Instrumentation Facility (AIF)

Jacob Jones, Director, Analytical Instrumentation Facility

The Analytical Instrumentation Facility (AIF) (http://www.aif.ncsu.edu) provides NC State faculty and students with the highest level of modern microanalysis instrumentation currently available as well as trained specialists to assist with teaching, training, instrument operation, and experimental design. The unique combination of extensive analytical instrumentation and specialized staff makes AIF a valuable asset to both teaching and research at all levels. AIF staff provides the expertise to access AIF’s state of the art analytical capabilities, conducts training and provide guidance to students. AIF is located in the Larry K. Monteith Engineering Research Center on the NC State Centennial Campus. This laboratory space, located in the mixed-use (private industry/academics) environment of Centennial Campus, provides the optimum environment for teaching, research and technology transfer. AIF analytical capabilities encompass analyses of materials including ceramics, metals, semiconductors, polymers, and biological materials. The Variable Pressure Scanning Electron Microscope (VPSEM), which can operate at high chamber pressure for charge neutralization, provides electron microscopy and EDS (Energy Dispersive X-Ray Spectroscopy) elemental analysis on uncoated non conductive samples including biological, polymeric, textile, and other materials. The VPSEM facility is used extensively by undergraduate students in a wide range of disciplines. AIF has extensive capabilities in the areas of Atomic Force Microscopy (AFM) for high resolution surface topography measurement, Field Emission Scanning Electron Microscopy (FESEM) for high resolution imaging of sample morphology, Field Emission Scanning Transmission Electron Microscopy (FE S/TEM) for atomic resolution imaging and chemical characterization, dynamic Secondary Ion Mass Spectrometry (SIMS) for trace analysis, Time of Flight SIMS for spatially resolved molecular surface analysis, X-Ray and Ultraviolet Photoelectron Spectrometry (XPS, UPS) for chemical surface analysis, X-Ray Diffraction (XRD) for crystallographic analysis and Focused Ion Beam (FIB) nanomachining for sample preparation and fabrication of nanostructures and a metallography laboratory. In addition, AIF has extensive facilities for specimen preparation for all of the above mentioned analytical techniques.

Animal and Poultry Waste Management Center

C. M. Williams Director
Box 7608, 212 Scott Hall
Raleigh, NC 27695-7608
phone: (919) 513-0469
e-mail: mike_williams@ncsu.edu
website: http://www.bae.ncsu.edu/topic/waste-mgmt-center/

The Animal and Poultry Waste Management Center (APWMC) within the College of Agriculture and Life Sciences (CALS) at North Carolina
State University (NCSU) was established in 1996. The APWMC primary mission is to support, conduct and administer programs for research, development and outreach objectives targeting environmental and social issues associated with animal production agriculture. Historically, this program has included establishment of research-based partnerships with land grant universities in the states of Alabama, Georgia, Iowa, Kentucky, Michigan, Mississippi, Missouri, Ohio, Oklahoma, Oregon, and Virginia, as well as with a number of agribusiness companies, environmental groups, and commodity associations in the food-animal industries throughout the world. APWMC current efforts are specifically targeting waste management technologies applicable for all food animal species, however the primary focus is on concentrated swine and poultry production. Broad topics include: a) air, soil and water quality protection impacting animals, production workers and society in general; b) animal and human health issues associated with pathogens of animal origin including zoonotic diseases; c) recovery of value-added products from animal waste/residuals (including energy); d) development and verification of economically feasible ‘environmentally superior technology’ per legislative mandates in N.C; and e) optimization of animal diet rations to lower feed costs and reduce environmental impacts.

Center for Advanced Processing and Packaging Studies
K. P. Sandeep, Site Director

The Center for Advanced Processing and Packaging Studies (CAPPSS) was established in October 1987 to promote cooperative research between university and industrial researchers and to further scientific knowledge in areas of food and pharmaceutical aseptic processing and packaging. The mission and focus of the center is to conduct industrially relevant research directed at developing methods and technologies for the safe production of marketable, high quality aseptic and refrigerated extended shelf-life products. The center is funded by industrial members from the food processing and packaging industries and received support from the National Science Foundation and the universities involved. Students working on CAPPSS projects will be exposed to industrial concerns and be given the opportunity to work first-hand with companies in solving problems and making practical application of their research. Cooperative research opportunities are available in the Department of Food, Bioprocessing and Nutrition Sciences at NC State and also at other universities, which are a part of the center.

Center for Chemical Toxicology Research and Pharmacokinetics
Dr. Ronald Baynes, Director

The Center for Chemical Toxicology Research and Pharmacokinetics (http://www.cvm.ncsu.edu/cctrp) performs scientific research on cutaneous function and structure focused on cutaneous toxicity, metabolism and pharmacokinetics and transdermal drug delivery, employing innovative animal and mathematical models and other predictive systems including cell cultures and novel analytical techniques. Current research is focused on the absorption of chemical mixtures and the toxicology of nanomaterials. This provides the necessary research base to support a rigorous graduate and post-graduate training program in comparative pharmacology and toxicology designed to produce health scientists for academia, industry and government. Besides laboratory research, CCTR also operates the US and global Food Animal Residue Avoidance Databank (FARAD), performs the residue avoidance data analysis, and provides assistance to those who have questions about how to prevent residues in animal-derived food.

Center for Engineering Applications of Radioisotopes
Robin P. Gardner, Director

The Center for Engineering Applications of Radioisotopes (http://www.ne.ncsu.edu/research) was established at North Carolina State University in 1980 to advance the measurement use of radioisotopes (and radiation) and to produce highly trained graduate students and postdoctoral professionals for that industry. CEAR’s faculty, Post Docs, and graduate students continue to do research at the frontier of this area, which by its very nature applies to a very broad area of technologies and sciences. CEAR has had government contracts with the USAEC, NASA, the National Cooperative Highway Research Program, EPA, NSF, NIH, the International Atomic Energy Agency (IAEA), NNSA/DOE, and Los Alamos National Laboratory (LANL) and industrial contracts with EXXON, DuPont, Alcoa, Energy Technologies Inc (ETI), Amoco, Conoco, ARCO, Mobil, Halliburton, Baker Atlas, Weatherford, Teleco, Japan National Oil Company, Shell, Computalog, Pathfinder, and Hexion (now Momentive). While this area of research and application is primarily experimental by nature, CEAR has concentrated from the beginning on the mathematical modeling (especially by Monte Carlo simulation) that is essential to understanding and use of this technology.

Center for Research in Scientific Computation
H. T. Banks, Director

The Center for Research in Scientific Computation (CRSC) (http://www.ncsu.edu/crsc) is a formally recognized, multidisciplinary center of the greater University of North Carolina System. The CRSC is administered by NC State and the College of Physical and Mathematical Sciences. The purpose of the center is to promote research in applied scientific computation and to provide a focal point for research in modeling, computational methods, and applied mathematics. Data-intensive and/or computationally intensive problems provide ideal projects for training undergraduate and graduate students in applied mathematics. With a wide range of computational methodologies, students and post doctoral fellows address important issues in applications involving model development and control design.

Research topics of interest to CRSC faculty include a variety of problems in scientific modeling and computation, numerical analysis, and numerical optimization with applications to such areas as fluid mechanics and flow control, smart materials and structures, nondestructive testing, acoustics, material sciences and manufacturing processes, population dynamics, environmental sciences, signal processing, and a broad range of biomedical and biological modeling. The CRSC, in cooperation with the Department of Mathematics, sponsors a university/industry research project program. The main goal of the Industrial Applied Math Program (IAMP) is to provide substantive non-academic research related experiences for undergraduate and graduate students, postdoctoral and faculty participants while contributing to the research efforts of industrial participants.
Center for Transportation and the Environment

Downey Brill, Director

The Center for Transportation and the Environment conducts programs of research, education, and technology transfer that seek to mitigate the impacts of surface transportation on the environment. Funded in part by the U. S. Department of Transportation and the North Carolina DOT, CTE is the only university transportation in the country that pursues ways to improve surface transportation systems while protecting the environment. CTE is considered a national resource for current information about transportation and environmental research, policies, and best practices. The center conducts an innovative and aggressive outreach program, using satellite- and computer-based technologies, to assist transportation and environmental professionals with their most critical information needs. For more information, visit CTE’s website (http://www.itre.ncsu.edu/cte).

Institute for Emerging Issues

Anita Brown-Graham, Director

The Institute for Emerging Issues (IEI) is a public policy, think-and-do-tank at NC State University. Through research, ideas, debate and action, IEI is a catalyst for innovative public policy, engaging students, faculty and the private sector in its ongoing programs of work. Encouraging civic leadership in business, government and higher education, IEI frames future challenges for North Carolina by identifying and researching emerging issues, specifically around topics that relate to the state’s growth and economic development.

To learn more about IEI, please visit http://iei.ncsu.edu/ or call (919) 515-7741.

Institute for Transportation Research and Education (ITRE)

Nagui M. Roupahil, Ph.D., Director

The Institute for Transportation Research and Education is an inter-institutional center of the University of North Carolina system. Chartered by the North Carolina General assembly in 1978, ITRE conducts transportation research and training for numerous public agencies at the federal, state, and local levels of government and private industry. Additionally, the Institute provides financial support and research opportunities for undergraduate and graduate students from various disciplines. The Institute is comprised of several specialty groups including public transportation, highway systems, visual analytic, modeling and simulation (VAMS) and pupil transportation. The Institute is also the home of the Center for Transportation and the Environment (CTE) and the North Carolina Local Transportation Assistance Program (LTAP), both federally-funded centers. To learn more about ITRE, please visit us at http://itre.ncsu.edu, or call us at (919) 515-8899.

Integrated Manufacturing Systems Engineering Institute

Steve Jackson, Director

The Integrated Manufacturing Systems Engineering (IMSE) Institute (http://www.imsei.ncsu.edu) 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, and mechatronics, and bio and medical device manufacturing.

Nanofabrication Facility

M.C. Ozturk, Director

The NC State University Nanofabrication Facility (http://www.nnf.ncsu.edu) offers NC State faculty and students the ability to fabricate micro/nano-structures and supports a large spectrum of interdisciplinary projects from different colleges and departments on topics including renewable energy, high speed electronics, memory, sensors and biotechnology. The facility is also open to users from other academic institutions and industry. The use of the facility by local industry for research and development is especially encouraged. The facility operates in a 7,400 sq. ft. Class 100/1000 clean room located in the Monteith Research Center of the Centennial Campus. The facility provides state-of-the-art equipment and processes for patterning via
projection (193 nm and i-line), proximity and nano-imprint lithography, thin film deposition by physical and chemical vapor deposition, chemical and plasma etching, Si oxidation and doping, annealing and Si/SiGe Epitaxy by ultrahigh vacuum rapid thermal chemical vapor deposition. Flexible equipment sharing programs enable both academic researchers and industry to install their tools in NNF space for shared use. The facility is also used as a teaching laboratory for a variety of undergraduate and graduate level interdisciplinary courses offered in five engineering departments including electrical, mechanical, chemical, materials and industrial engineering.

Nonwovens Institute

B. Pourdeyhimi, Director

The Nonwovens Institute is the world’s first accredited academic program for the interdisciplinary study of engineered fabrics through an innovative partnership of industry, government, and academia. The institute was established February 2007 to develop, educate, and train the next generation of industry professionals. The Nonwovens Institute serves the nonwovens and affiliated industries through research, training, product development, and test-bed facilities.

The research arm of the institute is the Nonwovens Cooperative Research Center (NCRC). NCRC was founded in 1991 as a State-Industry University Cooperative Research Center from matching grants from the National Science Foundation, the State of North Carolina, and the Industry. NCRC supports over 30 graduate students from engineering, textiles, and natural resources. The center provides opportunities to gain hands-on experience in nonwovens research to students studying toward various degrees. An undergraduate minor in the science of nonwovens is offered as well as a Graduate Certificate in Nonwovens. Faculty members from NC State, Georgia Tech, University of Illinois at Chicago, University of Akron, etc., are involved in several research projects funded by NCRC. Over 65 companies are industrial members. This includes the seven top roll goods producers representing over half of all worldwide sales in this area. Industrial members come from many countries including Germany, Italy, Japan, Korea, and Canada.

Contact: EMAIL: nonwovens@ncsu.edu and Website: http://www.thenonwovensinstitute.com/

Nuclear Reactor Program

Ayman I. Hawari, Director

The mission of the Nuclear Reactor Program is to enhance, promote, and utilize the PULSTAR research reactor and associated laboratory facilities for research, teaching, and extension. Specialized facilities are available to university faculty, students, state and federal agencies, and industry. The laboratory contains the 1 megawatt steady-state, pool-type, PULSTAR nuclear reactor with a variety of associated academic, testing, and research facilities including: Distance Learning through Video and Internet Tele-conferencing; an ultracold neutron source, a neutron radiography facility; an intense slow positron beam facility; a powder neutron diffraction facility; a neutron activation analysis and radioisotope laboratory; a low level counting laboratory equipped with high purity germanium gamma spectrometers and beta liquid-scintillation systems; and a Cobalt-60 gamma irradiation facility.

The 50,000 square-foot Burlington Engineering Laboratory complex on the NC State campus houses the Department of Nuclear Engineering and the 1 MW PULSTAR Nuclear Research Reactor Facility.

Contact: e-mail: ayman.hawari@ncsu.edu; website: http://www.ne.ncsu.edu/nrp/index.html; Phone: (919) 515-7294

Oak Ridge Associated Universities (ORAU)

NC State has been a sponsoring institution of Oak Ridge Associated Universities (ORAU) since 1949. ORAU is a private, not-for-profit consortium of 97 doctoral granting colleges and universities which also manages the Oak Ridge Institute for Science and Education (ORISE) for the U. S. Department of Energy (DOE). ORAU has principle offices located in Oak Ridge, Tennessee and staff at 17 locations in 16 states. Founded in 1946, ORAU provides and develops capabilities crucial to the nation’s technology infrastructure, particularly in energy, education, health, and the environment. ORAU works with and for its member institutions to help faculty and students gain access to federal research facilities; to keep members informed about opportunities for fellowship, scholarship, and research appointments; and to organize research alliances among members.

ORAU’s University Partnerships Office seeks opportunities for partnerships and alliances among ORAU’s members, private industry, and major federal facilities. Activities include faculty development programs, such as the Ralph E. Powe Junior Faculty Enhancement Awards, travel awards to enable collaboration, and support for events (see www.orau.org (http://www.orau.org)).

Through ORISE, undergraduates, graduates, postgraduates, as well as faculty enjoy access to a multitude of opportunities for study and research at over 200 locations. Many of these programs are designed to increase the numbers of students from underrepresented groups pursuing degrees in science and engineering-related disciplines. A comprehensive listing of these programs and other opportunities can be found at see.orau.org (http://see.orau.org). Contact the NC State Councilor to ORAU for more information about ORAU programs or visit www.orau.org (http://www.orau.org) that provides a description of programs and opportunities along with the name and contact information of the NC State Councilor.

Plant Disease and Insect Clinic

Website: www.ncsu.edu/pdic

The Plant Disease and Insect Clinic (PDIC) at North Carolina State University helps commercial growers and the public grow healthy plants by diagnosing plant disease and insect problems. In consultation with faculty in Plant Pathology, Entomology, and cooperating departments, the PDIC recommends ways to treat or prevent plant disease and insect problems after diagnosis. The PDIC was founded in the Department of Plant Pathology as the Plant Disease Clinic in 1951. The Department of Entomology joined in 1970 to form the PDIC. The PDIC receives about 3,000 samples from North Carolina and other states each year for diagnosis. As a member of the National Plant Diagnostic Network and the Southern Plant Diagnostic Network, and in cooperation with state and federal agencies, the PDIC helps to detect new or unusual outbreaks of plant diseases and insects to safeguard plant health in North Carolina’s crops, landscapes, and forests. To learn more about the PDIC, please visit us at http://www.ncsu.edu/pdic
Precision Engineering Center

The Precision Engineering Center, established in 1982, is a multidisciplinary research and graduate engineering program dedicated to providing new technology for high precision manufacturing. Research activity in the PEC involves measurement and fabrication of optical, biological, electronic, or mechanical devices where the tolerances required for operation are on the order of 1 part in 100,000; that is, for a 25 mm (1 inch) long part the error must be less than 250 nm (250 x 10-9m). Components that require this technology include contact lenses and other optical components, hard disk heads for computer memory devices, integrated circuits, space telescopes, injection molding dies, bearings and gears. Current projects in the center involve development of new mechanical designs and control algorithms, novel actuators that include piezoelectric and linear motors, unique fabrication and measurement techniques and high-speed controllers to implement these concepts. With support from government and industry, the PEC pulls together faculty, staff, and students from across the university to develop new ideas and transfer those ideas to US industry.

Sea Grant College Program
Susan White, Executive Director
1575 Varsity Drive, Varsity Research Bldg. Module 1NC State University Raleigh, NC 27695 (919) 515-2454; Website: www.ncseagrant.org (http://www.ncseagrant.org)

The North Carolina Sea Grant College Program is a state/federal partnership program involving all campuses of the UNC system, and, as appropriate, other universities in North Carolina. Headquartered at NC State, NC Sea Grant also has regional extension offices in three NC coastal communities. Sea Grant combines the universities’ expertise in research, extension and education to focus on practical solutions to coastal problems. Graduate and undergraduate research opportunities are available through Sea Grant funded faculty researchers and through several different North Carolina and nationally-based fellowship programs.

Southeastern Plant Environment Laboratory—Phytotron
C.H. Saravitz, Director
Website: www.ncsu.edu/phytotron

The Southeastern Plant Environment Laboratory, commonly called the Phytotron, is especially designed for research studies on the response of biological organisms to their environment. A high degree of environmental control makes it possible to simulate the wide range of climates found in tropical, temperate and northern zones and is organized to allow many combinations of environmental factors to be studied simultaneously within the more than 60 growth chambers and greenhouses. The Phytotron provides precise control of temperature, light, humidity, carbon dioxide, water, and nutrition for research projects.

The NC State Phytotron concentrates on applied and basic research related to agricultural problems encountered in the southeastern United States. Special facilities are available for plant pathology and air pollution problems, as well as temperature and pH controlled hydroponic units for root environment studies. The facilities are available to the resident research staff, participants in NC State’s graduate research program, and visiting scientists.

Triangle National Lithography Center
Mehmet C. Ozturk, Director

Operating under the NC State University Nanofabrication Facility offers state-of-the-art lithography services. The facility is equipped with an ASML 193 nm wavelength deep-UV stepper capable of forming nanostructures down to a minimum feature size of 80 nm on 6 inch wafers. Other lithography services include i-line projection lithography with a GCA stepper and contact/proximity printing with two Karl Zuss mask aligners that can handle sample sizes ranging from small chips to 6 inch wafers. The 6" Karl Zuss MA6 aligner is capable of backside alignment as well.

Triangle Universities Laboratory
Calvin R. Howell, Director
TUNL (http://www.tunl.duke.edu) is a laboratory for nuclear physics research, funded by the US Department of Energy. Located on the campus of Duke University in Durham, the laboratory is staffed by faculty members and students from Duke University, UNC-Chapel Hill, and NC State. There is extensive collaboration between the participating universities and with visiting physicists from the United States and abroad. The accelerators are a 15-MeV tandem Van de Graaff accelerator and low-energy accelerators dedicated specifically to nuclear astrophysics studies. The newest addition to the TUNL accelerators is the High-Intensity Gamma-ray Source (HIGS) at the Duke Free-Electron Laser Laboratory. Polarized and pulsed beams are available as well as cryogenically polarized targets. In addition, TUNL physicists perform experiments at major national and international nuclear physics facilities.

Water Resources Research Institute
Susan White, Director
website: www.ncsu.edu/wrri/

The Water Resources Research Institute (WRRI) of the University of North Carolina administers and promotes federal/state partnerships in research and information transfer on North Carolina’s water research needs. Located at NC State, WRRI serves all campuses of the UNC system and funds research conducted by faculty and students of senior colleges and universities in North Carolina. Findings from research funded by the Institute help local, state, and federal agencies make better decisions in managing water resources. Graduate and undergraduate research opportunities are available through WRRI funded faculty researchers and student internships are available through its partnership with the U.S. Geological Survey. WRRI also sponsors students to present oral and poster presentations each spring at its annual conference.

Financial Aid
Website: http://financialaid.ncsu.edu

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 as you navigate the process of applying for financial aid.

To be considered for financial assistance by the Office of Scholarships and Financial Aid, a student must complete the federal government’s
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 FAFSAs to the federal processor by March 1 are given first priority for need-based scholarship and grant consideration.

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.

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 government, 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 (http://www.ncsu.edu/finaid/academicprogress.html) on Satisfactory Academic Progress for Financial Aid Eligibility.

Please visit the Office of Scholarships & Financial Aid website (http://financialaid.ncsu.edu) for more detailed information regarding types of aid and how to apply.

**Pack Promise**

NC State’s mission has always been to extend a quality education to the broadest range of deserving students, regardless of income or financial need. Pack Promise (http://www.ncsu.edu/packpromise) is a formal extension of that mission, reaffirming NC State’s historical commitment to access, affordability, student success, and encouraging first-generation college students to attend college. The program guarantees a low-debt education, meeting 100% of participants’ demonstrated financial need through a combination of grants, scholarships, Federal Work-Study employment and student loans. Students who submit the FAFSA are automatically considered for Pack Promise.

**Scholarships**

NC State offers a variety of need-based scholarships (http://financialaid.ncsu.edu/types-of-aid/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, exhibit special talents or characteristics and demonstrate financial need. To apply for these scholarships, simply complete the FAFSA by March 1. Additionally, there are a limited number of academic scholarships for incoming freshmen which are awarded without regard to financial need. Students who apply for admission by November 1 are automatically considered for these scholarship programs.

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 specific criteria, application materials, and important deadlines.

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. A listing of some of these search services (http://www.ncsu.edu/finaid/schpoutside.html) is available on the Office of Scholarships & Financial Aid website (http://www.ncsu.edu/finaid).

**University Academic Scholarships**

**Park Scholarships**

The Park Scholarships program 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 campus, state, nation, and world.

Approximately 40 scholarships will be awarded this year to outstanding high school seniors 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 full cost of education 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. With a generous grant from the Park Foundation, the Park Scholarships program was established in 1996 to provide a superb educational opportunity for exceptionally talented and well-prepared young men and women who merit the intellectual challenge of a distinguished faculty and a superior university. To date, sixteen classes of Park Scholars have graduated and have built a vibrant alumni network. For more information, visit the Park Scholarships website (http://park.ncsu.edu).

**Goodnight Scholars Program**

Founded in 2008 by Dr. Jim and Ann Goodnight, The Goodnight Scholars Program develops North Carolina’s most promising and talented students to become valuable contributors and future leaders in the STEM and Education industries. Students who are selected to be a part of the Goodnight Scholars community participate in a variety of activities which focus on enhancing critical skills necessary to thrive in social, professional, and service-oriented environments while also preparing them to become invested members of the NC State community.

Each year, the Goodnight Scholars Program awards 50 renewable scholarships to entering first year students. The scholarship, valued at $17,500 supports a Goodnight Scholar’s tuition, fees, housing, and other university expenses. The scholarship is targeted at middle income families as North Carolina and is limited to students studying in the STEM disciplines or in affiliated Education majors. In addition to the scholarship, Goodnight Scholars are given the opportunity to apply for enrichment grants which can be used for a variety of personally and professionally enriching experiences including international travel, undergraduate research, and entrepreneurial endeavors. Last, but certainly not least, Goodnight Scholars are educated and inspired by...
professionals in the STEM and Education industries through year-round programming featuring NC State faculty & staff, professionals in the community, and globally-recognized industry leaders.

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 (http://emas.ncsu.edu/goodnight) 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 40 years at NC State has produced 1000+ outstanding alumni shaped by the Robert Greenleaf model of Servant Leadership. Supported through endowments held by the NC State Alumni Association, over 80 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 tuition stipend, all contingent upon a students’ 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 and the first semester transcript at NC State (minimum 3.25 GPA); high school transcripts 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 of the greater good are common qualities which are sought and developed in all Fellows.

Special Academic Programs

Cooperative Education Program (http://www.ncsu.edu/co-op_ed)

This optional program is structured so that students will alternate semesters of study with semesters of practical work as sophomores and juniors. Academic work is spread over a three-year period to permit alternating academic semesters with work-experience semesters. Students earn a salary while they are in industry. This income can prove useful in offsetting college expenses. The Co-op plan can be completed in five years, during which time the student receives 12 to 18 months of industrial experience.

NC State University offers undergraduate students formal opportunities for valuable experiential learning through the STEP (Short-Term Experiential Partnership) Program. STEP is an educational option that allows students to gain real workplace experience in corporate settings, schools, hospitals, government agencies, and non-profit organizations. The STEP Program is open to all NC State undergraduate students who are in good academic standing.

Students in all curricula may apply for the Co-op program if they have a grade point average of 2.5 or better. Application for admission into the Co-op program should be made early in the spring semester of the freshman year, however, it will be considered during the sophomore year or the first semester of the junior year. Undesignated students must be admitted into a degree program prior to beginning the first Co-op assignment. Further information may be obtained from the Cooperative Education Program, 2100 Pullen Hall.

NC State University offers undergraduate students formal opportunities for valuable experiential learning through the STEP (Short-Term Experiential Partnership) Program. STEP is an educational option that allows students to gain real workplace experience in corporate settings, schools, hospitals, government agencies, and non-profit organizations. The STEP Program is open to all NC State undergraduate students who are in good academic standing. Further information may be obtained from the Career Development Center, 2100 Pullen Hall.

Non-Degree Certificate Programs

Non-degree certificate programs are prescribed sets of regular academic courses that offer limited but structured non-degree opportunities. Many are designed expressly for Non-Degree Studies students. The issuing of a certificate from the department or college that offers that program recognizes satisfactory completion of the prescribed courses. Some programs utilize on-campus instruction, while others utilize Internet or videocassette delivery. The inventory of available programs changes over time in response to changing continuing education needs. The following is a sample of available programs: Computer Programming, Geographic Information Systems, Training and Development, Professional Writing, and Textiles. Several programs are designed for students who already possess a bachelor’s degree.

For information concerning enrollment requirements and prescribed courses for a particular certificate program, consult the department or college offering that program or visit the Certificate programs website (http://www.ncsu.edu/nds/certificates).
The Peer Mentor Program

The Peer Mentor Program (PMP) is a student advisory program that targets first-year African American, Native American, and Hispanic students. The program, founded in 1982, recognizes the challenges first-year students face as they embark upon this new and vastly different segment of their lives. PMP acknowledges the complexity of this situation for minority students, particularly on a predominately white campus. The primary objective of the Peer Mentor Program is to ease this situation by contributing to and aiding in the adjustment of these students to the academic, emotional and social aspects of college life. From a broadened perspective, the program aims to increase and maintain the enrollment and retention of minority students, ensuring that each student maximizes his/her potential.

African American, Native American, and Hispanic upperclassmen are selected as mentors through an application and interview process and are subsequently paired with one to three first-year students. In general, the mentor maintains close contact throughout the year with his/her mentee(s) and acts as a “big brother/sister,” advisor and oftentimes, as a friend. Whenever possible, freshmen are paired with upperclassmen enrolled in the same major and/or college. Through training seminars, a mandatory course and personal experience, peer mentors are prepared to assist first-year students with problems, questions and situations that may arise, or refer them to the appropriate university resources. Ultimately, the peer mentor works to ensure a smooth transition from high school to the college environment. Though it is impossible to determine all of the many benefits of the program for each individual, the Peer Mentor Program remains rewarding, both intrinsically and extrinsically, for first-year students as well as mentors.

This program is coordinated by The Department of Multicultural Student Affairs, call (919) 515-3835 for more information.

Supplemental Instruction

Supplemental Instruction (SI) is a series of weekly review sessions for students in selected sections of historically difficult courses. SI is provided for all students who want to improve their understanding of course material and improve their grades. At each session, students are guided through material by an SI leader, a competent student who has previously taken the course. Three or four sessions are offered at various times each week, usually during the late afternoon and early evening. Attendance is voluntary. A schedule of sessions can be found on the SI website (http://www.ncsu.edu/si).

Tuition and Fees

Note: Since tuition and fees for the 2015-2016 school year were not approved by the publication date, the rate schedules listed below represent estimated rates. These rates are subject to change. For the most current tuition and fee information available, please see the tuition information on the Cashier’s Office website (http://www.fis.ncsu.edu/cashier/tuition).

• North Carolina Resident: $4,275 per semester (effective 2015-2016 academic year)
• Nonresident: $12,450 per semester (effective 2015-2016 academic year)

A statement of tuition and fees is posted on each student’s account that registered during a normal registration period. Students 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 $8,175 per semester for tuition.

Estimated Annual Undergraduate Expenses
(Independent Student living on Campus)

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<thead>
<tr>
<th>Tuition and Fees</th>
<th>First Semester</th>
<th>Second Semester</th>
<th>Full Year</th>
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</thead>
<tbody>
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<td>890</td>
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<tr>
<td>Transportation - off campus/out of state</td>
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<td>890</td>
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Total Estimated Expenses

<table>
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<th>First Semester</th>
<th>Second Semester</th>
<th>Full Year</th>
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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 Cashier’s website (http://www.fis.ncsu.edu/cashier/tuition/de.asp) 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 (http://healthcenter.ncsu.edu).

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 Office of Scholarships and Financial Aid website (http://www7.acs.ncsu.edu/financial_aid/costs.htm).
Expenses Other than Tuition and General Fees

Application Fee: A nonrefundable fee $75 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 2015-2016 residence hall room rent ranges from $2,840 to $3,745 per semester and plus a mandatory $115.00 ResNet (internet) charge. The Wolf Village Apartments charge $3,075 per semester plus mandatory charges for ResNet ($115) and cable television ($46) per person per semester. Wolf Ridge Apartments range form $4,158 per person to $5,530 per person per semester plus mandatory charges for ResNet ($115) and cable television ($46) per person per semester.

Meals: During their first academic year, new freshmen electing to reside 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 2015-2016 range from $750 to $1,750. 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 $538 per semester for purchasing books and supplies.

Personal Expenses: Personal expenses vary widely among students but the estimate of $750 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 $430 for the 2015 Fall Semester, the 2016 Spring Semester, or the combined 2016 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.

College of Engineering Computing Fee: All students enrolled in the College of Engineering, both graduate and undergraduate, will be billed a $45 per semester fee to support the Engineering Computing Facility. Payment of the fee will provide students with access to standalone workstations that comprise the Engineering Computing Facility. 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 $300/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 Cashier’s Office website (http://www.fis.ncsu.edu/cashier/tuition) or by contacting:

University Cashier’s Office
NC State, Box 7213
Raleigh, North Carolina 27695-7213
919-515-2986 (Option 6), 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 Cashier’s website 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 Cashier’s website. 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 Cashier's Office website (http://www.fis.ncsu.edu/cashier/forms/appeal.asp).

Tuition Surcharge*

Any student in the UNC system may be subject to the 50% tuition surcharge if he/she accumulates more than 140 credit hours toward his/her first 4-year baccalaureate degree. A student enrolled in an officially designated 5-year degree program may be subject to the tuition surcharge if he/she accumulates 110% of the necessary credit hours required for graduation.

For more information about tuition surcharge calculation, and coursework or circumstances that qualify as exempt from the surcharge, visit the Cashier’s Office Website (http://www.fis.ncsu.edu/cashier/tuition/surcharge.asp).

* As set forth by North Carolina General Statute 116-143.7, Section 9.10(a), effective with the 2010-2011 academic year.

Residence Status for Tuition Purposes

The basis for determining the appropriate tuition charge rests upon whether a student is a resident or a nonresident for tuition purposes. It is the role and responsibility of each public institution of higher education to make an initial classification of each student as in-state or out-of-state for purposes of tuition depending upon the determination of “legal residence” of the student. Students are provided four opportunities to have their classifications reviewed:

First, a student’s initial residency determination is based on information provided as a part of the admission process.
Second, a student who believes that the initial classification is incorrect or experiences a change in circumstances that the student now believes makes him or her eligible for in-state status may seek re-classification at the institution.
Third, a student who believes that the re-classification determination is incorrect may seek an appeal to the Residence Appeals Board at the institution. 

Fourth, a student who believes that the appeal determination is incorrect may seek a final appeal through the State Residence Committee.

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.

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 review by the institution. 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 for enrollments while the member of the armed services is abiding in this State incident to active military duty in this State. In the event the active duty member of the armed services is reassigned outside of North Carolina or retires, the member shall continue to be eligible for the in-State tuition rate and applicable mandatory fees so long as the member is continuously enrolled in the degree or other program in which the member was enrolled at the time the member is reassigned. In the event the active duty member of the armed services receives an Honorable Discharge from military service, the member shall continue to be eligible for 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.

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 to be a legal resident of the State so long as he or she does not abandon North Carolina domicile.

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 instate tuition rate without having to meet the usual 12-month duration 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 corresponding 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 immigrant or non-immigrant status and does not give the EAD holder the legal capacity to establish residency for tuition purposes in this state.

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.

For additional information related to residency for tuition purposes, please view the North Carolina Residency Requirements (http://www.northcarolina.edu/legal/residence).

This information is subject to change.

University Housing

Living on campus is an investment in your success at NC State. With so many programs, activities, studies, research, classes, exams, labs and more, you have plenty to focus on during your time here. Let University Housing take the hassle out of finding the perfect place to live so you can spend more time focusing on your academics. Our residence halls (http://housing.ncsu.edu/view-residence-halls) and on-campus apartments
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. During the summer terms, housing is provided for any enrolled student as space permits.

For more information about living on campus, contact:
University Housing
housing@ncsu.edu
(919) 515-2440
http://housing.ncsu.edu/

Or visit our office at: 1112 Pullen Hall, Raleigh NC 27695-7315.

Living and Learning Villages
NC State’s Living and Learning Villages (http://housing.ncsu.edu/village-choices) are interested-based living communities that engage students both inside and outside the classroom. Villages provide an unparalleled living experience where you’ll make life-long friends and immerse yourself in the NC State community.

Arts Village
The Arts Village unites students from various personal and academic backgrounds who have a passion for the arts and expose them to theater, visual arts and crafts, music, dance and more.

EcoVillage
The EcoVillage provides an interdisciplinary educational experience that prepares students for life-long sustainable living.

Engineering Village
The Engineering Village is an exciting new Living and Learning Village exclusively for first year students passionate about engineering! Engineering Village provides personal, professional and leadership development.

Entrepreneurs Village
Entrepreneurs Village (http://housing.ncsu.edu/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.

First Year College Village
The First Year College 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
Global Village is a living and learning community for those interested in living and interacting with people from differing backgrounds, experiences, countries and viewpoints.

Honors Village
The University Honors Village provides a unique living-learning environment for students in the University Honors Program (UHP). Academic engagement and research opportunities are core to the mission of the University Honors Program and student experience in the Honors Village assists them in completing UHP requirements.

Impact Leadership Village
The Impact Leadership Village 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 world.

SAY Village
The 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.

Scholars Village
The University Scholars Village, a collaborative effort between the University Scholars Program and University Housing, is one of the most important components of the University Scholars Program. Life in the Village centers around a wide range of social, cultural and educational activities, all designed to help students become informed citizens, ethical leaders and active contributors to our campus and community.

S.T.A.T.E. Village
The S.T.A.T.E. Village 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.

Wellness Village
The Wood Wellness Village 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
The Women in Science & Engineering (WISE) Village is a living and learning community created for freshman and sophomore women engineers, mathematicians, statisticians and scientists. Live with other goal-oriented women as you pursue your STEM major.

Women Of Welch (WOW)
The Women Of Welch (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.
2015 Fall Semester

<table>
<thead>
<tr>
<th>Date(s)</th>
<th>Day(s)</th>
<th>Description</th>
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<tbody>
<tr>
<td>August 19</td>
<td>Wednesday</td>
<td>First day of classes</td>
</tr>
<tr>
<td>September 7</td>
<td>Monday</td>
<td>Holiday (Labor Day); university closed</td>
</tr>
<tr>
<td>October 8 - 9</td>
<td>Thur - Fri</td>
<td>Fall break; no classes</td>
</tr>
<tr>
<td>November 25 - 27</td>
<td>Wed - Fri</td>
<td>Thanksgiving vacation; no classes</td>
</tr>
<tr>
<td>November 26 - 27</td>
<td>Thur - Fri</td>
<td>Thanksgiving holiday; university closed</td>
</tr>
<tr>
<td>December 4</td>
<td>Friday</td>
<td>Last day of classes</td>
</tr>
<tr>
<td>December 7</td>
<td>Monday</td>
<td>Reading Day</td>
</tr>
<tr>
<td>December 8 - 16</td>
<td>Tues - Wed</td>
<td>Final examinations</td>
</tr>
<tr>
<td>December 18</td>
<td>Friday</td>
<td>Fall graduation exercises</td>
</tr>
<tr>
<td>December 24 - January 1</td>
<td>Thurs - Fri</td>
<td>Winter holiday; university closed</td>
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2016 Spring Semester

<table>
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<tr>
<th>Date(s)</th>
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<tbody>
<tr>
<td>January 6</td>
<td>Wednesday</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 7 - 11</td>
<td>Mon - Fri</td>
<td>Spring break; no classes</td>
</tr>
<tr>
<td>March 25</td>
<td>Fri</td>
<td>Spring holiday; no classes</td>
</tr>
<tr>
<td>April 25</td>
<td>Monday</td>
<td>Last day of classes</td>
</tr>
<tr>
<td>April 26</td>
<td>Tues</td>
<td>Reading Days</td>
</tr>
<tr>
<td>April 27 - May 5</td>
<td>Wed - Thurs</td>
<td>Final examinations</td>
</tr>
<tr>
<td>May 7</td>
<td>Saturday</td>
<td>Spring commencement</td>
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2016 First Summer Session

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<tr>
<th>Date(s)</th>
<th>Day(s)</th>
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</thead>
<tbody>
<tr>
<td>May 16</td>
<td>Monday</td>
<td>First day of classes</td>
</tr>
<tr>
<td>May 30</td>
<td>Monday</td>
<td>Holiday (Memorial Day); university closed</td>
</tr>
<tr>
<td>June 17</td>
<td>Friday</td>
<td>Last day of classes</td>
</tr>
<tr>
<td>June 20 - 21</td>
<td>Mon - Tues</td>
<td>Final examinations</td>
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2016 Second Summer Session

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<tr>
<th>Date(s)</th>
<th>Day(s)</th>
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<tbody>
<tr>
<td>June 23</td>
<td>Thursday</td>
<td>First day of classes</td>
</tr>
<tr>
<td>July 4</td>
<td>Monday</td>
<td>Holiday (Independence Day); university closed</td>
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<tr>
<td>July 27</td>
<td>Wednesday</td>
<td>Last day of classes</td>
</tr>
<tr>
<td>July 28 - 29</td>
<td>Thurs - Fri</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 (June 2015). Changes may be announced in official university publications subsequent to this publication and maintained on the Registration and Records website (http://www.ncsu.edu/registrar/calendars).
Academic Degrees and Programs

Undergraduate Degrees

College of Agriculture and Life Sciences
Agricultural Business Management; Agricultural and Environmental Technology; Agricultural Science; Agricultural and Extension Education; Animal Science; Molecular and Structural Biochemistry; Biomedical Engineering; Food, Bioprocessing and Nutrition Sciences; Horticultural Science; Natural Resources; Plant and Soil Science; Plant Biology; Poultry Science; Soil and Land Development; Turfgrass Science; Preprofessional Programs - Pre-dental, Pre-medical, Pre-optometry and Pre-veterinary

College of Design
Architecture (fifth year program); Environmental Design in Architecture; Art and Design; Design Studies; Graphic Design; Industrial Design; Landscape Architecture

College of Education
Business and Marketing Education; Elementary Education; Mathematics Education; Middle Grades Education with concentrations in Language Arts and Social Studies or Mathematics and Science; Science Education; Technology Engineering and Design Education

College of Engineering
Aerospace Engineering; Biological Engineering; Biomedical Engineering; Chemical Engineering; Civil Engineering; Computer Engineering; Computer Science; Construction Engineering and Management; Electrical Engineering; Engineering-Mechatronics; Environmental Engineering; Industrial Engineering; Industrial Engineering Furniture Manufacturing; Materials Science and Engineering; Mechanical Engineering; Nuclear Engineering; Paper Science and Engineering; Textile Engineering

College of Humanities and Social Sciences
Africana Studies; Anthropology; Arts Applications; Communication; Criminology; English; English Education option; French; French Education option; History; Interdisciplinary Studies; International Studies; Philosophy; Political Science; Psychology; Religious Studies; Science, Technology and Society; Social Studies Education options; Social Work; Sociology; Spanish; Spanish Education option; Women’s and Gender Studies

Poole College of Management
Accounting; Business Administration; Economics

College of Natural Resources
Environmental Technology and Management; Fisheries, Wildlife, and Conservation Biology; Forest Management; Natural Resources; Parks, Recreation, and Tourism Management; Professional Golf Management; Paper Science and Engineering; Sport Management; Wood Products

College of Sciences
Biological Sciences; Chemistry; Genetics; Geology; Marine Sciences; Mathematics; Meteorology; Microbiology; Natural Resources; Physics; Statistics; Zoology

College of Textiles
Polymer and Color Chemistry; Textile Engineering; Fashion and Textile Management; Textile Technology

Division of Academic and Student Affairs
Environmental Sciences

Graduate Degrees
For information about graduate programs at NC State, including admissions information, deadlines, international applications, financial support, and a list of graduate programs and their requirements, consult the NC State Graduate School website (http://www.ncsu.edu/grad/future-students). Also, please refer to the Graduate Catalog (http://www.ncsu.edu/grad/catalog).

Undergraduate Minors
Some departments at NC State offer undergraduate academic minors for students interested in a program of study in an area outside their major. All minors require at least 15 credit hours and may be either departmental or interdepartmental. Courses within the minor program may be used to satisfy university general education requirements, and the general requirements, including free electives, of a major curriculum, as applicable.

Minors are completely optional, the only requirement being that a student may not minor in the same discipline as their major. Only students who have matriculated into a major are eligible for a minor. A minor cannot be completed after graduating. Students pursuing a minor must consult with the minor coordinator on a plan of work and should file a copy of this plan with the advisor for their major as soon as the minor is declared. The student should also submit a Declare a Minor form signed by the minor coordinator to Registration and Records no later than the end of the regular registration period one semester prior to the semester of graduation. Successful completion of the minor will be noted on the final transcript following graduation. For more information about the minors available at NC State, please see the Minors website (http://oucc.ncsu.edu/minors).

Academic Minors:

Accounting
Africana Studies
Agricultural Business Management
Agricultural and Environmental Technology
Agroecology
American Literature
Animal Science
Anthropology
Applied Ecology
Applied Sociology
Art and Design
Arts Entrepreneurship
Arts Studies
Biological Sciences
Biomanufacturing
Agricultural Institute (p. 54)

Applicants must have graduated from an accredited high school with at least a 2.25 GPA (on a 4.0 scale), or have successfully passed the General Education Development (GED) test before being admitted to the Agricultural Institute at NC State. An Undergraduate Admissions application, a high school transcript and supporting documents must be submitted directly to the Admissions Office at NC State University. One letter of recommendation from someone other than a family member should be submitted directly to the Agricultural Institute Office. The regular college entrance exam (Scholastic Aptitude Test – SAT) is not required, but recommended. The 2.25 minimum high school GPA is waived for transfer students and for applicants 21 years or older at the time of enrollment in the Agricultural Institute. An Associate of Applied Science degree is awarded. Fields of study are:

- Agribusiness Management
- Agribusiness Management with Horticulture Concentration (No new students admitted after Fall 2014)
- Field Crops Technology
- General Agriculture
- Livestock and Poultry Management
• Ornamentals and Landscape Technology
• Turfgrass Management

Arts Studies

NC State offers a rich variety of courses in the history, analysis, and production of the arts - dance, film, music, theatre, and visual arts. Many of these courses are open to students without prerequisite, and are offered by 13 departments in four different colleges of the university.

In addition to these courses, most of which focus on a single art form, the Arts Studies Program offers courses which deal with several arts media or with the arts in connection with science and technology; these courses are listed in the back of this catalog and the schedule of courses each semester under the ARS prefix.

For students who want to concentrate in Arts Studies, a major in Arts Studies is available. It is administered by the Arts Studies Program in the College of Humanities and Social Sciences. In addition, there are minors in Arts Studies, Music, Theatre, Design and Film Studies.

Opportunities for students to participate in arts activities offered by ARTS NC STATE include many instrumental and choral semester student productions in University Theatre, craft instruction in the Craft Center, courses and concerts by the Dance Program, and the exhibitions. For these activities, many of which are integrated with academic courses, see Student Activities in this section of the catalog.

The Arts Studies Program together with the Music Department sponsors the Arts Now Series. The Series includes performances of and lectures about contemporary performance works that include music. Guest performers, composers, dancers, and video artists appearing in the series range from regionally based artists to international guests from Europe and South America.

Pre-professional Programs

Pre-Law Services Office of Advising Support, Information and Services

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. The University Coordinator of Pre-Law Services, in conjunction with the student’s academic adviser, assists any student with an interest in attending law school and provides information and planning strategies to prepare for this process. This can include: what needs to be considered in the academic record; the selection of appropriate electives and concentrations; law schools to consider; as well as, where to look for financial information. The Coordinator 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. At this time, the Pre-Law Advising Program is administratively housed in the Office of Advising Support, Information and Services within the Division of Undergraduate Academic Programs. For further information, contact the University Pre-law Coordinator Mary A. Tetro, 211P Park Shops, (919) 513-0912. You may also visit the Pre-Law website (http://www.ncsu.edu/prelaw).

Pre-Professional Healthcare Programs and Advising: Pre-Med, Pre-Dent, and Pre-Opt, Pre-Pharm, Pre-PT/OT, Pre-PA, Nursing etc.

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. NC State provides a variety of services to help students explore the health professions as a possible career choices and to enhance a student’s competitiveness for admission into a health professions school. These services include the Health Professions Advising Center or Health PAC (see the information below and website link). Health PAC assists with healthcare career planning and advising, mentoring, letters of evaluation, internship and clinical opportunities, as well as numerous programs and resources to help students achieve their educational and career goals in human healthcare. The center also assists in the actual application process including personal statement development, interview preparation and more, all targeted at developing the most competitive, well rounded applicants.

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. Students interested in a program that focuses on Human Biology should visit the following link on the Biological Sciences website (http://bio.sciences.ncsu.edu).

For further information on Health PAC, contact Anita Flick, MD at health_pac@ncsu.edu or visit the Health PAC website (http://hpac.dasa.ncsu.edu).

The Health Professions Advising Center (Health PAC) and the NC State Health Professions Review Committee

In addition to a student’s departmental academic adviser, the university provides the Health Professions Advising Center (Health PAC) to further assist students interested in health careers. Housed in 2720 Bostian Hall, Health PAC is available to all NC State students (including graduate and post bac students as well as alumni). Health PAC is dedicated to mentoring students throughout their college career, helping them to prepare their application for post-graduate studies. The center assists pre-health students by answering questions and helping them explore health career options, locating and obtaining clinical and service experience, and developing future career skills (such as technical writing, research review, etc.). Health PAC also helps students compile an Achievement Portfolio that provides an accounting of their academic, clinical, service/community, and social achievements for incorporation into their application to health programs and for the subsequent interview process.
The NC State Health Professions Review Committee is available to review student applications and to prepare a university committee recommendation, which is then submitted to each of their selected schools. The composite includes not only each student’s individual letters of recommendation but also a university recommendation of the applicant along with a detailed letter from the NC State Health Professions Review Committee Chair highlighting each student’s strengths and accomplishments. Many professional programs rely heavily on these university recommendations and often require them as a component of their application screening process.

For more information on the Health Professions Advising Center and NC State Health Professions Review Committee, please contact Anita Flick, MD at health_pac@ncsu.edu or visit the Health Professions website (http://hpac.dasa.ncsu.edu).

Pre-Veterinary Program

This area of study is a non-degree option offered by the College of Agriculture and Life Sciences. This option is available to students majoring in animal science, poultry science, zoology, or biological sciences as well as in many other science curricula, such as biochemistry or chemistry. If a student is accepted to veterinary medical school before completion of their undergraduate degree, some course credits may be transferable from the veterinary program toward completion of the Bachelor of Science degree. Arrangements for this procedure should be made with the degree granting school or department prior to entering veterinary college. For further information, contact the Academic Programs Office of the College of Agriculture and Life Sciences, (919) 515-2614, or the Admissions Office for Veterinary Students of the College of Veterinary Medicine, (919) 513-6205, for general information concerning admission to the Doctor of Veterinary Medicine program at NC State.

Academic Programs and Services

Academic Programs and Services (APS) (http://dasa.ncsu.edu)

Park Shops
NC State Box 7105
Raleigh, NC 27695-7105
Website: dasa.ncsu.edu
Phone: 919-515-3037 Fax: 919-515-4416

Jose Picart, Vice Provost

NC State University’s Academic Program and Services (APS) unit promotes excellence and effectiveness in undergraduate education. APS is charged with the development of a coherent vision for undergraduate education, the coordination of academic policy and curricular programming, and the strengthening of all academic support programs. APS seeks to engage undergraduate students in a wide range of academic activities that enhance their learning and result in more profound intellectual and civic development.

Academic Advising Services (AAS)

2751 Cates Avenue
FYC Commons and 211 Park Shops
NC State Box #7925
Raleigh, NC 27695-7925
Website: http://advising.ncsu.edu

Phone: 919-515-8130 Fax: 919-515-8267
Carrie McLean, Executive Director

Academic Advising Services (AAS) offers face-to-face, telephone, virtual, and email academic advising to NC State University degree seeking students who are exploring a change of major or needing advising assistance as they transition to a new major. Cross-curricular academic advisors rotate through a daily walk-in schedule. AAS advisors provide current information on general education, declaring majors and/or minors, and academic policies. Students who need long-term advising assistance may request to transfer into AAS (undesignated status) and be assigned to an AAS advisor. AAS offers a Career Exploration and Development course for students who need a structured major exploration experience. AAS also maintains an extensive and up-to-date advising FAQ database on the AAS webpage, a great resource for all students and advisors.

Summer START (Accelerated Summer Academic Programs (ASAP) (http://asap.dasa.ncsu.edu)

306 Park Shops
NC State Box 7105
Raleigh, NC 27695-7105
Website: http://asap.dasa.ncsu.edu/summer-start
Phone: 919-513-1883 Fax: 919-515-4416

Barbara Kirby, Associate Vice Provost

Summer START is designed to assist new freshmen with the transition from high school to college through five weeks of academic courses and co-curricular activities. Summer START will provide a strong introduction to the culture of NC State and to the city of Raleigh. Summer START’s living and learning experience will be limited to 400 freshmen. Last year’s program represented students from 8 different countries, 11 different states and spread across 40 different majors representing all 10 colleges at NC State. Summer START works closely with each college to ensure students will be enrolled in academic courses towards their curriculum to get them on the path to graduation. In addition to up to eight credit hours of university coursework, many optional co-curricular, college based, leadership, and service programs are planned throughout the week and on the weekends. This year the program has been expanded to include new Transfer students and other new student program initiatives.

College Advising Corps (CAC) (http://advisingcorps.dasa.ncsu.edu)

211 Park Shops
NC State Box 7105
Raleigh, NC 27695-7105
Website: http://advisingcorps.dasa.ncsu.edu/
Phone: 919-515-5247, Fax: 919-515-4416

Patti Baynes, Program Manager

In 2014, the College Advising Corps launched a partnership with the John M. Belk Endowment to expand to partner institutions in North Carolina. With over 685,000 rural students, North Carolina has one of the highest concentrations of rural students in the nation. With significant need to increase college access for high school students in rural North Carolina
and the substantial impact the Advising Corps' had already demonstrated in rural North Carolina, the partnership with the Belk Endowment allowed the Advising Corps to partner with four of North Carolina's top Higher Education institutions.

"The NC State College Advising Corp is extending educational opportunities to all students."

The NC State College Advising Corps was launched the summer of 2014, starting with nine advisors serving nine high schools. As recent graduates of NC State, the advisors are placed in underserved, rural high schools to assist students who may not have seen college as a possibility. They are often the key resources for students to persist in their education beyond high school and become mentors within the school setting. Further, the NC State College Advisor serves as a role model for service and an expressive voice of the importance of an educated workforce.

Disability Services Office (DSO)

Student Health Center and 204 Park Shops
NC State Box 7509
Raleigh, NC 27695-7509
Website: http://dso.dasa.ncsu.edu
Phone: 919-513-2840
Mark Newmiller, Director

The Disability Services Office (DSO) collaborates with students to determine reasonable accommodations to ensure equal opportunity. The DSO works with departments throughout the University to assure that the programs and facilities are accessible to every student at NC State.

NC State is committed to providing all students with equal access to educational programs, services and activities. Students who have, or think they may have, a disability (e.g. mental health, attentional, learning, vision, hearing, physical or systemic) are invited to contact the DSO (http://dso.dasa.ncsu.edu/contact-us) to arrange a confidential discussion at 919-515-7653 or disability@ncsu.edu.

EcoVillage (http://housing.ncsu.edu/ecovillage)

116A Bragaw Residence Hall
NC State Box 7105
Raleigh, NC 27695-7105
Website: http://housing.ncsu.edu/ecovillage
Phone: 919-515-4046 Fax: 919-515-4416
Meghan Lobsinger, Director

The EcoVillage, located in Bragaw Hall welcomes students from all majors, thereby creating an interdisciplinary education experience that prepares students for life-long sustainable living! Students go beyond the classroom to lead, serve, create, problem-solve and engage in complex issues facing the local and global energy and environmental challenges of society to advance sustainability.

The EcoVillage focuses on uniting students around the central goal of sustainable living and awareness. The EcoVillage broadly defines sustainability to include everything from agriculture and energy consumption, to transportation and recycling.

The EcoVillage provides unique experience allowing students to face the energy and environmental challenges of society. Beyond the classroom, members of the EcoVillage engage with faculty, facilities staff and sustainability staff to explore local, regional and global approaches to advance sustainability.

Environmental Sciences (ES)

2231 Jordan Hall
NC State Box 8008
Raleigh, NC 27695-8008
Phone: 919-515-5780
Website: http://www.ncsu.edu/project/esnr-dev/program/environmental-sciences/index.html
William E. Winner, Director

Interest in environmental issues has never been more important to our future and to the future of the next generations. Elements of climate change, extinction rates, changes in water resources, toxic compounds in the environment, and the security of food production are examples of why students face long-term environmental issues that will shape future societies. In addition, the uncertainties of sustainable life styles and transitioning to a new system for producing, distributing, and using energy add to the complexity of environmental issues. The Environmental Science Academic Program provides opportunities for students to prepare for professional careers and personal lives in a rapidly changing world.

First Year College (http://fyc.ncsu.edu/FYC)

2751 Cates Avenue
FYC Commons
NC State Box 7925
Raleigh, NC 27695-7925
Website: fyc.ncsu.edu
Phone: 919-515-8130 Fax: 919-515-8267
Carrie McLean, Executive Director

The First Year College (FYC) is the "college of options" for students entering NC State University. Established in 1995, FYC has developed a nationally-recognized model for successfully advising students through their first year at the University. From personal, one-on-one academic and career advising to our two-semester orientation course and our living-learning community, FYC provides a comprehensive experience for first year students who want to choose the right major and graduate on time. Cross-curricula, developmental advising is the hallmark of the FYC and the reason why FYC students can take a year to explore majors without extending their time to degree completion.

First Year College students work closely with their academic advisor. Students meet their advisor at least twice every semester for one-on-one advising, and they also see their advisor weekly in the USC 101 (fall) and USC 102 (spring) class. Personal attention gained through high-touch advising, teaching and co-curricula programming are the most popular and distinctive features of FYC. Other best-practices and advantages offered by FYC include the FYC Village Living and Learning Community (http://housing.ncsu.edu/first-year-college-village), Pack Study tutoring, leadership opportunities, the Resident Mentor (RM) program, and linked general education courses.

First Year Inquiry Program (http://www.ncsu.edu/firstyearinquiry) (FYI)
global experiences during their studies. Learn more about the GPC and get started today.

- encourage students to continue their global interests both overseas and within the United States.
- recognize students for their international studies and activities and lifelong friends. The goal of the Global Perspectives Certificate is to:
  - encourage students to continue their global interests both overseas and within the United States.
  - recognize students for their international studies and activities and lifelong friends. The goal of the Global Perspectives Certificate is to:

Global Perspectives Certificate (GPC) (http://gpc.dasa.ncsu.edu)

The First Year Inquiry Program (FYI) is designed specifically for first year students who will take general education courses during their first year at NC State. Each FYI course, which is designated with the “Q” suffix, fulfills a general education program (GEP) requirement. FYI faculty, for whom teaching and student success are priorities, engage FYI students through the use of “inquiry-guided” teaching methods. The three student-learning objectives to which the FYI program strives are sharpening of critical and creative thinking skills, enhancing development of intellectual maturity and increasing student responsibility for his or her own learning. Students further benefit from experiencing classes with a small faculty/student ratio that fosters a closer relationship among students and professor.

TRIO Programs

20 Enterprise Street, Suite 2
NC State Box 7317
Raleigh, NC 27695-7317
Phone: 919-515-4577, Fax: 919-515-4581
Website: http://trio.dasa.ncsu.edu

Marsha Pharr, Executive TRIO Programs Director

The TRIO Programs are Federal outreach and student services programs designed to serve and assist low-income 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 in grades 6-12 while the Student Support Services Program supports 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.

Student Support Programs (SSS) (http://trio.dasa.ncsu.edu/student-support-services)
NC State Box 7105
Raleigh, NC 27695-7105
Website: http://trio.dasa.ncsu.edu/student-support-services
Phone: 919-513-7774

Courtney Simpson, Director

NC State University TRIO Student Support Services (SSS) Program strives to encourage and enhance educational opportunities for undergraduate students by providing academic and personal support to enhance academic skills, increase retention and graduation rates, and as appropriate, facilitate entrance into graduate and professional programs. SSS provides opportunities for academic and personal development by assisting students with college requirements, motivating students toward the successful completion of their post-secondary education and promoting graduate school enrollment through individualized coaching and supplemental tutoring.

Undergraduate Courses and Curricula

308 Park Shops
NC State Box 7105
Raleigh, NC 27695-7105
Website: http://oucc.ncsu.edu
Phone: 919-515-9769 Fax: 919-515-4416

Catherine Freeman, Director

The Office of Undergraduate Courses and Curricula manages the implementation of the General Education Program (GEP) and the approval of all undergraduate course and curricula offerings at NC State. The office also maintains related guidelines, instructions, forms, and archives. The office serves as a point of contact for on-campus as well as off-campus entities and works directly with the University of North Carolina General Administration (UNG-GA), the University Courses and Curricula Committee (UCCC), the Council on Undergraduate Education (CUE), Registration and Records, the Colleges, and the Office of the Provost regarding undergraduate course and curricula related matters.

Undergraduate Research (http://undergradresearch.dasa.ncsu.edu) (OUR)
(//undergradresearch.dasa.ncsu.edu)

211T Park Shops
NC State Box 7576
Raleigh, NC 27695-7576
Website: http://undergradresearch.dasa.ncsu.edu
The University Honors Program (UHP) is a highly selective program of great expectations. The program exists to encourage and enable outstanding students to engage in research and scholarship in their chosen discipline. It is an opportunity for motivated students to craft for themselves a unique undergraduate education that draws on the full range of opportunities that exist at a major research, land-grant university such as NC State. Undergraduates can pursue research and scholarship in any discipline. In fact, there are students from every undergraduate college at NC State in the UHP.

Application to the University Honors Program is by invitation only. Incoming freshmen are invited to apply after they have been accepted to the university. All invitations are issued on a rolling basis throughout the university’s admissions process (typically mid-December through February). If you do not receive an invitation, but believe you are a strong candidate for the University Honors Program, you can contact us and request an invitation to apply. Admission is competitive and based on evidence of motivation to pursue research and scholarship in the discipline, academic achievement, extracurricular activities, and our desire to maintain an Honors community that includes students from a diversity of academic disciplines. Current NC State students may also request an invitation to apply.

University Tutorial Center (http://www.ncsu.edu/tutorial_center) (UTC) (http://tutorial.ncsu.edu)

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

Barbara B. Windom, Director

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 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.

University Honors Program (http://www.ncsu.edu/honors) (UHP) (http://honors.dasa.ncsu.edu)

219 Clark Hall
NC State Box 8610
Raleigh, NC 27695-8610
Website: http://honors.dasa.ncsu.edu
Phone: 919-513-4078 Fax: 919-513-4392

Richard L. Blanton, Executive Director

The University Honors Program (UHP) is a highly selective program of great expectations. The program exists to encourage and enable outstanding students to engage in research and scholarship in their
• Encourage students to develop a commitment to civil and thoughtful discourse which respects divergent views and diverse experiences, seeks multiple and competing sources of information when analyzing complex issues, and values the ability to articulate a viewpoint with evidence and clarity.
• Provide University Scholars with opportunities for leadership and professional development.
• Encourage academic excellence and a commitment to advanced and independent academic inquiry among University Scholars.

Environmental Sciences (http://www.ncsu.edu/envi)
2231 Jordan Hall
NC State Box 8008
Raleigh, NC 27695-8008
Phone: 515-5780
William E. Winner, Director - wewinner@ncsu.edu

Environmental sciences, in the broadest sense, is the study of the relationships between humans and nature. Using basic knowledge about the world’s environmental systems produces the basis for innovation leading to sustainable socio-economic development. Environmental sciences use interdisciplinary approaches that link natural science and social science disciplines. Such interdisciplinary approaches are essential for understanding changes in a rapidly changing world, and for understanding our past, present, and future. Environmental scientists will help ensure human prospects by improving both socio-economic development and environmental quality through innovation in new technologies and policies.

Public interest about environmental issues is increasing. Protecting and improving the environment involves knowledge and systematic problem-solving skills that are essential for environmental sciences. North Carolina State University’s environmental sciences degree program provides sound, individualized academic programs for students who can develop a wide range of careers. In addition, students can pursue post-graduate academic programs in areas such as environmental law, business, environmental education, and traditional masters and PhD graduate degrees. Successful completion of the B.S. degree in Environmental Sciences prepares students for careers and personal lives in a rapidly changing world.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

College of Agriculture and Life Sciences
111 Patterson Hall
NCSU Box 7642
Raleigh, NC 27695-7642
Phone: (919) 515-2614
fax: (919) 515-5266
e-mail: cals_programs@ncsu.edu
Visit the CALS website (http://www.cals.ncsu.edu).

Academic programs in the college represent a unique blending of the agriculture and life sciences. Agriculture is a very diverse industry that touches everyone’s life in some way or another. The life sciences provide foundations for studying medical and health-related disciplines as well as environmental experiences and molecular biology.

The goals of the instructional program in the College of Agriculture and Life Sciences include proving relevant, scientific, and practical knowledge of the food, agricultural, and life sciences to its students. These programs emanate from a highly qualified and accomplished faculty committed to academic excellence and the development of the individuals to their personal and professional potential. Central to the college’s goals is the cultivation of interdisciplinary problem-solving skills that will serve its graduates well as they pursue a lifetime of learning and adaptation to change.

The overall objectives of the academic program include:
• To provide an opportunity for a broad university education
• To provide a variety of learning experiences
• To offer a choice of specialization in agriculture and life sciences
• To provide background for graduate or professional programs

Degrees
• The Bachelor of Science degree is conferred upon the completion of one of the curricula in this college.
• The degrees of Master of Science, or Master of (non-thesis) degrees are offered in the various departments in the college.*
• The Doctor of Philosophy degree is offered in the following subject areas: animal science and poultry science, biochemistry, bioinformatics†, biological and agricultural engineering, biomathematics†, crop science, economics, entomology, fisheries, wildlife & conservation biology, food science, functional genomics†, horticultural science, immunology†, microbiology†, nutrition, physiology, plant biology, plant pathology, and soil science.*

• Further information on graduate offerings may be found in the Graduate Catalog.
† Joint program with the College of Sciences.

Curriculum Offerings and Requirements
A freshman enrolling in Agriculture and Life Sciences has common core courses. The first year-courses are appropriate in all curricula. This approach allows the student time to explore various programs before selecting a curriculum. The student selects a major in a department or interdisciplinary program. All departments offer science curricula (intended primarily for students who anticipate attending graduate or professional school), several technology curricula, and the Agricultural Business Management curriculum is offered in the Department of Agriculture and Resource Economics.

Departmental Majors
Business major:
Agricultural business management is offered through the Department of Agricultural and Resource Economics. A concentration in biological sciences and the opportunity for double majoring in business and other programs are available.

Science majors:
Agricultural education, agricultural science, animal science, biochemistry, biological engineering (joint program with the College of Engineering), bioprocessing science, extension education, food science, horticultural
science, natural resources, nutrition science, plant biology, plant and soil science, poultry science, and soil and land development. Preprofessional courses are offered in the science curriculum track.

**Technology/Industry majors:**

Agricultural and environmental technology, animal science, food science, horticultural science, plant and soil science, poultry science, and turfgrass science.

**Common First Year in the Life Sciences**

Beginning in fall 2014, CALS students interested in a life science-related major will pursue a common first year course of study. At the time of admission, students will select an intended major. They will not formally matriculate into that program until after their freshman year.

**Academic Minors**

Several departments in the College of Agriculture and Life Sciences offer a minor in their discipline. Students interested in additional information regarding a minor should contact the appropriate departmental office. At present, the following minors are available:

### Minors | Department
---|---
Agricultural Business Management* | Agricultural and Resource Economics
Agricultural and Environmental Technology | Biological and Agricultural Engineering
Agroecology | Crop Science
Animal Science | Animal Science
Biotechnology | Academic Programs
Crop Science | Crop Science
Extension Education | Agricultural and Extension Education
Feed Milling | Poultry Science
Food Science | Food, Bioprocessing & Nutrition Sciences
Horticultural Science | Horticultural Science
Leadership in Agriculture and Life Sciences | Agricultural and Extension Education
Nutrition | Food, Bioprocessing & Nutrition Sciences
Plant Biology | Plant Biology
Plant Biosecurity & Regulatory Science | Plant Pathology & Entomology
Poultry Science | Poultry Science
Soil Science | Soil Science
Turfgrass Science | Crop Science

**Undergraduate Certificate Programs**

- Agricultural Business Management* (Post Baccalaureate & Undergraduate level programs available)
- Agricultural Leadership**
- Agronomic Crop Production*
- Animal Nutrition**
- HACCP/Food Safety Managers*
- Feed Milling**

- Fundamentals of Entomology**
- General Horticulture*
- Plant Pests, Pathogens & People**
- Soil Science**

  * Available via Distance Education
  ** Available via Distance Education and On Campus

**Student Activities**

Students in the College of Agriculture and Life Sciences have numerous opportunities to take part in broadening extracurricular activities. Most departments have student organizations that provide the professional as well as social experience. Representatives of these clubs form the Agri-Life Council. This council is the student organization representing the college. Student tours provide an opportunity to see firsthand the application of classroom principles. In addition, students representing agrimarketing, agronomy, animal science, horticultural science, food science, poultry science and soil science compete regionally and nationally in a number of activities, providing student members a chance to learn by travel as well as by participation.

**Honors Program**

The College of Agriculture and Life Sciences has a comprehensive honors program for qualified students throughout their academic careers. The program includes a seminar discussion course and an independent research program. Faculty provide direction on an individual basis to each student with the students selecting their projects. Participation in the CALS Honors Program is limited to CALS students with a GPA of 3.35 or above. The following courses: ALS 398H, ALS 498H, ALS 499H, are required. In addition, students are expected to take at least six credits of 300-level or above honors coursework (at least 3 credits from CALS). Graduate or 500 level courses may also be used, and any course taken through Study Abroad can be used as one of the honors courses. Honors coursework must be completed with a "C" or better.

In other words, any of the following:

- Two 3-credit hour honors courses at the 300 or above level, one or both in CALS
- Two graduate (500-level) courses or one 300 or 400-level course and once 500-level course, at least one of these in CALS
- One 300-level or above course in CALS and one Study Abroad course at any level

**Joint College Honors Program**

The Department of Molecular and Structural Biochemistry’s Honors Program, which is administered through the College of Agriculture and Life Sciences and the College of Sciences, is designed to encourage excellent undergraduate biochemistry majors to develop their academic potential through a selection of courses and research that will challenge their abilities and better prepare them for postgraduate careers.

Admission: Students must complete the three-semester series of Calculus I, II, and III (MA 241, and MA 242) and calculus based Physics I and II (PY 205 and PY 208). [Exceptions may be made for highly talented students who transfer into the Biochemistry curriculum after their Freshman year, and had already taken MA 131 and MA 231.]

In the first semester of their Junior year (usually in the Fall semester), students who qualify in terms of their mathematics and physics
coursework and have an overall grade-point average of 3.5 or higher are invited to enter the Biochemistry Honors Program. Those students who qualify based on their mathematics and physics courses and have an overall grade-point average of 3.8 or better may be invited to enter the Biochemistry Honors Program during the second semester of their Sophomore year (usually in the Spring semester).

The Undergraduate Coordinator receives nominations from Advisors and prepares recommendations for the College of Sciences Honors Programs Committee.

Requirements: Biochemistry COS Honors Students are required to take Physical Chemistry I and II (CH 431 and CH 433), and to earn at least 3 credit hours in laboratory research (e.g., BCH 492 or BCH 493 or ALS 498H and ALS 499H). Six credit hours of research credit are highly recommended. Written scientific reports based on the students’ research are required. In addition, students in Honors Programs must complete at least 9 credit hours of coursework drawn from at least two of the following three categories:

Category 1: Special Courses for Honors Students (courses or sections designated S or H, such as ENG 101H, MA 341S, etc.)
Category 2: Advanced Courses, such as 500-level courses
Category 3: Independent Studies and Research (such as BCH 492, BCH 493, or ALS 498H and ALS 499H) [Minimum of three hours in this category]

Certification: Following receipt of an invitation to enter the Biochemistry Honors Program, a student should make an appointment with the Undergraduate Coordinator (Room 126 Polk Hall) to inform the department of the student’s desire to accept or reject the invitation. A Completion of Requirements form is prepared for each student entering the program, and as Honors requirements are met, they are recorded on the form. Upon completion of all Honors Program Requirements, the Honors Program Director (Undergraduate Coordinator) certifies that the student should receive appropriate recognition upon graduation.

Honor Societies

Students in all majors with strong academic records are recognized by national organizations that have local chapters, Phi Beta Kappa, Gamma Sigma Delta, Alpha Zeta, Alpha Epsilon Delta, and Phi Kappa Phi.

Scholarship Program

The College of Agriculture and Life Sciences awards approximately 550 scholarships each year on a combination of selection factors including merit, financial need, and leadership. In order to apply for scholarships in the College of Agriculture and Life Sciences and to assure proper consideration for all scholarships, students must complete the College’s online scholarship application here (http://harvest.cals.ncsu.edu/academic/index.cfm?pageID=416) by March 1st of each academic year in order to be considered for scholarships for the upcoming academic year. While March 1st is a priority deadline, applications will be accepted throughout the spring for newly admitted students.

Jefferson Scholars in Agriculture and Life Sciences and the Humanities

The Thomas Jefferson Scholars Program in Agriculture and Life Sciences and the Humanities is a joint program of the College of Agriculture and Life Sciences and the College of Humanities and Social Sciences. It is a program that leads participants to two degrees: one concentrating in an area of agriculture or life science and one in an area of humanities or social science. All majors in each college are available to meet each student’s particular interests and career goals. The purpose of the program is to produce potential leaders in agriculture and the life sciences who have not only technical expertise but also an appreciation for the social, political, and cultural issues that affect decision-making. The program includes special classes for Jefferson Scholars and a variety of social and service activities. Each spring a number of entering freshmen are chosen to participate in the Jefferson Program. Successful participants receive scholarship support after the sophomore year.

Accepted students interested in applying to the Jefferson Scholars program should contact either of the following people before January 15. An online application is available. Visit the Jefferson Scholars website (http://www.cals.ncsu.edu/student_orgs/jeffer) for details.

Dr. Samuel L. Pardue, Associate Dean and Director of Academic Programs
College of Agriculture and Life Sciences
NCSU Box 7642, Raleigh, NC 27695
Phone: (919) 515-2614

Dr. Derek Aday, Assistant Director of Academic Programs
College of Agriculture and Life Sciences
NCSU Box 7642, Raleigh, NC 27695
Phone: (919) 515-7484

Dr. Beth Wilson, Director of the Agricultural Institute
Assistant Director of Academic Programs
College of Agriculture and Life Sciences
NCSU Box 7642, Raleigh, NC 27695
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Interdisciplinary Programs

Curricula in Plant and Soil Sciences

Williams Hall, Room 2126
D. L. Lindbo, Undergraduate Coordinator Soil Science; Williams Hall, Room 2321
Phone: (919) 515-2643

Dr. Lori Unruh Snyder, Undergraduate Coordinator Crop Science, Williams Hall, Room 2126
Phone: (919) 515-7959

Visit the Department of Crop Science (http://www.cropsci.ncsu.edu) and the Department of Soil Science (http://www.soil.ncsu.edu) online.

Plant and Soil Sciences is a diverse program with concentrations in agronomy, agronomic business, agronomic science, crop biotechnology, crop production, and soil sciences.

Agroecology is the study of the ecological, environmental, economic and social interactions of agricultural production systems. In this program students learn about the latest practices and research innovations in sustainable agriculture locally and internationally through classroom studies, hands-on experiences, and field trips. This is a multi-disciplinary concentration that will prepare students for a diversity of employment opportunities.
Agronomic Business concentration is a degree program intended to prepare students for careers in marketing, management, sales, or other economic segments of agri-industry. This concentration is a science based curriculum with built-in flexibility that allows students to choose from a wide range of ARE or BUS electives, plant science courses, and career path electives.

Agronomic Science and Crop Biotechnology concentrations are degree programs designed for students who wish to establish professional careers in areas such as applied plant science and crop production research, crop biotechnology, plant breeding, genetics, or physiology. This program will be especially beneficial for students who wish to pursue advanced degrees in areas of applied plant sciences. Students preparing for plant biotechnology, breeding, or genetics careers must have a broad and thorough knowledge of the life and plant sciences, as well as hands on experience in the most recent scientific techniques. At the same time, scientists engaged in plant genetic manipulation at all levels should clearly understand the potential impact engineered plants may have in field production environments. The objectives of these two concentrations are to merge the scientific/technical expertise in the life sciences with knowledge of plant growth and plant development to prepare students for careers in today’s rapidly changing agricultural industries.

The Crop Production concentration prepares students for career in the crop management, production, or technology. Today’s job market demands that or graduates be well versed in the life sciences and the technical aspects plant agricultural production. This concentration is a science based curriculum with built-in flexibility that allows students to choose from a wide range of crop science courses and career path electives. The flexibility will enable our graduates to have successful careers in plant agriculture-related positions such as international agricultural development, plant protection, plant inspection, biosecurity, precision agricultural technologies, specialty crop production, and farm management.

The Soil Science concentration provides a focus on the soil resource component of crop and soil management. This concentration provides greater breadth and depth to the role of the physical, chemical and biological properties of the soil. A strong science background allows students to select from a variety of professional career opportunities. In addition to the role of soil in crop production, the soil science concentration prepares students for careers in waste management, watershed/water quality protection, erosion and sediment control, landing planning and soil survey. Opportunities exist in the public sector as well as the private with the potential to become licensed as a professional soil scientist.

The Departments of Crop Science and Soil Science administer the Plant and Soil Science curriculum jointly. Crop Science relates primarily to the agroecology, biotechnology, genetics, breeding, physiology and management of field crops. Soil Science is oriented toward soil physics, chemistry, origin, microbiology, fertility and management. For further information and employment opportunities, see the departmental headings for Crop Science and Soil Science.

Specific curriculum requirements are available on the Registration and Records website.

Curricula in Natural Resources

A. W. Oltmans, Undergraduate Coordinator Agricultural and Resource Economics; Nelson Hall Room 3304AH

D.L. Lindbo, Undergraduate Coordinator Soil Science; Williams Hall, Room 2321

Visit the Department of Soil Science online.

Wise use of all our natural resources (soil, water, air, minerals, flora, fauna, and people) for the benefit of current and future members of society is the goal of natural resource management. This important challenge recognizes the interdependence of people with their environment and requires an integrated, multi-disciplinary approach to solving society’s resource problems. Population growth, rising incomes, life style changes and urbanization lead to more intensive use of all natural resources. These trends present challenges to resource managers who must be trained in the basic principles of several disciplines in order to develop and apply sound management strategies to our resource problems. Natural resource professionals must understand resources and the social systems governing their use. They must be able to work in teams to analyze potential effects of resource use and to design ways to make efficient use of natural and environmental resources for current and future generations.

To accommodate the breadth and complexity of natural resource management, the Bachelor of Science degree in Natural Resources is a campus-wide program involving three colleges and four departments that administer seven concentrations. A common core of 84 credit hours of course work provides a balanced foundation in communication, humanities, social sciences, mathematics and the natural sciences. The core course requirements include a freshman orientation course and a senior level applications course that natural resource majors in all concentrations must complete. Within the College of Agriculture and Life Sciences, three concentrations are available: Economics and Management, Soil Resources, and Soil and Water Systems. For information on other concentrations see the Department of Forestry in the College of Natural Resources and the Department of Marine, Earth and Atmospheric Sciences in the College of Physical and Mathematical Sciences.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Department of Agricultural and Extension Education

Agricultural and Extension Education is a broad field of study and practice representing the blending of agricultural and behavioral sciences into educational programs for youth and adults. Agriculture impacts everyone’s life in terms of food, water, air, clothing, homes and the quality of life. Central to the department’s goals is the formal and nonformal teaching of problem-solving and learning skills for a lifetime of growing, evolving, and changing. The Agricultural Science degree provides graduates with both agricultural skills and leadership skills that are essential to leadership positions in the agricultural industry.

Regardless of which degree option you choose, the curriculum in agricultural and extension education has some common features. It begins with the general education courses that are required throughout the university. These courses are essential to developing a well-educated graduate. The second component of the agricultural and extension education program provides students with a broad understanding of agriculture. Students complete introductory and advanced courses in various agricultural disciplines. These courses will develop the student’s knowledge in agriculture essential to providing information to a wide
variety of clients. This exposure to so many areas of agriculture also helps students decide on a specific area of agriculture in which to specialize. The third component of the department's program requires students to complete a specialty area or a concentration in at least one area of agriculture. This specialization usually qualifies students for a minor in an agricultural discipline, which may provide students with additional employment opportunities. The final component of the agricultural and extension education program involves the courses related to providing information to people. These courses will vary, depending upon degree program selected.

There are many professional opportunities that are available to people participating in departmental programs. Graduates have the choice to plan for teaching, administrative leadership and public relations positions in secondary schools, community colleges, universities, Cooperative Extension Service, and agribusinesses. Graduates are highly qualified to enter agricultural careers and in agricultural and extension education. Career placement assistance is provided to all graduates.

Curricula

The Agricultural Education curriculum encompasses areas of study that will enable students to participate effectively in planning, promoting, and initiating educational programs in agriculture. The program leads to a Bachelor of Science degree and is designed to prepare teachers of agriculture for secondary schools and community and technical colleges. The demand for agricultural education teachers exceeds present supply in the Carolinas, Virginia, and throughout the nation.

The Extension Education curriculum leads to a Bachelor of Science and is designed to primarily prepare individuals for careers with the Cooperative Extension Service. Students are required to complete both classroom and laboratory studies on the NC State campus and a required closely supervised; semester-long practicum in a County Extension Center during their senior year. Students have two concentrations available in this curriculum: Agriculture and Natural Resources and Youth Leadership Development. Students in the Agricultural and Natural Resources concentration select an area of study that prepares them for the important role as agricultural and/or natural resource Extension agents. Students in the Youth Leadership Development concentration take courses to prepare them to be the catalysts for positive change within communities as the educators and administrators of youth leadership programs (such as 4-H).

The Agricultural Science curriculum is designed to prepare graduates for careers in a wide variety of agricultural industry positions. The program leads to a Bachelor of Science degree in Agricultural Science. Students complete a minimum of two agricultural specialty areas, increasing their options for careers in agriculture upon graduation. In addition to preparation in the agricultural industry, students also complete a series of leadership courses to prepare them for leadership positions within the agricultural industries. Internships are not required in this curriculum, but are strongly encouraged.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Minor in Extension Education

The minor in Extension Education is open to all interested baccalaureate students. The minor is especially appropriate for students enrolled in agricultural, natural resource, and nutrition majors and/or those interested in careers with the Cooperative Extension Service or other nonformal educational/community outreach organizations. Students completing a minor in Extension Education will become familiar with the organization, structure, and mission of Cooperative Extension, the planning and delivery of nonformal educational programs, the management of and leadership of volunteers; communication media and technology; and leadership theory, principles, and skills. The minor requires a minimum of 15 credit hours with 9 credit hours from a required core and 6 credit hours from a list of advised electives. The minimum grade required for all courses counting toward the minor is “C.” Additional information related to the minor can be found in the complete listing of minors (http://oucc.ncsu.edu/minors).

Minor in Leadership in Agriculture and Life Sciences

The Leadership in Agriculture and Life Sciences minor is open to all interested baccalaureate students in the College of Agriculture and Life Sciences. The minor is especially appropriate for students enrolled in agricultural and life science majors seeking a competitive edge when applying for supervisory or management positions in careers related to the agriculture and life sciences industries. Students completing this minor will be able to apply the theory, principles and skills required by leaders in their discipline. The minor requires a minimum of 15 credit hours, with 3 credit hours required and the remaining 12 credit hours from a list of leadership courses. The minimum grade required for courses counting toward the minor is a “C.” Additional information related to the minor can be found in the complete listing of minors (http://oucc.ncsu.edu/minors).

Certificate in Agricultural Leadership

The department offers a certificate program in Agricultural Leadership that is available to degree and non-degree students. Students in the certificate program complete a total of 12 credit hours in agricultural leadership courses. Those who complete the leadership certificate program will be better equipped to serve in leadership positions within agricultural industry. In addition to an introductory leadership course, students can choose from personal leadership, team leadership, organizational leadership, technical writing, or presentation skills. The minimum grade required for courses counting toward the certificate is a “C.”

Department of Agricultural and Resource Economics

The Department of Agricultural and Resource Economics serves agricultural, resource and related industries through its extension, research and teaching programs. Applying principles of economics, business, and related disciplines, these programs develop an understanding of contemporary economic and business problems and equip students with knowledge of business organization fundamentals and decision-making skills useful in the operation and management of business firms.

The department offers undergraduate programs leading to a Bachelor of Science degree in Agricultural Business Management (ABM). A concentration in biological sciences and business management (BBM) is offered within the agricultural business management program.

The Agricultural Business Management Program prepares graduates for management, marketing, sales, finance and related careers. The program has sufficient flexibility to provide more extensive course work in basic and applied science and math for those students desiring
to prepare for advanced graduate study as well. The concentration in biological sciences/business management prepares graduates for management, marketing, and sales careers in fields such as biotechnology, pharmaceuticals, health care, environmental protection, food processing and finance dealing with biological issues. This concentration is designed to be an attractive option for students with a strong background and interest in science who seek alternatives to technical science careers.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Opportunities

The growing number of specialized business firms producing and marketing services and products in agriculture, resource and life science-related industries has created an increasing demand for graduates trained in agriculture and biological sciences/business management, resource economics and management and environmental policy.

Employment opportunities include careers with companies in purchasing, processing, and marketing food, fiber and related products; firms producing and marketing production inputs (feed, equipment, chemicals, drugs, etc.) and services; banks; other financial and credit agencies; cooperatives; natural resources management units and consulting firms; and natural resources and environmental educational or regulatory agencies.

Many graduates pursue careers in research and education with various state and federal government agencies. These agencies include the Cooperative Extension Service, the Agricultural Research Service, the State Department of Agriculture and Consumer Services, Environmental and Natural Resources, the United States Department of Agriculture, and the Environmental Protection Agency.

Minor in Agricultural Business Management

The Department of Agricultural and Resource Economics offers a minor in Agricultural Business Management. This minor provides students an opportunity to learn basic concepts useful in many careers in agricultural business.

A total of 15 hours of course work is required, including ARE (EC) 201, and four additional courses chosen from a list of selected courses in agricultural and resource economics and related business fields. The ABM minor can be completed through regular courses on campus or through courses offered via Distance Education. Consult the Department of Agricultural and Resource Economics (http://www.ag-econ.ncsu.edu) for specific information on the requirements of the minor.

Department of Animal Science

Animal Science is a broad field centered on the biology, production, management, and care of domestic animals. Throughout history, animals have provided humans with a major source of food, fiber, pleasure, and companionship. Undergraduate students study subjects related to various phases of animal science. Courses are offered in anatomy, physiology, nutrition, genetics, reproduction, and management, and there are opportunities for the application of basic scientific training in animal care and well-being areas. Use of animals and animal specimens is critical to our educational program. To obtain full credit for Animal Science courses, students are required to participate in laboratory procedures involving animals and animal specimens. The Institutional Animal Care and Use Committee (IACUC) approves all activities with live animals. Many lectures also incorporate animals or animal specimens into the course. Animal Science students gain valuable hands-on experience in our newly-renovated on-campus teaching labs as well as at the five nearby teaching farms (horse, small ruminant, swine, beef, dairy).

Opportunities

Animal science graduates are qualified for positions in a wide variety of areas such as research and development at pharmaceutical and biotechnology companies; livestock, horse, or companion animal management; animal breeding and production; feed and animal healthcare product sales and service; livestock marketing; consulting; state and federal departments of agriculture; breed associations; educational and financial institutions; livestock, horse, and companion animal publications and other media; animal technical services; extension services; and public relations. Animal scientists can be found across the nation and around the world in all phases of production, research, sales, service, business, health, and education. Many students in pre-veterinary medicine obtain degrees in animal science, as do other pre-professional students including pre-medical and pre-dental before attending veterinary school, medical school or dental school. Students may elect graduate study, after which they will find opportunities in teaching, research, and extension. Advanced undergraduates have the opportunity to complete the Accelerated Bachelor's/Master's degrees, which allows students to earn both the B.S. and the Master of Animal Science degrees within five years. See listing of graduate degrees offered in the Graduate Catalog (http://www.ncsu.edu/grad/catalog). The Accelerated B.S./DVM for Animal Science Majors (3+1 Advising Guide) is a pathway for students admitted early to a College of Veterinary Medicine to complete the B.S. in Animal Science degree by transferring back 12 credits after one year in vet school.

Curricula

The degree of Bachelor of Science in Animal Science may be obtained by selecting one of three concentrations offered by the Animal Science Department in the College of Agriculture and Life Sciences. The veterinary bioscience concentration is for students who are interested in advanced study in DVM programs and has all veterinary school prerequisite courses built into the concentration. Students in this concentration must maintain an overall GPA of 3.0 or higher. The science concentration is designed for students with an interest in advanced study, such as MS and PhD programs, in disciplines such as physiology, nutrition, or genetics. This concentration gives students more flexibility to select courses that fit their disciplinary interests. The industry/business concentration is for students who are more interested in the business or production aspects of animal science. It offers flexibility in complementing animal science courses with business, economic, and applied science course work. There are many opportunities to gain undergraduate research experience with an Animal Science faculty member, to participate in one of the animal-related clubs, and to engage globally by participating in one of our Animal Science Study Abroad experiences.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Minor in Animal Science

A minor in Animal Science is open to all interested baccalaureate students who are not majoring in Animal Science. Students completing a minor in Animal Science will become familiar with animal production
and with its related industries. The minor requires a minimum of 15 credit hours with a grade of “C-“ or better, including Introduction to Animal Science, Animal Nutrition, and the student’s choice of Animal Science elective courses. The program is flexible in order that students may emphasize the discipline or species of their interest.

See the full listing of minors (http://oucc.ncsu.edu/minors/animal-science) for more information.

**Biological and Agricultural Engineering**

The Department of Biological and Agricultural Engineering applies engineering principles to biologically-based systems, primarily in agriculture and the environment. The BAE department provides excellent educational opportunities at the undergraduate level with programs that are well recognized as among the finest in the United States. Two undergraduate curricula are offered:

1. Biological Engineering (BE) and
2. Agricultural and Environmental Technology (AET)

The BE curriculum includes concentrations in agricultural engineering, bioprocess engineering, and environmental engineering. All concentrations within the BE curriculum emphasize core courses in biology, mathematics, physics, chemistry, hydraulics, mechanics, materials, and thermodynamics, which collectively provide solid training in basic science and engineering. The curriculum is designed to prepare each graduate to master fundamentals of engineering and biology, develop the ability to solve engineering problems, improve self-confidence, and apply the creative process of engineering design. The educational experience is capped off with a two semester senior level course that immerses each graduate in the team approach to developing engineering solutions to complex problems. By the time of graduation, approximately 80% of BE graduates will have passed the Fundamentals in Engineering exam and thus be well on their way toward licensure as a Professional Engineer.

The AET combines an understanding of agricultural, biological, and physical sciences with technology and economics so that the focus is on applying engineering principles to agricultural and environmental systems. Graduates are prepared to apply and manage the use of technical tools in production agricultural and environmental issues, or in other industries interfacing with natural resources or agriculture. The AET graduates provide a critical link in the agricultural and environmental spectrum by interacting directly with the production personnel as well as designers, implementers and managers of technological systems.

**Opportunities**

BE students learn to solve a wide variety of engineering problems and will have opportunities for specialization though selection of a specific concentration. Scientific and engineering principles are applied: to conserve and manage air, energy, soil and water resources; to manage, protect and restore natural ecosystems; to understand and utilize biological, chemical and physical processes for the production and conversion of biomass to bio energy; to analyze, understand and utilize mechanical properties of biological materials; to design and develop machinery systems for all phases of agricultural and food production; to design and evaluate structures and environmental control systems for housing animals, plant growth, and biological product storage; to develop improved systems for processing and marketing food and agricultural products; and to design sensor-based instrumentation and control systems for biological and agricultural applications.

Graduates of the BE curriculum receive a “B.S. in Biological Engineering,” qualifying them for positions in design, development, and research in industry, government and public institutions. The curriculum also prepares students for post-graduate work leading to advanced degrees. Typical positions filled by recent BE graduates include: stream and wetlands restoration project manager; product design; development and testing engineer; plant engineering and management; engineering analysis and inspection for federal and state agencies; engineering consultant and research engineer. Entry-level salary ranges for BE graduates are similar to those of Civil, Industrial, and Mechanical Engineering graduates.

The AET curriculum provides graduates opportunities in technical analysis, application and evaluation of agricultural production systems and environmental systems. The curriculum’s flexibility enables students to specialize technologically in agriculture, the environment, or business management. Careers include technical jobs in production agriculture, environmental systems, agribusiness sales and service, and agricultural extension.

**Curricula**

The BE curriculum is jointly administered by the College of Agriculture and Life Sciences and the College of Engineering and combines the fields of engineering, biology and agriculture. The BE curriculum is accredited by the Engineering Accreditation Commission of ABET, Inc. BE graduates are qualified to become registered professional engineers by passing the appropriate examinations and upon completing the engineering experience requirements. Specific curriculum requirements are available online.

The program educational objectives of the Biological Engineering (BE) Bachelor of Science (B.S.) degree are to:

- Educate students for successful careers in engineering by mastering the fundamentals of engineering and biology.
- Instill in the students time management skills and a sense of confidence in their ability to grasp and apply engineering principles to solve complex, real-world problems.
- Impart a sense of professional responsibility and work ethic.
- Establish an educational environment in which students participate in interdisciplinary activities.
- Offer a curriculum that provides students an opportunity to become broadly educated engineers and life-long learners.
- Recruit students with high potential who will contribute to the future economic and social well-being of North Carolina.

The AET curriculum is administered by the College of Agriculture and Life Sciences and is intended to uniquely prepare students for hands-on application of technology to efficiently manage agricultural and environmental systems. Flexibility within the program allows students to attain depth in science, business, or environmental areas. Graduates provide a critical link in the agricultural and environmental spectrum by interacting directly with both production personnel as well as the designers and implementers of technological systems.

The program objectives of the Agricultural and Environmental Technology (AET) Bachelor of Science (B.S.) degree are to:
Opportunities

There are numerous career opportunities for Plant and Soil Sciences and Turfgrass Science graduates. For example, Agroecology is a multi-disciplinary concentration that will prepare students for a diversity of employment opportunities including, government agricultural research, agriculture extension and education, non-governmental organizations, conservation and wildlife management and international agricultural research and development. Many of our Crop Biotechnology and Agronomic Science graduates enroll in graduate programs here at NCSU or at major universities throughout the country. Others find employment as research specialists with companies engaged in biotechnology, plant improvement, genetic enhancement of plant traits, and agri-chemical development. Crop Production and Agronomic Business graduates often secure jobs as consultants, extension agents, farm managers, seed production specialists, agribusiness agronomists and managers, soil survey specialists, soil conservationists, technical sales representatives, and waste management specialists. Graduates from our Turfgrass Science program find employment as golf course superintendents, athletic field managers, home and recreational lawn professionals, and turfgrass sod producers.

Minor in Crop Science

The Crop Science Minor is open to any degree seeking undergraduate student (except Plant and Soil Sciences majors) interested in gaining knowledge of the development, productivity and sustainability of crop management systems, genetic improvement and pest management strategies, and the interaction of crops with their physical and biotic environment. It is intended to complement other curricula that are related to crop-environment and agro-ecological studies. An appreciation of agronomic approaches, which lead to a more efficient use of crop production inputs and to a less invasive impact on the environment, is emphasized. It is not intended to prepare students for a professional career in Crop Science. Additional courses are recommended for students who plan graduate work in this discipline.

Minor in Agroecology

The Agroecology minor is open to all baccalaureate students (except Plant and Soil Sciences - Agroecology majors). It is designed for students majoring in the biological sciences, agronomy, horticulture and animal sciences, but will be of interest to a wide array of students as agriculture has broad implications in the life sciences, economics, and sociology. Agroecology instruction provides students a fundamental understanding of agriculture and its interaction with natural and social systems. Students selecting the Agroecology minor will gain an understanding of modern production agriculture from an ecological and sociological perspective, obtain new skills in analyzing agricultural systems, and acquire the knowledge to design a plan for change. This knowledge will improve a student’s ability to work with agricultural professionals to implement a system that meets ecological and social needs while remaining profitable for farmers.

Minor in Turfgrass Science

The Turfgrass Science minor is open to all undergraduate students except those with a major in Turfgrass Science. It is designed for students majoring in Plant and Soil Sciences, Biological Sciences, Horticultural Science, Parks and Recreation and related disciplines but will be of interest to a wide variety of students desiring expertise in establishing and maintaining turfgrass commonly grown throughout the United States. This knowledge will improve the student’s ability to provide high quality turfgrass cover for a variety of situations including home lawns, commercial grounds, parks and other areas.

Department of Crop Science

Crop Science is the discipline of producing abundant, safe and sustainable food, feed, fiber, and fuel crops and enhancing the quality of recreational and ornamental turfgrasses. The Department of Crop Science offers two areas of study: Plant and Soil Sciences (formerly Agronomy) and Turfgrass Science. The Plant and Soil Sciences major offers flexible curricula in several areas of study including concentrations in Agroecology, Agronomic Science, Agronomic Business, Crop Biotechnology, Crop Production and Soil Science (administered by the Department of Soil Science). Undergraduate students in both majors study adaptation, production practices, sustainability, genetics, pest management, soil management and soil fertility associated with producing various commodities. These curricula options allow students with diverse backgrounds and career goals to select courses that meet their individual interests and needs.

Department of Entomology

Undergraduate instruction in entomology provides introductory and advanced courses in the basic science of entomology and the management of beneficial and pest insects. Courses at the 200- and 400-level fulfill General Education Requirements in Natural Sciences or Science and Technology and serve students majoring in biological sciences, agronomy, horticultural science, agricultural education, crop science, forestry and plant biology. They also provide fundamental
training for graduate study in entomology (see the Graduate Catalog (http://www.ncsu.edu/grad/catalog)).

**Opportunities**

For graduates with advanced degrees in entomology, opportunities include research, teaching, and extension positions in colleges and universities; research, development, production, control, and sales positions in private industries; consultative positions in pest management; research and regulatory positions with state and federal agencies; and curatorial positions in museums.

**Curricula**

There is no undergraduate major in entomology. Those students with a primary interest in entomology are advised to choose a general biological science curricula and minor in entomology.

**Minor in Entomology**

The Department of Entomology offers an undergraduate minor available to all baccalaureate degree students at North Carolina State University. The minor is especially appropriate for (but not limited to) students interested in biological or agricultural sciences, veterinary medicine, or other health sciences. A basic knowledge of insect biology may also be useful to students seeking careers in government, industry, or education.

The minor consists of a minimum of 15 credit hours, including one core course (ENT 402 or ENT 425). The remaining hours can be selected from a group of restricted electives.

**Department of Food, Bioprocessing and Nutrition Science**

The Department of Food, Bioprocessing and Nutrition Sciences offers three undergraduate degree programs:

1. Food Science
2. Bioprocessing Science
3. Nutrition Science

These programs focus on the application and integration of chemistry, biology, biochemistry, biotechnology, and engineering disciplines in the development, production, and delivery of safe and nutritious foods and other products (including drugs) from food and bioprocessing operations, in addition to understanding the role of diet and how it generally affects human health. In support of each program, the department maintains modern, fully-equipped laboratories and a host of Nutrition outreach opportunities for teaching and research. All three undergraduate programs are compatible with pre-professional school curricula, such as pre-med or pre-vet, and many students elect to take on a minor in an area that enhances their major coursework. There are also opportunities to double major both within departmental majors as well as external majors such as Biochemistry.

**Opportunities**

Consumer demand for safe, high quality, nutritious foods and biopharmaceutical products, as well as for educational programs designed to promote healthy eating, creates a variety of career opportunities in the food, pharmaceutical and the allied health industries. Industrial opportunities include management, research and development,

**Food Science**

Many career opportunities exist in the food and beverage industry, the world’s largest manufacturing sector, for graduates with a Food Science degree. Food science professionals are involved in the discovery of new food sources, new methods of food preservation, advances in food chemistry and sensory science and even product development. Positions are found worldwide, providing technical support to the food, beverage, and pharmaceutical industries and also government agencies. Food scientists work to ensure the safety and quality of foods through the application of basic scientific principles. The demand for food scientists continues to increase as the food industry expands.

**Bioprocessing Science**

The Bioprocessing Science degree is a unique program designed to provide graduates with a special skill set specific to bioprocessing and biomanufacturing. Graduates from this degree program will have exciting opportunities to biomanufacture medicines, vaccines, enzymes and other products that improve the quality of life.

**Nutrition Sciences**

Jobs for those with training in Nutrition Science are increasing due to the growing and aging population, public interest, especially related to obesity and chronic disease risk, and a desire to develop nutritious products for a health conscious consumer. Nutrition scientists may be employed in a variety of settings including clinical or private practice, health management organizations, wellness centers, health-related government agencies or non-profit organizations, and the food industry. Because of the key role that diet plays in the prevention, development, and treatment of many major diseases, health professionals benefit from an understanding of nutrition. Therefore, a degree in Nutrition Science is also highly relevant for those desiring a career in an allied health field.

**Scholarships**

The department provides both merit and financial need scholarships to encourage and assist students preparing for careers in Food, Bioprocessing, or Nutrition Science.

**Curricula**

The Food Science Bachelor of Science degree is offered through two curricula emphasizing science or technology. The science curriculum is designed for students desiring a more analytically intense program leading to technical careers in the food industry or graduate school. Students with an interest in business opportunities will find the technology program permits greater flexibility to pursue coursework in business, agricultural economics, or related fields.

The Bioprocessing Science Bachelor of Science degree prepares students for technical careers in biomanufacturing through formal training in fundamental sciences, as well as preparing students for careers in industries whose products are based on biological systems, including biopharmaceutical and biotechnology companies.
The Nutrition Science Bachelor of Science degree has two sub-plans to choose from: the Science track or the Applied track. The Science curriculum is designed for those students with an interest in graduate school or post-graduate training in a human health profession for which physics and 4 semesters of chemistry are required. The Applied curriculum is designed for those interested in health-related jobs immediately after graduation, obtaining further training to become a Registered Dietitian after graduation, or going on for post-graduate training in a human health profession for which no physics courses and only 3 semesters of chemistry are required.

**Minor in Food Science**

The Food Science Minor is designed to provide students with important food science principles and concepts, giving a competitive edge to individuals seeking employment in the food, pharmaceutical and related industries. A minor provides technical information to improve the student’s knowledge and understanding of food and its manufacture. While a comprehensive coverage of Food Science cannot be accomplished in 15 credit hours, flexibility in developing the minor permits tailoring each program to complement a student’s major. An introductory course (FS 201) is required, but other courses are selected to build on the student’s major.

**Minor in Nutrition**

A Nutrition Science minor is designed to provide knowledge of the principles of nutrition associated with healthful diets and to apply an understanding of nutrient structure, function, and sources to the evaluation of information and policies concerning foods and dietary and/or feeding practices. Introductory Biochemistry is a required course; students then select an additional 12 credit hours from a list of 200-500 level classes, including on- and off-campus independent study or research experiences.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

**Department of Horticultural Science**

Horticulture is a dynamic segment of agriculture. The development, growth, distribution, and utilization of fruits, vegetables, flowers, and ornamental plants, plus the art and science of landscape designing enrich our lives with nutritious foods and more attractive surroundings. North Carolina’s varied climatic conditions favor the production of a wide variety of horticultural crops on a commercial scale, as well as numerous beautiful parks, gardens, and arboreta. The growing interest in local foods and home gardening has created a demand for more information about fruits and vegetable production and new crop varieties adapted to North Carolina’s environments. Urban population growth fuels a need for ornamental plants and a thriving nursery industry. Designers skilled in residential and commercial landscaping, interior plantscaping, and plant maintenance are in high demand. The growth in demand for horticultural information by the consumer, schools, and state and county government continues to increase.

Undergraduate programs in horticultural science offer a broad based education in physical and biological sciences and a sound production background. Students can concentrate in areas of fruit and vegetable science, floriculture, woody ornamental plant science, landscape design, or pursue a general approach encompassing all the specialties. They are prepared for graduate study or for diverse professional service.

**Opportunities**

Horticulture graduates fill positions in production, processing, sales, service, and outreach. Among these are:

- county extension agents
- vocational agriculture teachers
- landscape designers and landscape contractors
- farm operators
- orchard
- nursery
- greenhouse
- and garden center managers
- research
- production
- and promotional specialists with commercial seed
- fertilizer
- chemical and food companies
- urban horticulture specialists
- garden writers
- inspectors
- quality control technologists
- USDA specialists
- county and state government planners
- leaders in other phases of agricultural and industrial developments
- Students also prepare for careers in research, teaching or extension in horticulture

**Curricula**

The degree of Bachelor of Science with a major in horticultural science can be earned in either science or technology. Under the science curriculum, specialized education is offered in fruit and vegetable crops, floriculture, and ornamental horticulture. Under the technology curriculum, education is offered in landscape design or in a general approach, which allows for specialization in fruit and vegetable science, floriculture, and woody ornamental plant science.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

**Minor in Horticultural Science**

The academic minor in Horticultural Science is offered to students who desire a strong foundation in the principles of horticultural science. Students may choose to enhance their own major by selecting courses in a specialized area of horticulture such as fruits and vegetables, ornamentals, floriculture, or landscape horticulture, or they may pursue a more general approach to the entire field of study. Sixteen or seventeen credit hours are required for the minor, depending on courses selected.

**Certificate in Horticultural Science**

The undergraduate certificate in Horticulture provides a basic introduction into the science of Horticulture and Horticultural practices as they pertain to the home garden. A broad-range of courses are available in a
distance education format. A minimum of fifteen credits is required for the certificate.

Department of Molecular and Structural Biochemistry

Biochemistry is the science which is concerned with the discovery and understanding of the chemical principles of life. It is a wide-ranging field from the composition, biosynthesis, structure and function of biomolecules to the control and regulation of biochemical processes within organelles, cells, organs and organisms. Biochemical principles form the basis of most laboratory procedures within the life cycle.

Opportunities

The Biochemistry program provides B.S. graduates with the scientific background and skills required for employment in biochemistry, molecular biology, biotechnology, and genetics and for the health fields of medicine, veterinary science pharmacology, and related fields.

Awards

The H. Robert Horton Award is given to the outstanding student in Biochemistry based on scholarly and research achievements.

Honors

The honors program in Biochemistry is jointly administered within the College of Agriculture and Life Sciences and the College of Sciences. It is designed for students who wish to explore advanced courses and be rewarded for outstanding academic achievement.

To be admitted to the honors program, a student must complete the three-semester sequence of Calculus (MA 141, MA 241, MA 242) and the calculus based Physics sequence (PY 205 and PY 208). Exceptions can be made for transfer students. Students with a GPA of at least 3.5 are invited into the program in their junior year. To complete the program, a student must take two semesters of Physical Chemistry sequence (CH 431 and CH 433), at least three hours of research and six hours of advanced or honors courses at the 300- or 400-level. Interested students should contact the Undergraduate Coordinator of Biochemistry for more detailed information.

Curricula

The curriculum emphasizes the fundamentals of biological and physical sciences, offering students both breadth of knowledge and depth of understanding. It is designed to provide students with broad experience in biological and chemical sciences and to encourage the development of experimental skills. One important aspect is the requirement of at least one semester experience in a Biochemistry laboratory. Because of the breadth of the course requirements, many students can easily add a second major in Biological Sciences, Chemistry, or other science as well as add a minor in Genetics.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Department of Plant and Microbial Biology

The instructional program in Plant Biology provides classroom, laboratory, and field experience in the major areas of plant science. Undergraduates majoring in plant biology select major courses that are tailored to their interests within the discipline and are required to have a supervised research or teaching experience that allows them to work closely with departmental faculty. Majors, as pre-professionals in the plant sciences, are prepared for advanced study in plant biology and other biological fields, as well as in the applied plant sciences, such as horticulture, crop science, plant pathology, natural resource management and conservation.

Opportunities

The undergraduate degree is an excellent pre-professional degree in the plant sciences. Graduates are employed as researchers in academic, government, or industrial labs, as field botanists and conservationists in state and natural parks, and as employees of environmental education, or public service organizations. Many majors continue with graduate studies in a plant science discipline, after which they are qualified for teaching positions in community and junior colleges, prominent colleges and universities, for research positions in major federal and state government laboratories, and in private industry. Research technician positions in many life science areas in governmental and industrial laboratories are also career possibilities. The field of plant biotechnology provides additional opportunities with several graduates seeking employment in the biotechnology industry including companies in nearby Research Triangle Park. Graduates are also well qualified for professional training in the health professions.

Curricula

The Bachelor of Science degree with a major in Plant Biology is offered under the science curriculum of the College of Agriculture and Life Sciences. Students can choose to pursue a general major with courses in different areas of Plant Biology, or can specialize their study in one of the following areas: Ethnobotany, Plant Biotechnology and Cell and Molecular Biology; and Plant Ecology, Biodiversity, and Conservation. The Bachelor of Science in Plant Biology with a with double-major in another life science or applied plant science is possible, as is a double-major in economics or in a humanities and social sciences discipline (anthropology, English, history, philosophy, psychology, or political science). Selected faculty in Plant and Microbial Biology also work with the Biological Sciences faculty in the College of Sciences to offer the B.S. degree in Microbiology, details about which are located at: http://nextcatalog.ncsu.edu/undergraduate/collegeofsciences/biology

Minor in Plant Biology

The minor in Plant Biology is available to all degree-seeking students at NC State University who are not enrolled in the plant biology major. The minor requires 15 hours comprised of a 4 credit hour introductory course (PB 200 or PB 250) and 11 hours of plant biology elective coursework. Up to 4 credit hours of special topics or special problems courses can be used to meet the elective hour requirements.

Minor in Biotechnology

The Minor in Biotechnology provides first-hand laboratory experience with a variety of technologies that use gene manipulation, recombinant organisms, or cell culture. The laboratory courses typically are started in the junior year, following completion of BIO 183 and Organic Chemistry (CH 223) with a grade of C- or better. BIT 410, “Manipulation of Recombinant DNA” is required for all students but BCH 454 can be substituted. Other requirements for the minor include a 3 credit research internship, 4 credits of advanced biotechnology laboratory courses, and a
biotechnology ethics course. Interested students should visit the website http://biotech.ncsu.edu/, or contact Dr. Laura Ott at leneuder@ncsu.edu for more information.

Department of Plant Pathology

Plant Pathology is a diverse discipline that provides fundamentally important information to many of the undergraduate degree programs offered in CALS at NC State. Undergraduate instruction in plant pathobiology offers introductory and advanced courses on the biology of plant pathogens and the nature and control of plant diseases to students majoring in crop science, horticultural science, the life sciences, and forestry. It also provides the fundamental training necessary for graduate study in plant pathology and related fields.

Kelman Scholars

Thanks to the generosity of Dr. Arthur and Mrs. Helen Kelman, family and friends, the department offers the S.E. Kelman Memorial Scholarship to one or more outstanding undergraduates enrolled at NC State or other universities. This competitive program allows selected applicants to gain research experiences as interns working under the supervision of a faculty member in the Department of Plant Pathology. For details about this scholarship program, please see scholarship’s information page (http://www.cals.ncsu.edu/plantpath/kelmanScholars).

Curricula

There is no undergraduate major or minor in plant pathology. We co-direct with the Department of Entomology a certificate in Plant Pests, Pathogens, and People (http://oucc.ncsu.edu/plant-pests-pathogens-and-people-0), which offers a course of study in the biology, ecology, economic significance, and management of plant diseases and insects. This program may be completed on-campus or totally online.

Opportunities

As a graduate department, our graduates, with advanced degrees in plant pathology, are competitive for employment in many areas. Employment opportunities at the M.S. and Ph.D. levels include research, extension, teaching and regulatory sciences with universities and colleges, the U.S. Department of Agriculture, including APHIS and CPHiST, a wide array of agriculturally related industry, and private consulting. The rapid development of biotechnology, regulatory sciences, agricultural chemicals and biocontrol offers numerous opportunities for exciting and rewarding careers that service societal needs and advance our sciences.

Prestage Department of Poultry Science

The Prestage Department of Poultry Science provides instruction in the principles of vertically integrated poultry production and in such related disciplines as nutrition, physiology, genetics, immunology, toxicology, biotechnology, and general poultry management. Through teaching, research, and extension, the department serves students, poultry producers, and allied industries. Poultry production has increased rapidly during the last two decades and ranks first in North Carolina as a source of agricultural income. North Carolina currently ranks second (http://www.ncagr.gov/stats/crops/Ranking.pdf) nationally in the production of poultry products. Growing demand for poultry products, our climate and economic conditions in the state provide a sound base for continued expansion.

Opportunities

The transition from small farm operations to large commercial poultry enterprises has created more specialized positions than there are available poultry graduates. Production-oriented positions and off-the-farm operations in areas such as processing and distribution offer new job opportunities. The allied industries—feed, equipment, financing, pharmaceutical and other supplies—need additional employees trained in Poultry Science. Graduates hold positions as managers and field representatives for business identified with or serving the poultry industry. Graduates are also employed in the communication and public relations sectors, as teachers, and extension and research specialists. Some graduates develop their own poultry businesses.

Curricula

Students desiring a Bachelor of Science degree with a major in Poultry Science may choose either the science or technology curriculum offered by the Prestage Department of Poultry Science. One may obtain a double major in other curricula through careful use of electives and/or summer school attendance. These students should consult the undergraduate advisors in the department(s) concerned. Currently, the pre-veterinary science student may obtain all requirements toward a Bachelor of Science degree in the science option. The science curriculum reflects a student’s interest in the basic biological and physical sciences. These students are better prepared for advanced study in various disciplines such as genetics, nutrition, physiology, and pathology. Several pre-veterinary students are currently enrolled in this curriculum and are seeking a Bachelor of Science degree in Poultry Science. (See the Pre-professional Program in Veterinary Medicine).

The technology curriculum in Poultry Science is designed to prepare students for direct entry into the poultry industry upon graduation. It allows a greater selection of courses in business and economics; and offers a student both basic and applied knowledge in poultry production which can be utilized in a poultry operation upon graduation.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Minor in Poultry Science

A minor in Poultry Science is open to all interested baccalaureate students who are not majoring in Poultry Science. This minor is appropriate for (but not limited to) students majoring in Agricultural Business Management, Agricultural Economics, Agricultural Education, Agricultural Science, Agronomy, Animal Science, Biological Science, and with its related industries. The minor requires a minimum of 15 credit hours with a grade of “C-” or better. The program is flexible so that students may emphasize the discipline or species of their interest.

See the complete listing of minors (http://oucc.ncsu.edu/minors/poultry-science) for more information.

Minor in Feed Milling

This minor is appropriate for (but not limited to) students majoring in Agricultural Business Management, Agricultural Economics, Agricultural Education, Agricultural Science, Agronomy, Animal Science, Biological
Science, Food Science, Nutritional Science, Poultry Science and Zoology. Students completing a minor in Feed Mill Science will become familiar with the feed milling process and with its related industries. The minor requires a minimum of 15 credit hours with a grade of “C-” or better. The program is flexible in order so that students may emphasize the discipline or species of their interest.

See the complete listing of minors (http://oucc.ncsu.edu/minors/feed-milling) for more information.

Department of Soil Science

The Department of Soil Science trains students in the use and management of land. Graduates will understand both the fundamentals of soils and the principles of land management. The curriculum will show how these principles are applied in agriculture as well as real estate development. Soils constitute one of the largest capital investments in farming, and proper soil management is essential for efficient production. Future world food needs will be met by proper use of soil resources and fertilizers. Soil properties are important for non-agricultural, environmental, and real estate development as well. For managing any use of land, knowledge of soil and its interaction with potential pollutants is essential in maintaining environmental quality. People trained in soils and land management are sought by private consulting companies, land developers, agribusiness, research, service planning-development, education and conservation-related agencies.

Opportunity

Soil science graduates fill positions of leadership and service in land resource planning, environmental science, real estate development, conservation, natural resource management and agriculture. Among these are opportunities as: farm operators and managers; county agricultural extension agents; employees of other public advisory agencies; private sector soil consultants for real estate development, and Natural Resources Conservation Service and other conservation-related agencies concerned with soil resources. Graduates also serve as technical representatives and salesmen in fertilizer companies and in other agribusiness activities. Many opportunities exist for privately consulting soil scientists who serve a variety of clientele needs including helping plan real estate developments. Environmental concerns usually require soil science expertise, especially in land-based waste management. Provisions are made for students wishing for more thorough training in biological sciences, chemistry, mathematics and physics leading to graduate study. (See the Graduate Catalog for a listing of graduate degrees). Students with an advanced degree have greater opportunities in teaching, research, service and extension with state, federal and private educational or research institutions and agencies.

Curricula

The Bachelor of Science degree may be obtained with a major in Soil and Land Development, Plant and Soil science, or Natural Resources, Soil and Land Development is designed to train students for work in the real estate industry. Two concentrations are offered: Soil and Land Development and Soil Science. A minor in Business Administration is encouraged for students in the Land Management concentration who may want to start their own business. The Soil Science concentration will be of interest to students planning to go to graduate school. The Plant and Soil Science Program is administered jointly with the Department of Crop Science. A soil science concentration is available in the Plant and Soil Science curriculum. Two soils concentrations are available in the Natural Resources curriculum, Soil Resources and Soil and Water Resource Systems. (The Plant and Soil Science, Natural Resources, and Environmental Sciences curricula are shown previously within the College of Agriculture and Life Sciences).

Minor in Soil Science

The minor in Soil Science is offered to students desiring a strong knowledge of the principles of Soil Science to complement their major. The program is intended to strengthen the understanding of basic physical and chemical soil properties that would be relevant to students interested in land management. These interests may include (but are not limited to):

- Forestry
- Geology
- Natural Resources
- Environmental Sciences
- Plant and Soil Science
- Turfgrass Management
- Plant Biology
- Landscape Architecture
- Horticulture
- Biological and Agricultural Engineering
- Agricultural Business Management
- Agricultural Education

Note: Fourteen (14) hours of required courses and three hours of electives are necessary to complete the minor.

North Carolina Agricultural Research Service (NCARS)

The North Carolina Agricultural Research Service (NCARS) is the research function of the College of Agriculture and Life Sciences. Research programs range from fundamental to applied in support of agriculture, the environment, as well as health and well being. Forestry research is a jointly conducted program between NCARS and the College of Natural Resources. NCARS is funded principally by appropriations from the North Carolina General Assembly, federal formula funds, grants and contracts.

Our Mission

The mission of NCARS is to develop the knowledge and technology needed to:

- Improve productivity, profitability and sustainability of industries in agriculture and the life sciences;
- Conserve and improve the state’s natural resources and environment;
- Improve the health, well being and quality of life of North Carolina’s citizens;
- Provide the science base for research and extension programs.

Many research faculty in NCARS have joint appointments in teaching or extension. In classroom and informal teaching functions, our research scientists develop and teach quality science-based curricula in the fields of agriculture, biology, social sciences and the environment. Our faculty also contribute to the graduate training of students destined to become
leaders, teachers, and scientists who will help sustain viable agriculture and life science industries.

Publications
NCARS publishes bulletins and scientific papers on research solutions to problems and opportunities that will benefit citizens, businesses and communities. Copies of technical bulletins may be obtained from the Department of Communication Services Customer Service at (919) 513-3045 and scientific papers from authors.

Services
The faculty of NCARS conducts research, which has a direct impact on the agriculture and life science industries in North Carolina. This research includes field and laboratory experimentation in the agricultural, biological, physical, social, and environmental sciences. Primary emphases are devoted to two areas: 1) the production, processing, distribution, and consumption of the many agricultural and forestry commodities and products produced throughout the State and 2) developing and marketing life-science based processes and technologies. Together, these two research areas help improve the quality of life of both rural and urban citizens.

North Carolina Cooperative Extension Service
Patterson Hall, Room 120
Phone: (919) 515-2813

The NC Cooperative Extension Service at NC State University is part of a national Extension network that transforms the research knowledge of the university system into practical learning experiences and opportunities for all residents of NC to improve their lives. Client’s value Cooperative Extension based on our proven ability to help people improve their lives through their personal application of the new knowledge they learn. Dedicated staff are committed to finding the best unbiased information and then helping individuals one-on-one or creating educational programs to help solve real problems and address relevant issues. Respect for individual needs and the belief that education can improve lives has built a strong and respected relationship throughout the state and nation. The NC Cooperative Extension Service partners with County Governments and the Eastern Band of Cherokee Indian Tribal leadership to provide locally based Agents with the skills and passion to provide the education and hands-on training needed to impact local issues. Agents use advisory councils of local residents to identify key issues and concerns in their families, businesses, and communities. Once key issues are identified, agents develop educational programs and appropriate teaching and experiential learning methodologies to help targeted audiences learn what they can do to improve their practices, behaviors and lives. Outcomes and impacts of these programs are determined through evaluations to ensure public trust and accountability of resources provided.

North Carolina Cooperative Extension Service key areas of educational expertise include: Strengthening the economic and environmental vitality of NC food, feed, fiber and forest systems and ornamental plant based industries; Family health and nutrition; Positive youth development and leadership (4-H); and Community Development.

Agricultural Institute
100 Patterson Hall
NCSU Box 7642
Raleigh, NC 27695-7642
Phone: (919) 515-3248
Fax: (919) 513-1421
e-mail: ag_institute@ncsu.edu
Visit the AGI website (http://harvest.cals.ncsu.edu/aginstitute)

Modern-day society depends heavily on the abilities of highly trained people for its success. It would be impossible for a single individual to be a nutritionist, a plant and animal disease specialist, a mechanic, or a management expert all combined into one. These are only a few of the skills that make up the highly technical, rapidly advancing field we know as agriculture today.

The Agricultural Institute was organized by North Carolina State University in the fall of 1959 to meet the ever-increasing demand for technically trained people in agriculture and related fields. It is a two-year program that awards the Associate of Applied Science Degree upon successful completion of at least one of the curricula. Provision for the Agricultural Institute was made by the 1959 North Carolina General Assembly.

Instructional programs of the Agricultural Institute are organized and conducted as a part of the overall program in the College of Agriculture and Life Sciences. The Agricultural Institute is an addition to and not a substitute for the bachelor of science degree-granting program of the College of Agriculture and Life Sciences. However, faculty for the four-year program are responsible for organizing and teaching courses offered by the Agricultural Institute. The Institute uses the same facilities (classrooms, laboratories, farms) as the four-year program. Facilities are available for both teaching and observing how technology is applied in agriculture and other areas.

People with the kind of training offered by the Agricultural Institute are in demand in North Carolina and the nation. By adding new courses of study to keep up with rapidly changing technology, the Agricultural Institute strives constantly to meet the needs of its students. In doing so, it prepares them to be highly trained candidates for careers in agribusiness, agriculture, pest management, ornamentals, landscape, turfgrass, and other related areas.

Agricultural sciences and related areas are challenging businesses that continue to grow more complex every day. The scientific age in which we live has given an entirely different meaning to what we knew as agriculture a half century ago.

College of Design
NCSU Box 7701
Raleigh, NC 27695-7701

Now in its sixth decade, the College of Design at North Carolina State University has from the beginning prepared designers who, in the broadest sense, shape the world. Design education is more than an attempt to teach a set of technical skills. The environment—including the spaces in which people live and work, the products they consume, and the messages they receive—have a powerful impact on how humans function as a society. Good design, therefore, requires attention and sensitivity to social, economic, political, cultural, and behavioral issues.
The aim of the curricula in the College of Design is to develop the designer’s perception, knowledge, skills, and problem-solving abilities.

The College of Design admits students through a selective process that ensures a highly motivated and heterogeneous design community. The entering student body consistently ranks at the top of academic achievement in the university and the college graduation rates are the highest in the institution. While providing undergraduate and graduate study in multiple disciplines and encouraging individual plans of study, the college functions as a unified, interactive education center, dedicated to preparing designers capable of shaping the environment to various scales in response to society’s needs.

The First Year Experience

Students enter the College of Design into one of five majors: Architecture, Art + Design, Graphic Design, Industrial Design, and Design Studies (non-studio based major). The first year experience centers on courses that are populated with a mix of students from the five disciplines. They include introductions to the design process, a design vocabulary, and fundamental principles of designing. Project activities include hands-on work, discussions, demonstrations, critiques, and occasional field trips. Emphasis is on interaction, independence, self-discipline and self-motivation.

In both semesters, the first year experience emphasizes learning how to use the design process, establishing disciplined work habits, communicating about design, using studio design vocabulary, and working in collaboration with others, thus forming the foundation for all subsequent design activity in the college and later in the professions.

Curricula and Degrees

The College of Design offers undergraduate instruction leading to the four-year Bachelor of Environmental Design in Architecture, Bachelor of Art + Design, Bachelor of Graphic Design, Bachelor of Industrial Design, Bachelor of Arts in Design Studies (non-studio based), as well as a one-year postgraduate program leading to the Bachelor of Architecture. The General Education component of each curriculum consists of courses in mathematical and natural sciences, physical education, science/technology/society, and communication and information technology. In addition to 6-credit hour design studios (not applicable to Bachelor of Arts in Design Studies, a non-studio based major) where students apply their expanding knowledge and skills to theoretical and practical design problems, majors in the College of Design take support courses dealing with design knowledge and skills, such as communication and presentation, human behavior, environment, history, philosophy, physical elements and systems, methods and management. The curriculum path has some flexibility, affording students the opportunity to concentrate in one area, while making contact with the other design disciplines. In addition to their faculty mentors, students are exposed to a broad range of design professionals through guest lecturers, juries, projects, and workshops.

Graduate studies are designed for students who want to build on undergraduate education and professional experience, as well as for those who come from non-design backgrounds and want to pursue advanced design degrees. The college offers graduate study leading to the Master of Architecture, Master of Art + Design (Animation or Fibers), Master of Graphic Design, Master of Industrial Design, Master of Landscape Architecture, and Ph.D. in Design. Please refer to the NC State University Graduate Catalog for specific curriculum information on master’s and doctoral programs in the College of Design.

School of Architecture

In a world of changing conditions—social, cultural, economic and technological—the central task of the architect remains to give meaningful form to the physical environment. These rapid changes, however, force today’s architects to not only concern themselves with traditional design issues like shelter, appropriateness, comfort, and beauty, but also to address emerging concerns like sustainability, environmental conservation, rapidly expanding cities, adaptive uses and preservation of older buildings, providing built environments in a global market, and new means of producing architecture. The aesthetic revolution of the past few decades has also freed architects from the rigidity of earlier theory allowing for greater diversity and expressiveness in architectural design.

The School of Architecture has addressed the diversity of roles and responsibilities through its faculty and its curricula. Its distinguished faculty embrace a broad definition of the practice of architecture and is, therefore, free of a singular, dogmatic, or stylistic bias. This diversity is evident in the experience, area of interest, national origins, and educational backgrounds of the faculty. The architecture curriculum balances mathematics, English, natural sciences and humanities and integrates with architectural design studios and a rich selection of design support courses. The design studio- a working laboratory in which the student learns how to design buildings under the guidance of a professor-is central to the curriculum.

The undergraduate Bachelor of Environmental Design in Architecture is a pre-professional degree that stresses the education of the individual and serves as the foundation for advanced, professional study in the discipline. The first semester is spent on design fundamentals in a studio common to all students in the College of Design. Following this introductory experience students receive a broad introduction to architectural design, theory, history, technology, and design processes, while exploring educational opportunities within the university.

Following the pre-professional program students may continue their studies in either of two professional programs: the one-year, post-graduate Bachelor of Architecture or two-year Master of Architecture program (see the Graduate Catalog for information on the latter program). Entry into both of these programs is competitive. To be accepted students must demonstrate potential for professional accomplishment, capability in design, and satisfy a specific set of professionally-oriented undergraduate requirements. Many students spend one or more years gaining professional experience in architecture firms or related fields before pursuing the advanced degrees. Educational enrichment is an important characteristic of the architectural program. The College of Design regularly presents public lectures by leading professionals and exhibitions of design and artwork. Electives are available in related disciplines—painting, sculpture, photography, landscape architecture, industrial design, and graphic design. Also available are field trips to buildings in urban centers of architectural interest, urban design studios conducted at the College of Design’s Downtown Design Studio, and a variety of foreign study programs including the College of Design’s Prague Institute.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).
Accreditation
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 six-year, three-year, or two-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 NAAB Conditions for Accreditation, including the required Student performance Criteria, can be viewed on the NAAB website (http://www.naab.org).

The North Carolina State University School of Architecture offers the following NAAB accredited degree programs:

- B. Arch. (pre-professional degree + 30 in professional program)
- M. Arch. (pre-professional degree + 48 graduate hours)
- M. Arch (non pre-professional degree + 96 hours)

Next accreditation visit for all programs: 2017

Department of Art + Design
The Department of Art and Design awards the Bachelor of Art and Design degree and the Bachelor of Arts in Design Studies. The pedagogical core of the program aims to reinforce foundation principles of design theory as applied to two-and three-dimensional design. Our curriculum addresses broad cultural, ecological, and societal considerations and promotes in our graduates the ability to meet the challenges of collaborative design. We emphasize the application of creative thinking and problem solving to design projects ranging from single to mass-produced artifacts. The areas of application span the range from formal design, fibers and surface design to emerging areas in media arts. Examples of current areas of study are hybrid applications of traditional and digital media that encompass imaging, animation, fiber and surface design, photography, printmaking, illustration, form generation and installations.

The Department of Art and Design believes there is an essential need for students in a technically-based research university to engage in course work that fosters creative thinking and problem solving. To meet this need, the department offers courses to all students in the university a minor in Art and Design. Minors are guided through a selection of courses with the consultation from a design adviser.

Opportunities
Career opportunities for graduates of the Department of Art and Design range from independent artist-designers to corporate level art-design directors. Graduates of this department are currently working in fields such as software design, multimedia, illustration, textile design, fashion and apparel design, art and design education, photography, filmmaking, special effects-digital, set design, exhibition design, museum education, public art and entrepreneurs.

Curricula and Degrees

Bachelor of Art and Design
The Department of Art and Design awards the Bachelor of Art and Design degree. The Bachelor of Art and Design degree is a broadly based, multidisciplinary undergraduate experience that fully utilizes a diverse faculty and bridges art and design with new technology. Students work closely with faculty in a well-planned sequence of progressively complex and in-depth studios. Students are advised through learning paths designed to produce optimal outcomes. This degree program provides a sound, well-rounded visual design education with a focus on providing students skills that allow them to perform and succeed in a wide variety of art and design professions after graduation.

While the degree is not profession-specific, students selecting the Bachelor of Art and Design degree may wish to use it as a foundation for graduate study in a specific art or design discipline. The goal of the curriculum is to provide structure for the creation of a new model of art and design professional. These individual artistic and practical talents are developed as different expressions of one potentiality.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Bachelor of Arts in Design Studies
The Bachelor of Arts in Design Studies is a non-studio based program that provides an interdisciplinary orientation to the history and theory of the design disciplines, material culture and design thinking. Design Studies focuses on the social, historical, technological and physical contexts in which design is produced. It presents the formative role of design in shaping human values and experiences.

Undergraduate students will be introduced to the breadth of the design disciplines expanding their awareness of design and the design process. Students can explore the range of career options in the fields of design through Design Studies concentrations in Non-Profits Studies, Business Administration or Museum Studies. Individuals preparing for a graduate education in design theory and criticism, museum practice, business management, entrepreneurship or marketing in design may choose from courses suited to their unique objectives. Students who want more general education will develop an understanding of design and its intrinsic relationship to the broader culture.

Design Studies is:

- Open to students whose interests and talents in design are more general and/or cross-disciplinary than those in the specific student-based programs
- Broadly engaged in issues of material culture.
- Preparatory for later advanced study in the design professions
- A blend of aesthetic, cultural, historical, social, physical, technological, business and entrepreneurial knowledge
- Collaborative in providing the learning and background necessary for further study in archival and cultural preservation, museum practice, conversation, collections administration, costume and theatre design, criticism, research, and arts and nonprofits management

Design Studies is not a transitional program from which to transfer into one of the studio-based degree programs in the College of Design. Design Studies students who wish to change majors will need to apply for competing seats in the freshmen class of a studio-based program.
and are subject to the select admissions process that requires a portfolio review.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Minor in Art and Design

The Minor in Art and Design’s objectives are to discover basic principles through hands-on activities, to apply design process and theory to solve problems creatively and efficiently, to increase awareness of one’s self and environment, and to foster an appreciation and understanding of the disciplines of Art and Design. Any curious undergraduate student with an overall grade point average of 2.75 in the university who seeks alternative methods of experiencing the environment in which we live will benefit from this minor.

The minor in Art and Design consists of 15 total credits hours of study, of which six (6) hours must be satisfied at the basic course level. The remaining nine (9) hours of courses may be selected from the course list in the information provided by the Art and Design adviser. A grade of “B” or better will be required for credit in all courses in the minor in Art and Design program. The course selection will be determined with guidance from the student’s minor adviser and tailored to the needs, interests, and goals of the student. Interested students seeking this minor should contact Professor Charles Joyner.

Although, all efforts are made to accommodate minors, it is important for potential students to know and understand that access to Art and Design courses are based on a hierarchy where priority access goes to Design majors.

Minor in Design Studies (Non-Design Majors)

This minor’s objectives are to provide a general orientation to the practice and theory of design for students whose primary study and employment will be in the other disciplines, to clarify the role design plays in society, and to create informed consumers who are able to make intelligent decisions about communication, products, and environments in work and in their personal lives. Any undergraduate student in the university who is not majoring in a design discipline would benefit from this program. Any student seeking this minor should contact the Associate Dean for Undergraduate Studies and Academic Support in the College of Design for an application and assignment of a minor adviser.

Graphic Design

Graphic design is the process of bringing meaningful visual form to communication. Graphic designers translate communication goals through printed, environmental, and electronic presentations of information. Graphic designers use words and images to express messages that inform, persuade, and incite people to action. Graphic designers are active in all aspects of communication design. For example, they design books, magazines and newspapers for the publishing industry. They also create printed materials such as logotypes, symbols, annual reports, newsletters, business forms, and other related literature for corporations, institutions, businesses, and governmental agencies. Graphic designers create multimedia presentations, websites, computer interfaces, and motion graphics such as film titles and typographic treatments for video, as well as on-air graphics for television. Graphic designers are employed in a variety of settings, including graphic design offices, advertising agencies, communication businesses, as well as corporations, institutions, or governmental agencies as part of internal communications departments.

The Graphic Design program is a part of the Department of Graphic and Industrial Design. The Graphic Design program awards a Bachelor of Graphic Design, a professional degree, recognized by the American Institute of Graphic Arts (AIGA) and is accredited by the National Association of Schools of Art and Design (NASAD). The program includes the study of visual, theoretical, historical, and technical aspects of the discipline. The curriculum provides comprehensive experiences in the analysis of communication problems, the development of creative solutions to those problems, and the implementation and evaluation of those solutions. Required courses in typography explore the role of words and language in graphic communication, while courses in imaging provide students with experiences in a range of photographic, videographic, and computer media. Instruction in computer software programs is fully integrated in design courses, and is not taught as a separate activity. In their studio coursework, graphic design majors prepare for careers in the field through the execution of demonstration projects of varying complexity and scale.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Industrial Design

The Industrial Design program is a part of the Department of Graphic and Industrial Design. The Industrial Design program awards a Bachelor of Industrial Design degree. The pedagogical core of the department aims to reinforce the foundation principles of design theory as applied to traditional and advanced technologies, i.e. new media, materials, and production techniques. Our curriculum addresses broad cultural, technological, and societal considerations and promotes in our graduates the ability to meet the challenges of technological complexity through collaborative design. We emphasize the application of creative thinking and problem solving to design projects ranging from single to mass-produced artifacts. The areas of application span the range from industrial design to interactive multimedia. The program is recognized by the Industrial Designers Society of America (IDSA) and accredited by the National Association of Schools of Art and Design (NASAD).

Opportunities

Career opportunities for graduates of the Department of Graphic and Industrial Design span the range from industrial design to virtual design. Graduates of this department are currently working in fields such as product development, furniture design, recreational product design, toy design, exhibition design, textile design, fashion design, photography, film making, special effects, set design, ergonomics and human factors.

Curricula and Degrees

The Department of Graphic and Industrial Design offers a four-year bachelor degree and two-year or more master’s degrees. Industrial Design is concerned with all human aspects of machine-made products and their relationship to people. The industrial designer is responsible for product safety, aesthetics, maintenance, and cost. Industrial designers deal with consumer and industrial products. In order to achieve these ends, designers must be involved in four major design and research areas: human behavior, human-machine relationships, the environment, and the product itself. In addition, the designer’s responsibility extends into sustainability product liability and cross-cultural issues.
Areas of study in the Bachelor of Industrial Design include:

- furniture
- textiles, house wares
- appliances
- transportation
- tools
- farm equipment
- medical instruments
- electronics
- human-computer interfaces
- recreational support equipment

The goal of the Industrial Design curriculum is to teach the design and development of products or product systems and their relationship to human beings and the environment.

Graduates of the Bachelor of Industrial Design program have career opportunities in three general types of practice: corporate design offices in manufacturing companies, independent consulting offices, and governmental agencies.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Department of Landscape Architecture

Landscape architecture is a multi-faceted profession dedicated to the welfare of the physical environment and the living communities of the earth. It is a diverse and growing design profession that combines art, science, engineering, and technology. Landscape Architecture at the College of Design is especially concerned with the stewardship, restoration, and regeneration of the natural and cultural environments in urban, rural, and wilderness settings.

Bachelor of Landscape Architecture

The Bachelor of Landscape Architecture program was phased out beginning Fall 2011. No new students will be accepted into the program. If you are interested in pursuing landscape architecture at the College of Design, please view our Master of Landscape Architecture program.

The Department of Landscape Architecture currently enjoys full accreditation from the Landscape Architecture Accreditation Board (LAAB).

Minor in Landscape Architecture

The Minor in Landscape Architecture will provide a basic understanding of the nature of the profession of Landscape Architecture. Knowledge of Landscape Architecture history and theory provides a useful addition to a major in any of the University disciplines.

The Minor in Landscape Architecture is designed to:

- Provide a general background in the discipline with regard to landscape architecture research, development and design for students, whose primary professional practice will be in another discipline.
- Clarify the role of the profession of Landscape Architecture.

For more information, contact Gene Bressler: gene_bressler@ncsu.edu

College of Education

NCSU Box 7801
Raleigh, NC 27695-7801

Mission

The College of Education is a voice of innovation for learning across the life span. We prepare professionals who educate and lead. Our inquiry and practice reflect integrity, a commitment to social justice, and the value of diversity in a global community.

Vision

To be a nationally ranked, research-intensive, professional College of Education with distinction for working, teaching and learning in technology enhanced environments.

Undergraduate Degree Programs

Undergraduate degree programs that lead to a public school teaching license are offered in elementary education (K-6), mathematics education (9-12), middle grades education (6-9) (language arts, social studies, math, science), science education (9-12), and technology engineering and design education (7-12). In addition to being admitted to a curriculum, all teacher education candidates must meet program and unit requirements for admission to candidacy in teacher education (including a minimum 2.75 overall grade point average after completing 45 semester hours) and for admission to student teaching (including a minimum 2.75 GPA overall.)

All teacher education students must successfully complete a set of core courses (ED 204, ED 311, ED 312, EDP 304, ELP 344) as part of their professional studies course work. Candidates for licensure must also complete the edTPA and a required number of non-credit professional development activities.

The College of Education also jointly administers teacher preparation programs with the College of Agriculture and Life Sciences (Agriculture Education, 7-12) and the College of Humanities and Social Sciences (English, 9-12 and World Languages, K-12). Candidates enrolled in these affiliated programs must also complete the college core courses, edTPA, and non-credit professional development activities.

Students enrolled in a natural science or a mathematical science curriculum have the option of double majoring in the Department of Science, Technology, Engineering and Mathematics Education to earn a license to teach (6-9 or 9-12).

In addition, the College of Education offers graduate programs in:

- Adult and Higher Education
- New Literacies and Global Learning
- Counselor Education
- Higher Education
- Curriculum and Developmental Supervision
- Middle Grades Education
The College also offers a Master of Arts in Teaching (MAT) for individuals who have degrees in other fields but wish to pursue a program leading to a master's degree and an initial teaching license. The MAT program includes elementary education (K-6), English as a second language (K-12), English education (9-12), math education (9-12), middle grades education (6-9), science education (9-12), secondary social studies education (9-12), special education: general curriculum (K-12). Candidates for licensure must also complete the edTPA and a required number of non-credit professional development activities.

See the Graduate Catalog or contact faculty members for information on graduate programs. Public schools post-master's licensure programs are available in some curricular areas.

All of the bachelor's level and graduate level licensure programs are approved by the North Carolina State Board of Education. The college is accredited by the Council for the Accreditation of Counseling & Related Programs (CACREP) and the National Council for the Accreditation of Teacher Education/Council for the Accreditation of Educator Preparation (NCATE/CAEP).

The College of Education is located in Poe Hall. It includes a Media Center and Instructional Computing Labs. The building houses laboratories for technology engineering and design education, reading, science, counseling and testing activities.

**Student Success and Advising Center (SSAC)**

The Student Success and Advising Center provides professional advising for all freshman, sophomores and transfer students in programs within the College of Education. The SSAC also serves as a resource for all College of Education students by offering services and programing such as student success workshops, student engagement opportunities and leadership development opportunities. Advisors are trained professionals who can supply valuable information about majors, courses, careers, requirements, policies, social life, academic support and transition issues.

**Scholarships and Awards**

Through the generous support of corporations and friends, the College of Education is able to offer over 45 scholarships to our undergraduate and graduate students each year based on merit and/or need. Scholarship amounts range from $200 to $5,000. High school counselors receive information and applications for all College of Education scholarships.

Find more information about Scholarships and Awards online [here](http://ced.ncsu.edu/student_services/scholarship_info.php).

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**Honors Society**

**Kappa Delta Pi**

The College of Education maintains the Omicron Rho chapter of Kappa Delta Pi ([http://www.kdp.org](http://www.kdp.org)), an international honor society in education. It elects those to membership who exemplify high academic achievement and exhibit the ideals of scholarship, high personal standards, and promise in teaching and allied professions.

Contact Dr. Drinda Benge for more information, E-mail: Drinda_Benge@ncsu.edu

**Pi Omega Pi**

Pi Omega Pi is the National Business Education Teacher Honor Society, which has the purpose of promoting scholarship and service in the area of business education. For over 80 years, Pi Omega Pi ([http://catalog.ncsu.edu/undergraduate/collegeofeducation/%20http://ced.ncsu.edu/academics/departments/cice/business-and-marketing-education/undergraduate](http://catalog.ncsu.edu/undergraduate/collegeofeducation/%20http://ced.ncsu.edu/academics/departments/cice/business-and-marketing-education/undergraduate)) has provided its members with a variety of services pertaining to business education. The Zeta Lambda Chapter at NCSU provides students with opportunities to develop leadership skills, professional dispositions, content competence, and a service mentality. The aims of Pi Omega Pi as given in the National Constitution are:

- To create a fellowship among teachers of business subjects.
- To create and encourage interest and promote scholarship in business education.
- To encourage civic responsibility.
- To foster high ethical standards in business and professional life among teachers of business.
- To teach the ideal of service as the basis of all worthy enterprise.

Contact Dr. James R. Smith for more information, E-mail: James_Smith@ncsu.edu

**EPSILON PI TAU International Honor Society for Professions in Technology**

Epsilon Pi Tau ([http://ced.ncsu.edu/student-life/organizations](http://ced.ncsu.edu/student-life/organizations)) recognizes student excellence in the study of technology and prepares practitioners for the technology professions. The Department of Science, Technology, Engineering, and Mathematics Education hosts the local chapter Alpha Pi.

Contact Dr. Walter Kelly, Chapter Trustee, for more information, E-mail: Walter_Kelly@ncsu.edu

**SAY Village**

The college and University Housing have partnered to provide a living and learning residential experience for first year students called Students Advocating for Youth (SAY Village). Housed in Syme Hall, this experience targets students interested in working with elementary-aged youth. No matter what the major or aspirations for the future, advocating for youth spans many fields of study. For more information, visit the SAY Village website ([http://www.ncsu.edu/housing/villages/say](http://www.ncsu.edu/housing/villages/say)). Additionally, sophomore students who return to SAY Village and live in Syme Hall comprise what is known as the “DAY” portion of the program - “Determined Area Youth.” The DAY component enables those students returning to SAY to teach self-advocacy skills to area middle school youth.
International Activities

Faculty members have been involved in overseas projects in China, Ghana, Honduras, Japan, New Zealand, Peru, Puerto Rico, Russia, and South Africa. Some of the foreign language teacher education students spend a year in France or Spain in an exchange program. International students in several of the education programs and elsewhere at NC State participate in on-campus, multi-cultural opportunities. The College of Education has begun extensive efforts at globalization that will include opportunities to study abroad and student teach in countries such as China, Brazil, and other sites. You can find more information about the College of Education’s Study Abroad opportunities (http://ced.ncsu.edu/ study-abroad) online.

Accreditation

All of the bachelor’s level and graduate level licensure programs are approved by the North Carolina State Board of Education. The college is accredited by the Council for the Accreditation of Counseling and Related Programs (CACREP) and the National Council for the Accreditation of Teacher Education/Council for the Accreditation of Educator Preparation. (NCATE/CAEP). Please visit the College of Education’s website (http://ced.ncsu.edu/academics/licensureaccreditation).

Department of Leadership, Policy, Adult and Higher Education

This program is only offered at the graduate level. For more information on this program, please visit the Graduate Catalog (http://www.ncsu.edu/ grad/catalog).

Department of Curriculum, Instruction, and Counselor Education

The Department of Curriculum, Instruction and Counselor Education prepares undergraduate students to become teachers of language arts and social studies in middle grades (6-9). The Department currently includes a diversity of highly qualified students. All programs emphasize scholarship and individually designed study, and include cross-disciplinary work, field-based experiences and allow for semester abroad options.

Curriculum in Business and Marketing Education

Curriculum in Middle Grades Education

Middle Grades Education, Language Arts and Social Studies

The Middle Grades Language Arts and Social Studies (MSL) undergraduate program in the Department of Curriculum, Instruction, and Counselor Education seeks to prepare teachers who can effectively educate young adolescents, while being responsive to their unique needs, interests, and abilities. Graduates earn licensure for teaching in grades 6-9 in two subject disciplines: language arts and social studies.

Even though the Undergraduate Catalog states, “All undergraduate students will be required to have at least a 2.0 GPA in order to graduate,” the Department of Curriculum, Instruction, and Counselor Education requires its students to maintain a 2.5 GPA throughout the program. A 2.5 GPA is a statewide requirement to student teach. Therefore, it is likely that all MSL majors will graduate with a higher GPA than required by the university. Specific curriculum requirements are available on the OUCC website (http://oucc.ncsu.edu/category/eight-semester-display-department/education).

For Middle Grades Education, Mathematics/Science, see the Department of Mathematics, Science, and Technology, Engineering, and Design Education.

English Teacher Education

Tompkins Hall, Room 268
Jason Miller, Teacher Education Coordinator and Advisor jason_miller@ncsu.edu

Students desiring to become secondary English teachers in grades 9-12 will be enrolled in the College of Humanities and Social Sciences. In that college’s section of this catalog, curriculum requirements for the teacher education option can be found under the Department of English. Students desiring to become language arts teachers in grades 6-9 will be enrolled in the College of Education.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

French Teacher Education

Withers Hall, Room 413
Karen Tharrington, Program Coordinator kltharri@ncsu.edu

Students desiring to become teachers of French will be enrolled in the College of Humanities and Social Sciences. In that college’s section of this catalog, curriculum requirements for the teacher education option in French can be found under Foreign Languages and Literatures. See the CHASS website (http://fll.chass.ncsu.edu/french/ltf.php) for more information.

Spanish Teacher Education

Withers Hall, Room 413
Karen L. Tharrington, Coordinator kltharri@ncsu.edu

Students who wish to become licensed to teach Spanish K-12 by the State of North Carolina will be enrolled in the College of Humanities and Social Sciences. The curriculum requirements for the teacher education option in Spanish (LTA curricula) can be found under information for the Department of Foreign Languages and Literatures in the College of Humanities and Social Sciences.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Middle Grades Education, Mathematics Concentration

Poe Hall, Room 502F
Phone: (919) 513-0505
Department of Elementary Education and Teaching

The Department of Elementary Education offers both undergraduate and graduate degrees. The undergraduate program culminates with a recommendation for a North Carolina “A” level K-6 teacher’s license. The program prepares elementary teachers in all curricular areas, with emphasis in the Science, Technology, Engineering, and Mathematics (STEM). Professional studies courses and experiences include innovative, rigorous pedagogical courses and diverse field experiences. The elementary education curriculum provides NC State University future teachers with more study in the disciplines of mathematics and the sciences than is customary in elementary teacher preparation programs. As a means of directly addressing the competencies required by The NC Department of Public Instruction and to be at the leading edge of the professional field, the NC State program also includes more specialized methods courses as well and supervised field experiences in mathematics, science, and technology than typical elementary education teacher preparation programs. Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

The Department of Elementary Education also offers Master of Education (MEd) and Master of Science (MS) (http://ced.ncsu.edu/academics/departments/departments(elm)/masters) degrees for students holding a K-5 elementary license and want advanced study. These programs provide options for study in particular curricular areas and/or foundational research and content knowledge for PhD or ED programs. Curricular requirements are available on the College of Education's website (http://ced.ncsu.edu/elementaryed).

Curricula in Education, General Studies

The General Studies Education program serves those students previously enrolled in teacher education programs at North Carolina State University, but whose career goals have changed. Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Curricula in Middle Grades Education

Specific curriculum requirements (http://oucc.ncsu.edu/category/eight-semester-display-collegedepartment/education) are available online.

Curricula in Mathematics Education, Secondary

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Mathematics Education, Secondary

Student Success and Advising Center
Poe Hall, Room 505
Phone: (919) 515-0595

Allison McCulloch, Undergraduate Program Coordinator
Poe Hall, Room 502 L
Phone: (919) 513-2803

Tina Starling
Poe Hall, Room 502 J
Phone: (919) 513-1754

Middle Grades Education, Mathematics Concentration

Student Success and Advising Center
Poe Hall, Room 505
Phone: (919) 515-1062
Curricula in Science Education, Secondary

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Curricula in Science Education, Secondary

P.E. Simmons, Undergraduate Program Coordinator
Poe Hall, Room 510 N
Phone: (919) 515-5920

Middle Grades, Science Concentration
P.E. Simmons, Undergraduate Program Coordinator
Poe Hall, Room 510 N
Phone: (919) 515-5920

Curricula in Technology, Engineering and Design Education

Specific curriculum requirements are available on the OUCC website (http://oucc.ncsu.edu/category/eight-semester-display-collegedepartment/education).

Curricula in Technology, Engineering and Design Education

Aaron Clark, Undergraduate Program Coordinator
Poe Hall, Room 510 E
Program phone: (919) 515-1771

Joe Busby
Poe Hall, Room 112
Phone: (919) 513-0221

Minor in Graphic Communications

This 15 hour minor develops competencies in selecting and applying graphic techniques in both career and leisure activities, provides in-depth manual and computer skills, and enriches visual perception and critical thought in graphic areas. Minor programs are individually designed to meet the needs of the student and to fit with the student’s major, such as engineering or technology, engineering, and education.

Brian Matthews, Minor Program Coordinator
Poe Hall, Room 502 O
Phone: (919) 515-1751

Agricultural Teacher Education

Overview:

Students desiring to become teachers of agriculture will be enrolled in the College of Agriculture and Life Sciences. The curriculum requirements for the teacher education program can be found under the Department of Agricultural and Extension Education. Below is a brief summary of the degree:

Agriculture remains one of the largest and diverse components of the economy of this country and the world. Teaching agriculture at the middle school or high school level is an exciting career. Agriculture teachers prepare students to either enter this dynamic industry of agriculture or for advanced study at two-year or four-year institutions leading to agricultural careers.

In addition to classroom and laboratory instruction in agriculture, our graduates are prepared to assist students in developing and conducting supervised agricultural experience programs that reinforce what is learned in the classroom. They also develop the skills necessary to be an FFA advisor and to provide those leadership and career development opportunities for their students.

Completion of the B.S. in Agricultural Education leads to teacher licensure in Agricultural Education, grades 6-12. There is a strong demand for agriculture teachers, and salaries are competitive with other agricultural careers. There are over 350 secondary agriculture teachers located throughout North Carolina.

Because agriculture is a diverse industry, students are allowed to select one area of agriculture in which to concentrate their studies. The concentrations are listed to the left. Often students choose to complete a minor in a second area of concentration.

For more information, please see the Agricultural and Extension Education website (http://www.cals.ncsu.edu/agexed).

College of Engineering

118 Page Hall
NCSU Box 7904
Raleigh, NC 27695-7904
Phone: (919) 515-3263
Fax: (919) 515-8702
E-mail: engineering@ncsu.edu

Men and women who seek a challenging technical career in research and development, design, construction, production, maintenance, technical sales, management, teaching, or other careers requiring a methodical, creative approach to problem solving, should consider an engineering or computer science education. At NC State, the College of Engineering has a distinguished and internationally recognized faculty, and the College
of Engineering offers the opportunity for ambitious men and women to become the leaders and prime movers of our increasingly technological world. Because of the great influence of science and technology on our everyday lives, today's engineers and computer scientists must be acutely aware of, and responsible for, the effects their creations may have on society. In addition to safety, aesthetics, economics, and energy, today's technologists must consider environmental, sociological, and other "human concern" costs.

College of Engineering graduates work in diverse careers around the world. Most are practicing engineers, but because their education has equipped them well to address problems in a wide variety of fields, many College of Engineering graduates have become corporate presidents, lawyers, medical doctors, and leaders in government. The College of Engineering has engineering degree programs in nine academic departments and three affiliated departments. These departments include: Biological and Agricultural Engineering; Biomedical Engineering; Chemical and Biomolecular Engineering; Civil, Construction, and Environmental Engineering; Computer Science; Electrical and Computer Engineering; Industrial and Systems Engineering; Materials Science and Engineering; Mechanical and Aerospace Engineering; Nuclear Engineering; Paper Science and Engineering within the Department of Forest Biomaterials; and Textile Engineering. Eighteen undergraduate degree programs are offered in these twelve departments. In addition, a degree program in Engineering is offered by special arrangement to the very few students who can clearly demonstrate the need for an individualized program of study. All departments also offer advanced studies leading to master's degrees and the Doctor of Philosophy degree. Consult the Graduate Catalog (http://www.ncsu.edu/grad/catalog) for graduate degrees.

The College of Engineering requests and receives accreditation from the Engineering Accreditation Commission of ABET, Inc. for sixteen of its undergraduate engineering degree programs. These are aerospace engineering, biological engineering, biomedical engineering, chemical engineering, civil engineering, computer engineering, construction engineering and management, electrical engineering, engineering-mechatronics, environmental engineering, industrial engineering, materials science and engineering, mechanical engineering, nuclear engineering, paper science and engineering, and textile engineering. The Bachelor of Science in Computer Science program is accredited by the Computing Accreditation Commission of ABET, Inc. Accreditation ensures that these programs satisfy requirements for acceptance by these nationally recognized agencies. All curricula and programs are designed to maintain the college's national and international reputation while meeting the needs of the people and industries of the state and region through effective instruction, competent research, and the development of new and meaningful contributions to scientific knowledge.

The University Career Development Center is maintained by the university to assist continuing students and graduating students in achieving their career goals.

Degrees

Entering students receive assistance in planning an appropriate program of study and have available continued guidance from academic advisers throughout their academic careers. Beginning freshmen enroll in the Engineering First Year (EFY) Program for one to two years. After successfully completing college requirements, students may be admitted to a departmental degree program. In order to be eligible to apply for admission into a degree program, students must successfully complete the following courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH 101</td>
<td>Chemistry - A Molecular Science (C or better)</td>
<td>3</td>
</tr>
<tr>
<td>CH 102</td>
<td>General Chemistry Laboratory (C or better)</td>
<td>1</td>
</tr>
<tr>
<td>MA 141</td>
<td>Calculus I (C or better)</td>
<td>4</td>
</tr>
<tr>
<td>MA 241</td>
<td>Calculus II (C or better)</td>
<td>4</td>
</tr>
<tr>
<td>PY 205</td>
<td>Physics for Engineers and Scientists I (C or better)</td>
<td>3</td>
</tr>
<tr>
<td>PY 206</td>
<td>Physics for Engineers and Scientists I Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENG 101</td>
<td>Academic Writing and Research (pass)</td>
<td>4</td>
</tr>
<tr>
<td>E 101</td>
<td>Introduction to Engineering &amp; Problem Solving (pass)</td>
<td>1</td>
</tr>
<tr>
<td>E 115</td>
<td>Introduction to Computing Environments (pass)</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: Acceptance into a department must occur in a timely manner.

Bachelor of Science

The baccalaureate program provides preparation for entry into industry, government, business or private practice as well as graduate school. Graduates with a B.S. degree in engineering or computer science may be engaged in design development, production, construction, sales, maintenance, or the planning, operation or management of industrial units.

The undergraduate curricula offer programs of study leading to bachelor's degrees in aerospace engineering, biological engineering, biomedical engineering, chemical engineering, civil engineering, construction engineering and management, computer engineering, computer science, electrical engineering, engineering-mechatronics, environmental engineering, industrial engineering, materials science and engineering, mechanical engineering, nuclear engineering, paper science and engineering, and textile engineering. Graduation requirements include completion of one of the curricula with an overall grade point average of 2.0 and a grade point average of 2.0 in the major courses. The total number of required credits ranges from 120 to 128 semester hours.

Double Degree Programs

NC State students may wish to earn Bachelor of Science degrees in two fields from the College of Engineering. When the two courses of study are planned early and carefully, a number of courses can simultaneously satisfy requirements in both degrees. Humanities, social science, physics, mathematics, chemistry, English, and physical education sequences are common to most curricula. Students interested in such a program should consult the Office of Academic Affairs (118 Page Hall).

Other students may wish to combine a Bachelor of Science from the College of Engineering with a Bachelor of Science or Bachelor of Arts degree in another college at NC State University. A number of courses required for one degree may also satisfy requirements for a second degree. When the two courses of study are planned early and carefully, a double-degree program can be completed in as few as five years. Students interested in such a program should contact the Office of Academic Affairs (118 Page Hall).

Student Activities

Each department (http://www.engr.ncsu.edu/departments) in the College of Engineering (http://www.engr.ncsu.edu) has technical societies open to every student enrolled in the respective degree program(s).
In most cases, these are student chapters of national professional organizations. Each curriculum also has one or more honor societies to give recognition to students who have earned superior academic records. In addition, there are college-wide honor, professional, and service societies that offer personally and educationally rewarding opportunities for students. Such societies include, for example, the Engineers’ Council, Society of Women Engineers (SWE), and National Society of Black Engineers (NSBE). The complete list of student organizations (http://students.engr.ncsu.edu/orgs) provides more details.

International Opportunities

The College of Engineering is actively educating engineers that will impact our global marketplace. Student participation in overseas opportunities -- study, research, service, or work -- is highly encouraged. Students in the College of Engineering should consider exploring these possibilities through the Career Development Center (work), Center for Student Leadership, Ethics, and Public Service (service), our tenure-track faculty (research), and the Study Abroad Office (study). College of Engineering students may participate in opportunities throughout the world, for example: Prague Institute, Czech Republic (GEP study); Munich, Germany (work); Zhejiang, China (study); San Juan de la Maguana, Dominican Republic (Service); Rio de Janeiro, Brazil (research); or many others. Students interested in these opportunities may learn more through the Office of Academic Affairs (118 Page Hall).

Cooperative Education Program

This optional program is structured so that the student will alternate semesters of study with semesters of practical work as sophomores and juniors. The freshman and senior years are spent on campus, while sophomore and junior academic work is spread over a three-year period to permit alternating academic semesters with work-experience semesters. Students earn a salary while they are in industry. This income can prove useful in offsetting college expenses. The Co-op plan can be completed in five years, during which time the student receives 12 to 18 months of industrial experience.

Students in all curricula in the College of Engineering may apply for the Co-op program if they have a grade point average of 2.5 or better. Application for admission into the Co-op program should be made early in the spring semester of the freshman year. Students must be accepted into an engineering degree program prior to beginning the first Co-op assignment.

Further information may be obtained from:
Cooperative Education Program (http://www.ncsu.edu/co-op_ed)
Career Development Center
2100 Pullen Hall

Induction to the Profession

All graduating students in the College of Engineering are invited to participate in the Induction to the Profession ceremony, held during each graduating season. The event acknowledges the fellowship of engineers and computer scientists who are trained in science and technology and who are dedicated to the practice, teaching, or administration of their profession.

Initiation into the Profession includes commitment to the "Obligation" and acceptance of a stainless steel ring to be worn on the little finger of the working hand. Only those who have met the high standards of professional engineering and computer science training or experience are invited to accept the Obligation, which is voluntarily received for life. This commitment is not a trivial act but is, rather, like the Hippocratic Oath, a promise to practice the profession ethically, with integrity, tolerance and respect. The ring is worn as a visual symbol to attest to the wearer's calling and symbolizes the unity of the profession in its goal of benefiting humankind. The stainless steel from which the ring is made depicts the strength of the profession.

Benjamin Franklin Scholars Program

A limited number of freshmen in the College of Engineering apply and are selected to participate in the Benjamin Franklin Scholars Program. Students completing the program earn a Bachelor of Science in an engineering discipline or in computer science and a bachelor's degree in humanities or social sciences.

This double-degree program, a joint undertaking of the College of Engineering and the College of Humanities and Social Sciences, provides a unique opportunity to integrate a solid base of knowledge in technology or science with a broad humanistic and social perspective. The curriculum for the double-degree program has four main components: (1) a strong general education, (2) specially designed interdisciplinary courses, (3) all technical course requirements associated with the engineering or computer science degree, and (4) a second major in the humanities and social sciences chosen from among the traditional majors or an interdisciplinary major. Students who have been accepted into a College of Engineering degree program, have declared a major in the College of Humanities and Social Sciences, and have at least a 3.0 GPA are generally eligible for scholarships from the program. With careful planning, the program can be completed in five years.

For more information, contact:
Dr. Ross Bassett, Program Director
ross_bassett@ncsu.edu, (ross_bassett@ncsu.edu)
or the Office of Academic Affairs (118 Page Hall).

Computers

The College of Engineering provides its students with a large number of workstation labs for the purpose of running high-end engineering applications. In addition, incoming freshmen are encouraged to own a laptop computer to use in classroom, lab, and mobile settings. The first-year computer lab course, E 115, Introduction to Computing Environments, instructs students in the use of their own computers to interface effectively with the vast resources of the college computing environment, named “Eos.” The course emphasizes the student’s responsibility for his or her own computer, including security and hands-on maintenance. Computers, both lab-based and student-owned, are central to engineering education in the college.

Transfer Program

Students with non-engineering degrees or one or more years of academic work completed at other institutions may apply for transfer admission to the College of Engineering through the Office of Undergraduate Admissions. Students are admitted from four-year institutions as well as from junior and community colleges. Students currently attending or anticipating attendance at other institutions are advised to contact the Office of Academic Affairs for information on transfer requirements, transfer course credit and admission to NC State.
Golden LEAF Biomanufacturing Training and Education Center

Biomanufacturing is the production of useful products such as penicillin through the use of biological molecules and living organisms. The Golden LEAF Biomanufacturing Training and Education Center (BTEC) simulates a biomanufacturing pilot plant capable of producing biopharmaceutical products and packaging them in a sterile, current Good Manufacturing Practices (cGMP)-like environment, and is the only facility of its kind in the nation and one of only a few in the world.

The BTEC hands-on, laboratory-intensive academic program is provided using large-scale equipment, including bioreactors, downstream separation and purification processes, bioreactor control systems, and aseptic processing operations. In addition to undergraduate and graduate courses, the BTEC educational program includes an undergraduate Minor in Biomanufacturing, and a University Certificate in Biomanufacturing. A Post-baccalaureate Certificate in Biomanufacturing is available for students who have earned a bachelor’s level degree. Undergraduate students majoring in chemical engineering may elect to complete a concentration in biomanufacturing sciences. The BTEC graduate program will include a Minor in Biomanufacturing, a Master of Science degree, and a Professional Science Masters in Biomanufacturing.

For additional information, please visit the BTEC website (http://www.btec.ncsu.edu).

Department of Biological and Agricultural Engineering

The Department of Biological and Agricultural Engineering applies engineering principles to biologically-based systems, primarily in agricultural and environment. The BAE department provides excellent educational opportunities at the undergraduate level with a Biological Engineering program that is well recognized as among the finest in the United States.

The BE curriculum includes concentrations in agricultural engineering, bioprocess engineering, and environmental engineering. All concentrations within the BE curriculum emphasize core courses in biology, mathematics, physics, chemistry, hydraulics, mechanics, materials, and thermodynamics, which collectively provide solid training in basic science and engineering. The curriculum is designed to prepare each graduate to master fundamentals of engineering and biology, develop the ability to solve engineering problems, improve self-confidence, and apply the creative process of engineering design. The educational experience is capped off with a two semester senior level course that immerses each graduate in the team approach to developing engineering solutions to complex problems. By the time of graduation, approximately 80% of BE graduates will have passed the Fundamentals in Engineering exam and thus be well on their way toward licensure as a Professional Engineer.

Opportunities

BE students learn to solve a wide variety of engineering problems and will have opportunities for specialization though selection of a specific concentration. Scientific and engineering principles are applied: to conserve and manage air, energy, soil and water resources; to manage, protect and restore natural ecosystems; to understand and utilize biological, chemical and physical processes for the production and conversion of biomass to bio energy; to analyze, understand and utilize mechanical properties of biological materials; to design and develop machinery systems for all phases of agricultural and food production; to design and evaluate structures and environmental control systems for housing animals, plant growth, and biological product storage; to develop improved systems for processing and marketing food and agricultural products; and to design sensor-based instrumentation and control systems for biological and agricultural applications.

Graduates of the BE curriculum receive a “B.S. in Biological Engineering,” qualifying them for positions in design, development, and research in industry, government and public institutions. The curriculum also prepares students for post-graduate work leading to advanced degrees. Typical positions filled by recent BE graduates include: stream and wetlands restoration project manager; product design; development and testing engineer; plant engineering and management; engineering analysis and inspection for federal and state agencies; engineering consultant and research engineer. Entry-level salary ranges for BE graduates are similar to those of Civil, Industrial, and Mechanical Engineering graduates.

Curricula

The BE curriculum is jointly administered by the College of Agriculture and Life Sciences and the College of Engineering and combines the fields of engineering, biology and agriculture. The BE curriculum is accredited by the Engineering Accreditation Commission of ABET, Inc. BE graduates are qualified to become registered professional engineers by passing the appropriate examinations and upon completing the engineering experience requirements. Specific curriculum requirements are available online.

The BAE faculty, in concert with program constituencies, has developed the following undergraduate program objectives. Graduates of NC State’s Biological Engineering program, within the first five years following graduation, will:

- Solve real-world problems using the application of engineering principles, and procedures;
- Function in a professional and ethical manner;
- Be able to communicate effectively;
- Engaged in life-long learning and professional development.

Joint Department of Biomedical Engineering

Biomedical engineering is a profession that develops and applies engineering knowledge and experience to solve problems in biology and medicine and to enhance health care. Biomedical engineers are professionally trained to combine the rigor of medical and biological studies with the power of engineering analysis and design. People become biomedical engineers to be of service to others, to enjoy the excitement of understanding living systems, and to use state-of-the-art science and technology to solve the complex problems of medical care. The emphasis in biomedical engineering is on finding solutions by researching, testing, and applying medical, biological, chemical, electrical, and materials information. Biomedical engineers are unique individuals who make contributions to health care that are both satisfying to themselves and beneficial to others.
Opportunities

Biomedical engineers are employed by hospitals, pharmaceutical companies, medical device and testing companies, government agencies, universities, and medical schools. With so many areas of specialization within the field, graduates are encouraged to further their education by attending graduate or professional school after graduation from NC State. Graduates from this program have attended graduate programs in biomedical engineering, physical therapy, mechanical engineering, industrial engineering, microbiology, virology, public health, and sports physiology, among others, at many different institutions. Graduates who have taken additional courses to satisfy entrance requirements have also been accepted by medical, dental and pharmacy schools.

Program Educational Objectives

The Biomedical Engineering Program is preparing its graduates to:

• Define and solve problems in basic medical sciences and human health by integrating engineering and biology using engineering analysis, experimentation, mathematical, and scientific principles.
• Design biomedical systems, components, and processes by applying the scholarly and practical skills of engineering and life sciences using methods of modern engineering design and manufacturing, teamwork, and communication skills.
• Use technical and hands-on knowledge in engineering practice, research, and management while exercising ethical and professional responsibility in the public, private, and academic sectors.
• Become leaders and mentors that consistently enhance their information literacy by participating in activities that introduce them to advances in biomedical engineering practice and research.

Curriculum

The department offers the Bachelor of Science in Biomedical Engineering.

Novel aspects of the undergraduate program include capstone engineering design projects that use a design control process based on the FDA’s Quality System Regulations, opportunities to apply for industrial internships after completing junior-level engineering courses, continuous and caring faculty advising, student involvement in program evaluation and improvements, and engineering specialization in one of three areas: Biomechanics, Biomaterials or Bioinstrumentation. Computers are used throughout the program. Graduates will be prepared for professional employment in research, design, engineering and the life sciences. First year students interested in this curriculum should enroll in the Engineering First Year program and select BME as their intention. The biomedical engineering program is accredited by ABET. It is the only accredited BME program in a North Carolina public university.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Scholarships

Students in this degree program are eligible for scholarships from the College of Engineering.

Facilities

Teaching facilities are located in Engineering Building III. These facilities include state-of-the-art classroom and laboratory facilities, study space, and convenient access to computing resources. Extensive Internet and video-conferencing capabilities are deployed to facilitate convenient faculty-student contact.

Research facilities include advanced materials testing instrumentation, imaging resources, rapid prototyping facilities, biomedical instrumentation, and clinical resources.

Minor in Tissue Engineering

The Minor in Tissue Engineering is intended to provide graduates with the knowledge base and practical skills that will prepare them to quickly contribute to research and manufacturing of devices designed for repair and replacement of tissues and organs. Interested students should contact the BME Student Services Coordinator for information and application materials.

Department of Chemical and Biomolecular Engineering

Chemical engineers create, develop, and manage processes that effect molecular change, including changes in chemical composition, physical state, structure, and/or purity. The end goal is technologies and products that are useful to society.

Since in-depth knowledge of chemistry is an important tool most chemical engineers use in their work, in some situations there’s an overlap between the professional interests of chemical engineers and their nearest scientific relatives, chemists. An important difference between the two is that most chemists are concerned with how a molecule can be synthesized and what series of steps might achieve the highest yield of the compound, while most chemical engineers focus on applying chemistry, other sciences, and technical knowledge to solve “real-world” problems. Chemists usually work in a laboratory environment, while most chemical engineers work on “large-scale” projects outside the laboratory environment. It has been stated that chemists typically ask “why” questions and chemical engineers ask “how” and “what for” questions.

Example projects for chemical engineers are: preventing pollutants from entering the air and water; using fermentation to produce penicillin and many other pharmaceuticals; converting crude oil into fuel and valuable components that can be processed further into products such as cosmetics, synthetic fibers, dyes, and plastics; manufacturing microchips, paper, paints, textiles, and all manner of chemicals; and designing a process or plant to accomplish these tasks.

Opportunities

Careers in chemical engineering are sometimes exciting, always demanding, and ultimately provide a sense of accomplishment and achievement. Graduates find employment in sub-disciplines such as production, technical service, sales, management and administration; research and development; and consulting and teaching. Students desiring careers in teaching, research, or consulting are encouraged to continue their education and pursue a graduate degree (consult the Graduate Catalog). The undergraduate curriculum also provides strong preparation for graduate study in a wide range of professional specialties, and chemical engineering graduates often pursue careers in the medical sciences, business management, and law.
The successful practice of chemical engineering requires a broad, diversified preparation which promotes original and disciplined thought, enthusiastic inquiry and, ultimately, original and constructive accomplishment. The knowledge base chemical engineers develop in organic, physical, and inorganic chemistry is similar to the level of expertise that’s developed by chemistry majors. Mathematics, physical sciences, and distributed humanities courses are also valuable areas of study.

The undergraduate curriculum emphasizes the scientific, engineering, and economic principles involved in the design and operation of chemical processes. Design methodologies are practiced in all core chemical and biomolecular engineering courses, and this integrated design experience culminates with the senior design sequence, CHE 450 and CHE 451.

In order to gain in-depth understanding in a specialized technical area, students can elect to pursue studies in one of several chemical engineering curriculum concentrations. In all cases, the degree earned is the Bachelor of Science in Chemical Engineering, and graduates from all the concentrations are fully qualified to work in any chemical engineering environment. The curriculum concentrations are:

**Biomanufacturing Sciences Concentration in Chemical Engineering**

The Biomanufacturing Sciences Concentration provides students with the knowledge base and hands-on skills that prepare them to quickly contribute to a biomanufacturing operation. Pharmaceuticals, vaccines, enzymes, and bio-fuels are example products. Students completing this concentration also receive a Minor in Biomanufacturing.

**Biomolecular Concentration in Chemical Engineering**

The Biomolecular Concentration emphasizes hands-on laboratory molecular biology skills that are highly relevant to pharmaceutical, medical, engineering, and agricultural fields. Students completing this concentration also receive a Minor in Biotechnology.

**Nanoscience Concentration in Chemical Engineering**

The Nanoscience Concentration develops students’ understanding of the scientific and technological principles associated with the design and manufacture of patterns and devices with features and advanced functionality on the nanometer scale.

**Sustainable Engineering, Energy, and the Environment Concentration in Chemical Engineering**

The Sustainable Engineering, Energy, and Environment Concentration connects chemical engineering concepts with global grand challenges in the generation of clean and affordable energy, as well as sustainable and environmentally responsible engineering practices.

**Honors Program in Chemical Engineering**

The Honors Program allows students to gain a deeper understanding of chemical engineering principles than would be acquired by completing the standard CHE curriculum. Admission to the program requires students to have earned a minimum overall GPA of 3.5 and a minimum GPA of 3.5 in CHE 205 and CHE 225. An honors thesis based on a supervised research experience and completion of at least one semester of faculty-supervised research are required for completion of the Honors Program.

**Program Educational Objectives**

Given the foundation of knowledge, skills, experiences, and the discipline of hard work and critical thinking provided by the curriculum, our students are expected to achieve one or more of the following within five years of graduation:

Excel in engineering practice and/or entrepreneurship in various industries, including petrochemical, biochemical, pharmaceutical, fine chemical, environmental, semi-conductor, pulp and paper, advanced materials, and health care. Advance in positions of increasing leadership responsibilities in their chosen career fields. Earn an advanced degree or certification leading to a career in academia, law, medicine, or research and development. Exhibit professionalism, ethical responsibility, a habit of life-long learning, an interest in contemporary issues of importance to society, and an appreciation of the impact of engineering development in a societal context.

The chemical engineering program is accredited by the Engineering Accreditation Commission of ABET, Inc. Curriculum requirements are available on the Department of Chemical & Biomolecular Engineering website (http://www.che.ncsu.edu/academics/curriculum.html). Information for prospective students (http://www.che.ncsu.edu/information/prospective-undergrads.html) is also available on the site.

**Department of Civil, Construction, and Environmental Engineering**

The Department of Civil, Construction, and Environmental Engineering offers three undergraduate degree programs concerned with the improvement and care of both public and private infrastructure and natural environments. The degree programs address the planning, design, construction, operation, and maintenance of buildings, dams, bridges, harbors, power facilities, pollution control facilities, and water supply and transportation systems. The curricula provide academic preparation for students considering careers in civil, construction, or environmental engineering.

The department offers undergraduate degree programs leading to the Bachelor of Science in Civil Engineering, the Bachelor of Science in Construction Engineering and Management, and the Bachelor of Science in Environmental Engineering. All three programs are accredited by the Engineering Accreditation Commission of ABET, Inc. Graduation from an ABET accredited engineering degree program is the first step toward licensure as a Professional Engineer. All three programs also prepare students for graduate education.

**Opportunities**

People will always need constructed facilities to live, work, and sustain their lives and environment, and civil, construction, and environmental engineers will always be needed to plan, design, and construct these facilities. Civil, construction, and environmental engineering comprise such diversified fields that graduates have a wide choice in types and locations of employment. Jobs range from federal, state, or municipal agencies to a variety of manufacturing and processing industries, consulting firms or construction companies. The work may be performed partially or wholly in an office or in the field and may be located in a small
community, a big city, an industrial center, or even in a foreign country. Careers in either professional practice or teaching and research are common for many graduates who complete advanced degrees.

Facilities

The Department of Civil, Construction, and Environmental Engineering is well-equipped with computer laboratories that provide both individual computers and collaborative learning spaces. The College of Engineering at NC State maintains a state-of-the-art computing environment known as Project Eos, a large-scale distributed system that consists of hundreds of computers across the college on both main and Centennial Campuses. Eos is a client-server network running a location-independent file system that delivers a comprehensive suite of engineering applications to both Windows and Linux computers, and to student-owned computers through remote access and the Virtual Computing Lab. Project Eos is operated by a professional support group that provides consultation and basic system and software services.

The department’s other laboratories contain a variety of special equipment for instruction and research in structures, mechanics, soils, construction materials, construction engineering, hydraulics and environmental engineering. Environmental engineering research facilities include over 5000 sq. ft. of laboratory space devoted to environmental chemistry, microbiology, process engineering, and hydraulics. Students have the opportunity to conduct research on water and wastewater treatment, ground water contaminant transport and site remediation, refuse decomposition, anaerobic microbiology, analytical chemistry, and applied molecular microbial ecology.

The Constructed Facilities Laboratory (CFL) on Centennial Campus features unique facilities devoted to all aspects of constructed infrastructure research and assessment. Facilities include: specially designed reaction floors and walls for testing large-scale structural systems to failure, such as full scale bridge girders up to 100 feet long and beam-column systems subject to earthquake loading; and large pits up to 20 feet deep for testing granular and compacted soils for foundation strength. State-of-the-art facilities like these heighten students’ learning experiences by exposing them to the forefront of technological advances.

Curricula

The Department of Civil, Construction, and Environmental Engineering at NC State is home to the educational programs in Civil Engineering, Construction Engineering, and Environmental Engineering. A single department head and management structure direct the educational missions of these three related fields. Each curriculum is designed to prepare the graduate for a career in the respective field and for lifelong learning through graduate education, continuing education and/or self-study.

Civil Engineering Degree

The Civil Engineering curriculum provides academic discipline in mathematics, the physical sciences, the humanities and social sciences, and the technical aspects of civil engineering. After introductory exposure to several of the professional areas such as environmental and water resources, geotechnical, structures, and transportation engineering, the student builds additional depth in one of these specialties.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Educational Objectives in Civil Engineering

The educational objectives of the civil engineering program at North Carolina State University are to prepare its graduates to:

1. Function successfully in a professional environment by utilizing and enhancing their problem-solving and communication skills.
2. Continue learning through graduate or other professional education and obtaining licensure where appropriate.
3. Provide professional leadership within their companies, engineering societies and civic organizations, and provide mentoring to those under their supervision and influence.
4. Promote organizational success with consideration of cost and time management while practicing and promoting ethical behavior and stewardship of a sustainable environment.

Construction Engineering Degree

The Construction Engineering curriculum is designed for the student interested in the planning, design, direction, and management of construction projects. It includes the core course requirements in mathematics, the physical sciences, and the humanities and social sciences. After exposure to engineering fundamentals and engineering design of facilities, the curriculum provides a series of specialty courses in construction engineering related to the analysis, design, and management of the construction process. The General Construction Concentration is designed for students pursuing careers in the building, residential, highway, and heavy construction industry. The Mechanical Construction Concentration is designed for students pursuing a career emphasizing construction of mechanical systems for buildings, residences, and industrial facilities.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Educational Objectives in Construction Engineering

The educational objectives of the construction engineering and management program at North Carolina State University are to prepare its graduates to:

1. Function successfully in careers emphasizing application of construction engineering and management principles with the ability to solve a broad set of engineering problems in construction.
2. Practice construction engineering including the design and management of the construction process to achieve needed safety, quality, durability, sustainability, and economic objectives.
3. Function and communicate effectively in team-oriented, multidisciplinary, open-ended engineering activities considering the societal and economic impacts of construction, and the professional and ethical responsibilities of the construction engineer.
4. Engage in life-long learning through graduate study, self-study, or continuing education; pursue licensure; provide mentoring to those under their supervision and influence; and provide leadership in their employment organizations, industry associations, and professional societies.

Environmental Engineering Degree

The Environmental Engineering curriculum is designed for students interested in environmental sustainability. The curriculum provides students with the foundations in science, mathematics, and engineering
required to observe, understand, model, and analyze environmental systems as well as to design critical components of society’s infrastructure. Upon graduation, students are prepared to work in such areas as water treatment, water resources engineering and management, air pollution control, solid waste management, and energy management. The curriculum emphasizes the interdisciplinary nature of environmental engineering with courses in both engineering and life sciences, including specialized courses on energy and climate, pollution control, and waste management.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Educational Objectives in Environmental Engineering

The educational objectives of the environmental engineering program at North Carolina State University are to prepare its graduates to:

1. Function successfully in a professional environment by utilizing and enhancing their problem-solving and communication skills while practicing and promoting ethical behavior.
2. Continue learning through graduate or other professional education and obtaining licensure where appropriate.

Post-Baccalaureate Study

If a student is interested in more specialization in one particular area, advanced level education is available leading to the Master of Civil Engineering, Master of Environmental Engineering, Master of Science in Civil Engineering, Master of Science in Environmental Engineering, or the Doctor of Philosophy in Civil Engineering. The MCE and MENE degrees are also available through the Engineering Online program. Specialization areas include coastal engineering, computing and systems, construction engineering and management, construction materials, environmental and water resources engineering, geotechnical engineering, structural engineering and mechanics, and transportation engineering. With judicious choices of electives during the B.S. program, a student may also prepare for additional studies in law, business administration, business management, or city and regional planning.

Student Activities and Scholarships

Student chapters of the American Society of Civil Engineers, American Concrete Institute, Associated General Contractors, National Association of Home Builders, Institute of Transportation Engineers, and Air and Waste Management Association undertake projects to further student exposure to the profession. Guest speakers representing various aspects of engineering practice speak at weekly lunch meetings. Students who accumulate outstanding academic records may be considered for membership in the Chi Epsilon Honorary Society. Through the generosity of industry and program alumni, many scholarships are available on a competitive basis to students in addition to university, college, and need-based financial aid.

Department of Computer Science

Computers

Computer software is ubiquitous in modern life. In addition to high-tech machines like aircraft and medical imaging systems, everyday devices as diverse as automobiles, vending machines, refrigerators, and videogame consoles now contain some type of computer. Computers help design our highways, bridges, pharmaceuticals, electronic circuits, and buildings; handle banking, stock trading, and other financial transactions; assist in management decisions; control communications, utilities, and manufacturing processes; and analyze farm production. Computers watch over our health, security, and safety. Computers serve as vital research tools for scientists, from those exploring the farthest reaches of the cosmos to those searching for subtle patterns in the human genome. Explosive growth in computer gaming, digital entertainment, and multimedia-based education has spawned entirely new industries in recent years. Computers are linked together in worldwide networks that provide information and computing power to nearly anyone who wants it, anywhere in the world.

Opportunities

Designing computer systems, and the software that runs on them, is the job of computer scientists. Computer scientists can find demand for their innovation, design, analysis, and engineering skills in the full gamut of professions. As a direct consequence of the increasingly critical role of computers in society, the discipline of computer science has enjoyed rapid growth for many years, and the trend looks likely to continue. The most credible employment projections indicate a serious and worsening nationwide shortfall in the supply of people skilled in information technology, and a resulting steady rise in demand and salaries, for decades to come. Computer Science graduates from NC State are in high demand, including by employers that are extremely selective in their national recruiting.

Architecting one corner of the world-famous Research Triangle Park, and located in modern state-of-the-art teaching and research facilities on NC State’s Centennial Campus, the department and its students and faculty benefit from strong and active industry partnerships. NC State Computer Science is one of the top suppliers in the nation of new graduate hires to a number of high-tech companies, including several Fortune 500 companies, some with a substantial presence in the Research Triangle. Starting salaries for our undergraduates now average over $65,000 and show a steady increase. Opportunities are also plentiful for graduate study for those who wish to pursue the field in more depth.

Curriculum

Like all freshmen in the College of Engineering, Computer Science freshmen take a core of courses in the humanities, chemistry, mathematics, physics, and computing. After successfully completing the required courses, students may apply to join the Department of Computer Science as degree-seeking students.

The Computer Science curriculum teaches students the skills necessary to understand, design, implement, test, and deploy computer systems and software of all kinds, in addition to exposing students to the application of computers to problem solving in diverse fields, and the mathematical methods needed to analyze and compare both computation problems themselves and alternative approaches to solving them.

Core courses provide a foundation for all students in programming languages, data structures, software engineering, computer architectures, numerical analysis, theory of computation, and the social and ethical dimensions of the practice of computer science.

Computer science electives are chosen in consultation with advisers, usually starting during the junior year. These electives allow exploration of more advanced areas: among them artificial intelligence, database management systems, computer graphics, human-computer interface design, multimedia technology, web technologies, networks, privacy and security, remote sensing, computer architecture, distributed computing,
and operating systems. Electives can be chosen to provide coherent concentration in areas such as computer and network security, software engineering, and computer game design. A special focus is on skills that help our students be competitive in the global economy. These skills include technical communication, understanding of business principles in organizations that use information technology, an aptitude for innovation, an understanding of intellectual property issues, and an understanding of the latest technologies, such as web-services, security and sensors, as well as both closed and open source solutions and engineering issues.

All Computer Science majors must complete a team project, most often in an area such as networking, computer graphics, computer gaming, database technology, or web services. Projects under the auspices of the department’s Senior Design Center have industry sponsors, so student teams gain experience working jointly with industry representatives to achieve project goals. The department’s location near the Research Triangle Park also means many opportunities for Co-ops and internships, part-time employment, and forging the industry contacts often vital in a successful job search.

The undergraduate curriculum leads to a Bachelor of Science in Computer Science. This program is nationally accredited by the Computing Accreditation Commission of ABET, Inc.

**Game Development Concentration**

Computer games are some of the most complex software development projects and employ some of the most advanced technologies of any application area of computer science. The entertainment software sector is a multi-billion dollar industry with increasing demand for new employees trained in these technologies and methods. In addition to the more familiar entertainment sector, these technologies also have applications to such areas as training, education, visualization, and social interaction forums — so-called “serious games.” North Carolina is now among the top tier of US states with centers of game industry employment. As the game industry continues to grow, demand by North Carolina companies for new graduates with strong background in computer science with a focus on game development will also expand.

Many aspects of computer game development are unique to the game industry and the game development concentration provides specialized coursework in these areas. The game development concentration focuses on game development technologies while preserving the breadth and depth of the general computer science BS degree. The concentration requires that students take both the initial course on computer graphics (CSC 461) and the initial course on game development (CSC 481). They must choose as a concentration project either the graphics or game development advanced elective (CSC 462 or CSC 482, respectively). Two additional game restricted electives are chosen from a list of CSC courses with content highly relevant to game development. Of the nine credit hours required for other electives, students in the concentration must select three courses from a list that spans topics such as fiction writing, film, and music. These courses provide grounding in the creation of conventional media and provide the background in these disciplines needed to participate in the multidisciplinary aspects of the design of games.

**Program Educational Objectives**

The CSC undergraduate program at NCSU prepares its B.S. graduates to achieve the following career and professional goals:

1. To apply their knowledge of computer science problems encountered in their professional careers or in pursuit of advanced degrees.
2. To use evolving technologies, analytical thinking, and design to address contemporary issues.
3. To communicate well orally and in writing, interact professionally, and work effectively on multidisciplinary teams to achieve project objectives.
4. To uphold high ethical standards, including concern for the impact of computing on individuals, organizations, and society.
5. To engage in lifelong learning to enhance their professional capabilities.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

**Minor in Computer Programming**

The Department of Computer Science offers a Minor in Computer Programming to undergraduate majors in any field except Computer Science and Computer Engineering. The objectives of this minor are to:

1. Encourage students to combine computing with their own disciplines.
2. Promote quality in programming techniques.
3. Give graduating seniors with a minor in computer programming an added advantage in the job market.

The minor requires completion of 21 credit hours from the Computer Science core.

**Scholarships and Financial Aid**

The College of Engineering and the Department of Computer Science have a number of endowed and other scholarships available to students. There is also opportunity for financial aid sponsored by industry and for Co-op and internship positions. Interested students are invited to apply through the College of Engineering. In addition, the department organizes job-fairs and maintains a job matching service for our industrial partners (ePartners) and others who wish to hire our students for the summer or part-time during the academic year.

**Facilities**

North Carolina State University boasts one of the most extensive and sophisticated advanced high-performance communications infrastructures available for student use today. It ranges from a 10 Gbps research network, to wireless computing, to sensor networks. NC State University High-Performance Computing operations provide NC State students and faculty with entry and medium level high-performance research and education computing facilities and consulting support. Another service, called the Virtual Computing Laboratory (VCL), provides on-demand and reservation-based utility computing services from NC State’s extensive library of Engineering, Design, and Scientific software applications, as well as support for research projects. It is intended to address the increasing needs of local and distance students, faculty and researchers for virtualized resources by providing 24x7 access to advanced computing laboratory facilities through a variety of computer systems they own.

In addition, the Department of Computer Science has over 30 general purpose and specialized teaching and research laboratories, centers and other facilities that support its educational and research mission. These facilities are located in four buildings: Daniels Hall, Engineering Building II, Engineering Building III, and Montieth Research Center. Facilities range from introductory programming laboratories, to networking laboratories, to a games center, to an advanced visualization center, to a senior design
Department of Electrical and Computer Engineering

Box 7911, Engineering Building II
NC State University, Raleigh, NC 27606
Phone: (919) 515-2336

The professions of electrical engineering and computer engineering are concerned with the analysis, design, construction and testing of systems based on electrical phenomena. In contemporary society, electrical methods are used to communicate and store information, control equipment and systems, perform mathematical operations, and convert energy from one form to another. Frequently, two or more of these functions are important in the design of systems such as television, radio, telecommunications, computer, robots and intelligent machines, telemetry systems, solid-state electronics, vehicle safety systems, biomedical devices, environmental controls, electric machinery, and electric power generation and transmission facilities.

Computer engineering is a field in which digital techniques are used in system design. Low-cost solid-state microprocessors and memories permit computers to be widely incorporated in many different types of devices from toys to traffic control systems. To work effectively in this rapidly growing field, the computer engineer must understand both hardware and software techniques and must effectively use both in order to design, build and test complex digital systems. Both the electrical engineering and the computer engineering programs, which lead respectively to the degrees, Bachelor of Science in Electrical Engineering and Bachelor of Science in Computer Engineering, are accredited by the Engineering Accreditation Commission of ABET, Inc.

Program Educational Objectives

The Electrical/Computer Engineering Program graduates will be competent in the following areas:

1. Engineering problem definition and solution using engineering analysis, experimentation, and creativity based on sound mathematical and scientific principles.

2. Electrical/computer systems, components, processes, design knowledge of the discipline, teamwork, communication, skills and an ability to work with a diverse set of constraints.

3. Productive engineering practice, research or management using technical, hands-on and professional knowledge, skills and initiatives required for success in the public, private or academic sectors.

4. Continuing education and learning on the job, experiential learning, leading and mentoring others and the ability to apply lessons learned to new situations.

Scholarships and Awards

Superior academic performance is recognized within this department in three ways: election of students to membership in the electrical engineering honor society, Eta Kappa Nu; awarding of merit scholarships; and presentation of awards to outstanding seniors. The department has one endowed merit scholarship for rising sophomores, the Eugene C. and Winifred Sakshaug Scholarship, and twenty-seven endowed scholarships which are usually awarded to juniors and seniors: William E. Clark, Elizabeth P. Cockrell, Eugene C. Denton, Virginia Stewart Easter Memorial, Ferrell Family, William and Tipton Gray, John and Ann Hauser, Llewellyn Hewett, William and Carol Highfill, Jessie Reid Holshouser, Jr., Charles Kenneth Little, L. A. Mahler, Robin & Susan Manning, Amelia N. Mitra, Dewey Carr Ogburn Memorial Scholarship, Frank T. Pankotay, Ronald G. Pendred, Pratt Family, William DeRosset Scott III, E. Chester Seewald, Shruthi Sorra, Oracle, Fredrick J. Tischer, Herbert B. Walker, Simon B. Woolard, North Carolina Electric Membership Corporation, and William D. Stevenson, Jr., the latter two of which are for students studying electric power systems. The department also from time to time has scholarships provided by industrial organizations such as Duke Power, Progress Energy, Northrup Grumman, Cisco, and ABB. Academic merit is generally the primary requirement for these awards, but other characteristics, such as demonstrated leadership, may also be specified. In addition, the endowed William M. Cates Scholarship Program provides multiple scholarships for students having documented financial need and high academic performance. These are awarded each fall to juniors, with provision for continuation in the senior year.

Facilities

Many courses are accompanied by coordinated laboratory work and projects. These assignments typically focus on real-world systems and problems and involve computer simulation and analysis, design, development and testing of hardware and software associated with electrical, electronic, and electromechanical systems, circuits, and devices.

Extensive facilities are provided for experimental study of analog and digital circuits, microprocessors, computers, VLSI devices, photonics, robots and intelligent machines, power systems, and telecommunications. The Department of Electrical and Computer Engineering maintains 16 teaching labs, all located in Engineering Building II on Centennial Campus. These labs provide students with state-of-the-art equipment designed to teach the students many practical, industry sought skills. Approximately 250 computers and a variety of other equipment—oscilloscopes, multimeters, power supplies, and function generators—are in use by the students on a daily basis. The William F. Troxler Design Center, 2,600 square feet senior design laboratory, provides resources for industry-sponsored, semester-long design projects. The departmental electronic and machine shops provide students with electronic components, hardware and tools.

In addition, Engineering Building III houses a 24/7 public lab of over 70 computers running a variety of operating systems and industry standard hardware. This lab is available to all engineering students and is staffed by trained student operators. A student-owned laptop platform has been developed in the College of Engineering; combined with a comprehensive wireless network and many remote computer services, this program allows education to expand outside of traditional classroom and laboratory facilities.

Nearby, the state-of-the-art James B. Hunt, Jr. Library gives students an innovative environment filled with technology-abled furniture, high-definition video walls, 3D computing and visualization space, videoconferencing and telepresence facilities, and over 100 meeting areas for group work and study. Inspiring a spirit of discovery, the Hunt Library will help to produce the next generations of technology-savvy citizens, employees, researchers, and scholars.

Core Courses

The electrical and computer engineering curricula share core courses comprising a substantial portion of the first three years of study. Many
of the core courses are offered three times a year in fall, spring, and summer. A strong emphasis is placed on fundamental concepts in core courses so that graduates are prepared for rapid technological changes common in the electrical and computer engineering professions. A comprehensive foundation in mathematics and the physical sciences in the freshman year is followed in subsequent years by additional core courses in mathematics, physics, electric circuit theory, digital logic, computer systems, electronics, electromagnetics, and linear systems. Laboratory work is designed to demonstrate fundamental principles and to provide experience in designing and testing electronic hardware and computer software. Both curricula have a required two semester senior design project which gives students comprehensive experience in designing, building, and testing physical systems.

Curricula

In addition to the core courses described above, students in the electrical engineering curriculum take two foundational electives and four specialization electives in areas of their choice within the discipline and two technical electives that can be in either electrical engineering or selected engineering courses offered by other departments. Beyond the core, students in the computer engineering curriculum take courses in discrete mathematics, data structures, embedded systems, and complex digital systems, in addition to four specialization electives in areas of their choice and one technical elective. For both curricula, a variety of elective courses are offered in communications, computational intelligence, controls, digital signal processing, digital systems, nanotechnology, mechatronics, microelectronics, networking, robotics, and VLSI design. There are typically a dozen or more of these courses offered each fall and spring semester and two or three available each summer.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Individualized Degree Program in Engineering

Page Hall, Room 118
Phone: (919) 515-3263

The B.S. in Engineering degree offers an individualized academic program for those exceptional students who have academic and career goals that cannot be accommodated by the other engineering degree programs. Before being admitted into the program, students must complete the freshman year, have at least a 2.5 grade point average, have completed the requirements for admission into an engineering degree program and have a plan of study approved. For more information, contact the Assistant Dean for Academic Affairs at (919) 515-3263.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Bachelor of Science in Engineering - Mechatronics Concentration

Joint Degree with University of North Carolina at Asheville (http://www.unca.edu/ncsu_engr)

Phone: (828) 251-6640

The Joint Mechatronics Engineering curriculum (JEM) combines the best that two nationally recognized universities have to offer. From NC State University comes the engineering component comprising course work from the Departments of Mechanical and Aerospace Engineering (MAE), Electrical and Computer Engineering (ECE), and mechatronics courses taught by NC State University faculty on the campus of the University of North Carolina at Asheville. Hands-on laboratories are integral to the engineering course work. From the University of North Carolina at Asheville comes an engineering-themed Humanities and Social Science component with a rich liberal arts foundation. As an NC State site-based engineering program, students must attend classes on the campus of UNC Asheville. Transfer students should contact the program office for information about the transfer of courses from other educational institutions.

Mechatronics engineering focuses on the precision control of mechanical and machine systems. In today’s modern engineering systems, control is achieved electronically through sensors, actuators and microprocessors. The marriage of modern control systems with mechanical devices is key to the design and development of high-performance engineering systems. Just a few examples of computer-controlled mechanical systems are robots, engine-fuel systems, hybrid automobiles, autonomous aerospace vehicles, stair-climbing wheelchairs, garage door openers and alternative power generation systems. Through modern mechatronics engineering, new avenues of thinking and design can greatly enhance the utility, performance, and efficiency of modern machinery.

Program Educational Objectives

Two-to-three years after graduation, Mechatronics graduates will be able to:

1. Apply mechanical engineering and electrical engineering knowledge and skills to problems and challenges in the areas of mechatronic engineering.
2. Integrate and use systems or devices incorporating modern microelectronics, information technologies and modern engineering tools for product design, development and manufacturing.
3. Demonstrate professional interaction, communicate effectively with team members and work effectively on multi-disciplinary teams to achieve design and project objectives.
4. Engage in lifelong learning in their profession and practice professional and ethical responsibility.

The Engineering - Mechatronics program is accredited by the Engineering Accreditation Commission of ABET, Inc.

Specific curriculum requirements are available on the Mechatronics webpage.

Edward P. Fitts Department of Industrial and Systems Engineering

Daniels Hall, Room 400
Phone: (919) 515-2362
Visit the ISE website (http://www.ise.ncsu.edu)
Ranked in the top 10, the Edward P. Fitts Department of Industrial and Systems Engineering (ISE) offers an ABET accredited undergraduate B.S. program in Industrial Engineering.

**What is Industrial & System Engineering?**

Industrial engineers are problem solvers! We analyze processes and ask “how can we make these processes faster, better, and cheaper?” ISEs play a pivotal role in end to end business operations from product development to product and service delivery. It is this holistic view that makes ISE unique. We rely heavily on gathering and evaluating data to help make decisions that are based on statistical and engineering methods. Here are some of the tasks that ISEs lead in industry today:

- Assess the feasibility of manufacturing a new product with existing technologies, resources, and capacity or develop new ways to make products including automation
- Create and monitor quality plans that ensure that faulty products will not be shipped to the customer.
- Determine improved methods of scheduling patients for surgery that decreases patient wait time and surgeon’s overtime.
- Model a retail chain’s inventory and supply chain methods to improve on-time deliveries.
- Develop computer simulation models to design and control large complex manufacturing, supply chain, or service delivery systems.
- Design controls in an airplane cockpit that are Human-centered.

As you can see ISEs enjoy the freedom to explore almost any industry. The career paths that you can take with ISE are virtually limitless! Watch these videos to hear about ISE careers: ISEs in action! (http://www.ise.ncsu.edu/undergraduate)

**Program Educational Objectives**

The program educational objectives of the ISE department are to produce graduates capable of world-class performance in the following areas:

1. Engineering problem definition and solution using engineering analysis, experimentation, client/customer needs, and creativity based on sound mathematical and scientific principles.

2. System, product and process design requiring knowledge of the discipline, multidisciplinary teamwork, effective communication skills and an ability to work with multiple constraints, understanding the importance of time and cost.

3. Productive engineering practice, research, leadership or management by using the technical, professional, ethical and societal knowledge and skills required for success in the public, private, or academic sectors.

4. Continuing formal and informal education, applying lessons learned to new situations and leading and mentoring others.

The Bachelor of Science in Industrial Engineering is accredited by the Engineering Accreditation Commission of ABET, Inc.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

**Curriculum**

Throughout the curriculum students will develop a breadth of knowledge in all of the ISE focus areas resulting in a broad base of knowledge and skills. There is a pervasive thread throughout the curriculum on the measurement, design, and continuous improvement of production and service systems. The result is a data-driven, efficiency-focused engineer that is highly attractive in many industry segments. Our courses are designed to be hands-on whether that is in our state-of-the-art laboratories or using the latest software applications to solve real problems. The senior design capstone course is designed to give students an opportunity to apply what they have learned in the classroom to solve an industry-sponsored project. In addition to ISE courses, students take a wide variety of science, engineering, math, and statistics courses to form a well-rounded education.

**Opportunities**

Industrial and systems engineers can be found everywhere! According to the Bureau of Labor Statistics, ISEs will be highly sought after in the coming decade. This is not surprising given the cost and efficiency pressure on both manufacturing and service sectors. Industrial engineers are hired by virtually all segments of industry. They may work in hospitals and healthcare consulting firms to make healthcare delivery more cost effective as well as in high tech manufacturing industries. Another area in which ISEs play a pivotal role, is in successful integration of global business partners. As companies continue to seek a global presence, industrial engineers will be involved in the design of new supply chain networks or qualification of manufacturing processes/facilities. Given the level of impact made by ISEs in industry today it is not surprising that our current job placement rate is among the highest in the College of Engineering, above 90% within 3 months of graduation. Many ISEs rise to the management ranks throughout the career and there have been several ISEs who have become CEOs: Tim Cook (Apple Inc.), Mike Duke (Walmart) & Charles Holliday (Dupont) to name a few.

**Minor in Industrial Engineering**

The minor in Industrial Engineering is designed to provide undergraduate engineering students and other science majors in curricula other than Industrial Engineering with the fundamentals of industrial engineering necessary for advanced study in the discipline and/or employment in industrial engineering. Students minoring in Industrial Engineering will learn basic principles of ISE as well as more advanced principles in at least one specific area of interest.

**Admissions and Certification of Minor**

The minor must be completed no later than the semester in which the student expects to graduate from his or her degree program. Paperwork for certification can be found in 410 Daniels Hall and should be completed no later than during the registration period for the student’s final semester at NC State.

For more information contact Dr. Vila-Parrish: arvilla@ncsu.edu or (919) 515-0605.

**Accelerated Baccalaureate/Masters (ABM) Program**
This program will allow exceptional undergraduate students to complete both undergraduate and graduate degrees at an accelerated pace. The student is allowed up to 12 credit hours to be counted towards both the undergraduate and graduate degrees.

Requirements

- Students must have completed a minimum of 75 credit hours and up to a maximum of 96 credit hours by the end of the current semester (includes transfer credits).
- Students must have earned a GPA of at least 3.5 for all courses and 3.5 for all Industrial Engineering courses.
- Students must have satisfied all prerequisite requirements for 400 level courses.
- A letter of recommendation from the undergraduate teaching adviser identifying the applicant as a participant in the ABM program should accompany the application as well as the course numbers and titles of the 12 credit hours to be used for both the bachelor’s and master’s degree programs.

Department of Materials Science and Engineering

Engineering Building I, Room 3002
Phone: (919) 515-2377
Visit the Materials Science and Engineering website (http://www.mse.ncsu.edu)

Our world is driven by the materials that are currently available. Millions of everyday objects and technologies are made better because of a new and improved material. The automobile industry has lighter, impact-resistant car bodies. Textile companies have stronger, brighter fibers. Of course, we have all benefited from the versatile, inexpensive polymeric materials commonly known as plastics. In fact, many of today’s industrial problems await materials solutions: electrical engineers ask for better semiconductors, and computer technology demands material systems that store more and more information. Even parts of the human body are being replaced by specially designed biologically compatible materials. Materials Science and Engineering faculty and students at NC State are working on these and related problems right now. The Department of Materials Science and Engineering at NC State has 5 research focus areas, which include Structural Materials, Electronic/Optical/Magnetic Materials, Soft Materials and Biomaterials, Structural Characterization, and Computational Materials Science.

What is Materials Science and Engineering?

Materials science and engineering deals with the behavior of any material and its relationship to structure on all levels: atomic structure, nanostucture, microstructure, and macrostructure. Structure determines the properties of matter: how materials act, how materials react, and how materials function in different environments. Through an understanding of these structure-property relationships, materials engineers can develop new materials or adapt existing ones to meet the design and economic requirements that ultimately advance industry, technology, and society.

Materials scientists and engineers are often asked to:

- develop new materials and/or improve existing materials;
- determine how a material responds to an external stimulus.

What is the Curriculum Like?

The materials engineer must understand the wide range of phenomena that occur in all classes of materials: metals, polymers, composites, and electronic materials. The MSE curriculum includes fundamental courses in thermodynamics, kinetics and structure, followed by more applied courses that cover mechanical, thermal, electrical, magnetic and optical properties of materials. Two laboratory courses introduce students to analytical methods used to characterize the structure of materials at all length scales and to measure properties of all classes of materials. Cutting-edge technologies in materials science and engineering such as nanotechnology, biomaterials, computer modeling and forensics (materials degradation and failure analysis) are covered. Five technical electives are included, which allow students to select from a broad range of courses in materials processing, engineering, chemistry, physics, mathematics and other disciplines. The flexibility afforded by these technical electives allows students to customize their education to prepare them for careers in industry or for graduate school.

The two-semester capstone senior design sequence provides a bridge between concepts learned in the classroom and practical application of these concepts in an industrial setting. Teams of students work on real-world materials problems submitted by local industrial sponsors.

The materials science and engineering program, which is accredited by ABET, Inc., leads to the degree Bachelor of Science in Materials Science and Engineering. In addition the the base curriculum in Materials Science and Engineering, the department also offers curriculum concentrations in biomaterials and nanomaterials.

An accelerated 5-year BS/MS program is available for advanced study and further specialization. Graduate degrees are also offered (consult the Graduate Catalog (http://www.ncsu.edu/grad/catalog)).

How Does MSE at NC State Compare to Other Departments?

The mission of the NC State Department of Materials Science and Engineering is to provide students with a sound materials science and engineering education, advance the understanding and application of scientific principles, enhance economic development, and improve the quality of life of our citizens through teaching, research, and outreach programs.

Materials Science and Engineering at NCSU is a small and friendly department, and we are consistently ranked in the top 20 nationally by US News and World Report. Students, professors and professional staff all get to know each other. There is plenty of opportunity for personal attention, for learning, for professional growth and for social gathering.

Program Educational Objectives
With the background knowledge in science, engineering, critical thinking and teamwork provided by the MSE curriculum, our alumni are fully prepared to achieve one or more of the following within five years of graduation:

- Practice materials engineering in appropriate industrial, government or entrepreneurial organizations in fields such as aerospace, automotive, advanced textiles, petroleum, biomedical, electronic materials, plastics, metals, ceramics, or composites.
- Earn an advanced degree such as MS, PhD or MBA, leading to a career in academia, research and development, or technical management.
- Be promoted into leadership roles in their chosen career.
- Demonstrate by their participation in technical societies, community service, and professional activities, a high degree of service and ethical responsibility to their professional field and the community.

**Minor in Materials Science and Engineering**

The Materials Science and Engineering minor is designed to provide undergraduate engineering and science majors, in curricula other than MSE, with the fundamentals of modern materials science and engineering. Completion of the MSE minor requires a minimum of 15 credit hours, which include 9 hours of required courses and at least 6 hours of elective courses. Further information regarding a Minor in Materials Science and Engineering is available from the MSE Director of Undergraduate Programs (http://www.mse.ncsu.edu/profile/caparzel).

**Department of Mechanical and Aerospace Engineering**

Engineering Building 3, Room 3002  
Phone: (919) 515-2365  
Visit the Mechanical and Aerospace Engineering website (http://www.mae.ncsu.edu/)

The Department of Mechanical and Aerospace Engineering is among the largest nationally, offering doctor of philosophy, masters, and undergraduate degrees, and on-line delivery of graduate courses for remote students.

The undergraduate curricula in mechanical engineering and aerospace engineering are nearly the same for freshmen and sophomores but differ greatly for juniors and seniors. The freshman and sophomore courses in each program provide the student with an understanding of the basic principles in the applied sciences and technology. Both programs are accredited by the Engineering Accreditation Commission of ABET, Inc. Detailed information is available online.

**Aerospace**

Aerospace engineering applies science and engineering principles to design, development, manufacture, and operation of aerospace systems and vehicles. Aerospace vehicles include aircraft such as low-speed propeller-powered aircraft, remotely autonomously piloted vehicles, micro air vehicles, hovercraft, and helicopters and spacecrafts such as rockets, space stations, and planetary rovers. Aerospace engineering not only involves design, development, manufacture, and operation but also considers environmental, economical, ethical, and social issues.

The undergraduate curriculum provides the student with knowledge of aerodynamics, aerospace materials, structures, propulsion, flight mechanics, and vehicle stability and control plus knowledge of selected topics in orbital mechanics, space environment, altitude determination and control, telecommunications, space structures, and rocket propulsion. The program educates students to define, formulate, and solve aerospace engineering problems, to function in multi-disciplinary teams, and to communicate effectively.

In addition to taking strong foundational courses, aerospace engineering students gain experience with low-speed and high-speed wind tunnels and structural and material facilities for testing prototype models. A prominent feature of the program is the year-long senior design experience in which students choose from two possibilities: (1) design, construct, and flight-test a fly-by-wire aircraft; a unique 25-year tradition of the aerospace engineering program, or (2) design a prototype spacecraft, like a satellite or a planetary rover. Many of the students are involved in the department's student clubs, such as the Aerial Robotics and Rocketry clubs that compete regionally and regularly place in the top 3.

Aerospace engineering undergraduates are employed by the aerospace industries and other industries with similar technical problems. Many of our students enter graduate school after which they are employed by these same industries and by government laboratories such as NASA, NAVAIR, and the Air Force.

**Mechanical**

Mechanical engineering applies mechanical, thermal, and fluid principles to research, design, development, testing, manufacture, and operation of products and systems. Mechanical engineering is the broadest of the engineering programs, providing a technological foundation that serves societal needs in energy, health, safety, and all walks of life. Mechanical engineers solve problems dealing with energy and environmental systems (alternative fuels and renewable technologies), advanced materials and manufacturing (precision metrology, smart materials, and auto-adaptive materials), robotics and sensor technologies (opto-mechanical systems, MEMS, energy harvesting, human centric and bio-inspired intelligent systems), and transportation (automotive and high speed rail).

In addition to taking strong foundational courses, mechanical engineering students gain experience in experimental laboratories for measurement and data analysis, performance evaluation of thermal systems, and testing and analysis of mechanical components. The senior design experience is a distinctive joint departmental-industry effort in which students solve industrial problems by designing, building, and testing prototype machines with the support of facilities for machining and electronics. Many of the students are involved in the department's student clubs, such as its Eco car and SAE car clubs that compete internationally and regularly place in the top 10.

Because of the discipline’s wide breadth, mechanical engineering students have a wide variety of employment opportunities. Undergraduate students enter engineering fields that deal with, to varying levels, design, development, manufacturing, plant operation, testing and experimentation, consulting, sales and service. The employers come from industry, government and service organizations. Many of the undergraduate students go on to graduate school to pursue advanced degrees in engineering, science or business, as well as professional degree programs such as medicine, accounting and law.
Honors Program in Mechanical and Aerospace Engineering

Students enter the mechanical and aerospace honors program by invitation. Students in these programs participate in special educational experiences involving deeper investigations into subjects and research projects.

Bachelor of Science in Engineering - Concentration in Mechanical Engineering Systems

The NC State Mechanical Engineering Systems (MES) BSE program is a site-based program located on the campus of Craven Community College in Havelock, North Carolina. Students in the program earn a Bachelor of Science in Engineering with a concentration in Mechanical Engineering Systems. Upon graduation from the MES program, students have the qualifications to apply for any job seeking mechanical engineering applicants.

Opportunities

In the MES program, you will receive a solid foundation in mechanical engineering principles including structural mechanics, materials, fluid mechanics, dynamics, vibrations, controls, thermal sciences, mechanical design, and thermal design. You will also receive training in the formal systems engineering approach to the design and realization of integrated systems. Your training in formal systems engineering gives you the ability to understand and work through the broad complex issues involved with integrated systems. Your training in mechanical engineering principles gives you the skill and confidence required to understand and solve detailed technical problems. The unique combination of these skills allows you to be well prepared to meet the technical and non-technical challenges of today’s engineering workplace.

Curriculum

MES students are drawn from a diverse population that includes not only the traditional college student, but also military personnel and civilian staff of FRC-East.

The 10 mechanical engineering courses in the MES program are taught by the nationally recognized NC State MAE faculty in Raleigh and delivered to the MES students in Havelock via interactive high-definition video teleconference.

Local NC State faculty teach the Systems Engineering content, conduct all laboratory experiences, and direct students in the two-semester capstone design experience where they are partnered with an industry sponsor to design and build a solution to a real-world problem. Hands-on laboratory exercises allow students to explore and experience theoretical concepts learned in their courses and practice important modern skills such as manual and computerized measurement techniques, data analysis, design of experiments and technical communications.

The MES program is located within a short distance of the Naval Air Systems Command’s Fleet Readiness Center- East, Cherry Point (FRC-East). FRC-East is North Carolina’s largest industrial employer east of interstate highway I-95 and the MES program takes advantage of the synergies afforded by its close location and relationship with the more than 500 engineers working at FRC-East.

The MES program was evaluated under the criteria for Mechanical Engineering Programs and is accredited by the Engineering Accreditation Commission of ABET.

Admissions

Students in the MES program typically begin by taking their general education courses such as physics, chemistry, calculus, and the humanities at one of North Carolina’s Community Colleges or from another approved university program. Once students satisfy all transfer requirements, they apply for acceptance into the College of Engineering at NC State as a transfer student majoring in the MES program. Current NCSU engineering students can pursue the MES program if they are willing to relocate to the Havelock area. For more information on admissions, click here (http://www.engr.ncsu.edu/mes/enroll-bse.php) or go to www.engr.ncsu.edu/mes.

Program Educational Objectives

Alumni of the BSE with concentration in mechanical engineering systems will attain the following objectives within 3-5 years of graduating:

1. Obtain entry level engineering positions and engage in the professional practice of mechanical engineering systems, or be enrolled in graduate school.
2. Establish themselves as problem solvers in the workplace through the practical application of mechanical engineering systems knowledge and skills.
3. Function effectively in a professional environment by utilizing written and oral communication, teamwork, project management and leadership skills, and their ability to view their own work in a broader context.
4. Continuously improve and expand their technical and professional skills through formal study, as well as through informal means.

Click here (http://www.engr.ncsu.edu/mes) for more information on the MES Program or go to www.engr.ncsu.edu/mes.

Department of Nuclear Engineering

Burlington Engineering Laboratories, Room 3140 Phone: (919) 515-2301 Visit the Nuclear Engineering website (http://www.ne.ncsu.edu/)

Nuclear engineering is concerned with the engineering aspects of the control, release, and utilization of nuclear energy from both fission and fusion nuclear reactors. Nuclear reactors serve many functions: they serve as heat sources for electric power plants and are used in the production of radioactive isotopes for a variety of peaceful applications. Nuclear methods are applied in medical diagnosis and treatment, scientific research, and the search for new resources. The nuclear engineering program educates individuals in scientific and engineering principles essential for effective and productive contributions in industrial, university and government service. The Department of Nuclear Engineering maintains its national graduate rankings in the top 10 among all nuclear engineering programs. The undergraduate program continues to be highly respected by the nuclear industry.

Opportunities

Nuclear power reactor operation continues with over one hundred reactors operating in the nation, increasing our reliance upon nuclear energy as a substitute for energy from fossil fuels. Development of advanced fission and fusion reactors offers the potential of vast new
energy sources. Industrial and medical applications of radiation continue to increase in diverse industries. Demand for nuclear engineers is on the rise within the electric power industry and national laboratories, naval reactors, and other industries. According to the National Society of Professional Engineers, nuclear engineers are among the top five best compensated of the engineering disciplines.

Scholarships and Awards

Several special scholarships exist for NC State nuclear engineering students, including the Duke Energy, Institute for Nuclear Power Operations, American Nuclear Society - national, U.S. Department of Energy and the U.S. Nuclear Regulatory Commission scholarships. A special department fund supports scholarships for exceptional upperclassmen. NC State nuclear engineering students have received special recognition awards at the Undergraduate Research Symposium and have gained national recognition by several times receiving the Student Design Award of the American Nuclear Society. NC State nuclear engineering students are also frequent recipients of nationally awarded fellowships.

Facilities

Facilities for nuclear education include a nuclear research reactor (PULSTAR), which can be operated at a steady state power of 1 MW; radiation detection laboratories; nuclear materials laboratory; thermal hydraulic laboratory; prompt gamma facility; neutron activation analysis laboratory; radio-chemistry laboratories; neutron radiography unit; positron facility; ultra cold neutron source; neutron diffractometer; numerous computer facilities including, departmental computer workstations, College of Engineering EOS engineering workstations, microcomputers; reactor simulation laboratory; plasma generation and diagnostics laboratory, atmospheric plasma science laboratory, and plasma launchers laboratory.

Mission

The Department of Nuclear Engineering has four primary missions:

1. Provide a quality education at both the undergraduate and graduate levels to students who desire to pursue careers in nuclear science and engineering.
2. Develop research programs in areas of emphasis related to applications of nuclear science and engineering.
3. Assist industries and government in North Carolina, nationally and internationally in their efforts to apply these nuclear technologies to the betterment of the economy and the environment - in a safe, effective, and innovative manner.
4. Enhance, promote, and utilize the PULSTAR research reactor and associated facilities in an exemplary manner, leading to national recognition as a premier 1 MW Nuclear Reactor Program dedicated to research, teaching, and extension.

Program Educational Objectives

Consistent with the Department of Nuclear Engineering’s mission, the department has developed the following objectives for undergraduate education.

The Nuclear Engineering program is preparing its graduates for:

1. solving nuclear engineering problems.
2. applying the creative process of nuclear engineering design.
3. performing nuclear engineering tasks with understanding of the professional and ethical responsibility and accountability for the social and environmental impact of nuclear engineering practices.
4. working on interdisciplinary teams.
5. applying written and oral communication skills necessary to communicate effectively with a variety of audiences.
6. applying advances in nuclear engineering practice and research
7. continuing to learn and being successful in pursuing graduate and professional education opportunities that are available.

Curriculum

Nuclear engineers work in nuclear systems research, design, development, testing, operation, environmental protection, and marketing. The Bachelor of Science program prepares graduates for positions in industry, national laboratories, or for graduate study (consult the Graduate Catalog [http://www.ncsu.edu/grad/catalog]). The curriculum incorporates basic sciences and engineering, with emphasis on mathematics and physics, followed by course work in nuclear science and technology. Design concepts are introduced in numerous nuclear engineering courses throughout the curriculum to provide an integrated educational experience, cap-stoned by senior nuclear projects involving reactors and radiation systems. Attention is also given to the efficient utilization of energy resources and to the environmental aspects of nuclear energy. Computers are widely used throughout the curriculum.

The nuclear engineering program, which is accredited by the Engineering Accreditation Commission of ABET, Inc. leads to the degree of Bachelor of Science in Nuclear Engineering. Advanced undergraduates who desire to attend graduate school at NC State may enter a combined 5-year B.S./MNE professional program or B.S./M.S. bachelor/master degree program during their senior year which will culminate at the end of their fifth year with both the Bachelor of Science in Nuclear Engineering and the Master of Nuclear Engineering or the Master of Science degrees, respectively.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Textile Engineering Program

Textile Building/Centennial Campus, Room 3250

The Textile Engineering (TE) Program at North Carolina State University is administered jointly by the College of Textiles and the College of Engineering and is an interdisciplinary curriculum drawing on diverse science and engineering principles. Textile engineering students develop a unique background, through undergraduate research, summer intern experiences, and design projects ranging from artificial blood vessel development to the design of novel high-tech sporting equipment. Textile engineers also design computer information systems that can integrate a worldwide distribution program eliminating a company’s reliance on regional stockpiles or streamline an industrial process using Six Sigma quality saving a company millions of dollars. The program offers small class sizes with personal attention from faculty. With the focus on interdisciplinary research, the opportunities for textile engineers have never been brighter.

Opportunities

Textile engineers, teaming with chemists, physicists, materials scientists, and other engineers are designing new polymers, fibers, and textile structures to revolutionize the future of materials. Whether it be for personal protective garments such as bullet proof vests and Gore-tex®
or materials used in the next generation space shuttle and the stealth bomber, textile engineers are developing products that are stronger, lighter, and more durable than current materials. Textile engineers are employed in a wide variety of industries that include aerospace, automotive, chemical, composites, management consulting, fiber processing, medical devices, manufacturing and retail, and textile processing.

The TE Program provides a fundamental engineering degree with a working knowledge of the very large textile industry as well as its allied industries. We have our own career planning and placement center to assist students in identifying and selecting internships and permanent careers. Historically, TE graduates have had nearly 100% placement into graduate school or full time employment with starting salaries among the highest at N.C. State University. Compared to the rest of North Carolina State University, the College of Textiles has the highest percentage of students participating in scholarship programs. Indeed, over 50% of all Textile Engineering students receive scholarship support! Owing to the size of the program, many of our undergraduate students participate in research with our world renowned faculty further providing financial assistance as well as professional growth. Almost all of our textile engineering students participate in summer internships. Most of our graduates select jobs that are located in the Southeast, but others who desire to work in other regions of the country have opportunities to do so. Our graduates work in the biomedical industries on the east and west coasts and in Chicago, the automotive industry in Michigan, the aerospace industry in Texas, as well as large apparel and retail companies in Oregon, Maryland, California, Utah, Ohio and North Carolina.

Curriculum

The TE program has three concentrations allowing a customized curriculum that fits your specific educational goals. All three programs are accredited by the Engineering Accreditation Commission of ABET, Inc. The concentrations emphasize Information Systems Design, Chemical Processing and Product Engineering. Minors in associated engineering fields (e.g., Computer Science, Industrial Engineering, and Materials Science) as well as foreign language minors are strongly encouraged as part of the academic plan. For exceptional students, dual degree programs with Chemical and Biomolecular Engineering, Biomedical Engineering, and Materials Science and Engineering provide a bachelor degree in two engineering majors with one additional semester of course work.

Educational Objectives

The Textile Engineering Program of the Department of Textile Engineering, Chemistry and Science is committed to instill a strong academic program whereby graduates, within the first few years after graduation are prepared for the following accomplishments:

They will be able to define, analyze, and solve complex, real-world problems by utilizing the principles of mathematics and basic sciences integrated with statistical experimentation and engineering analysis. They will possess an appreciation for commitment to being life-long learners by seeking educational and developmental opportunities in their personal and professional lives such as pursuing advanced degrees and professional licenses. They will excel in careers in diverse fields in the public and private sectors, and across various industries within or outside the textile complex, including textiles and its ancillary industries. They will demonstrate productive engineering practice, entrepreneurial behavior, research and leadership, or management within the public, private or academic sectors by using the technical professional, ethical and societal knowledge, skills and attitudes required for success in the complex modern world.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

College of Humanities and Social Sciences

Box 8101 Raleigh, NC 27695-8101

The College of Humanities and Social Sciences offers programs of study that lead to baccalaureate and advanced degrees in the disciplines of the humanities and social sciences. The college also offers courses in these disciplines that are required in all undergraduate programs. In this way the university provides its students the opportunity to prepare for a full life in the professions and occupations that require intellectual flexibility, broad knowledge, and a basic comprehension of human beings and their problems.

The college is comprised of nine departments or schools: Communication, English, Foreign Languages and Literatures, History, Philosophy and Religious Studies, School of Public and International Affairs, Psychology, Social Work, and Sociology and Anthropology. Interdisciplinary programs are administered through Academic Affairs in the college Dean’s Office.

The college offers undergraduate majors in: Anthropology; Arts Studies; Communication; Criminology; English; French; German Studies; History; Interdisciplinary Studies; International Studies; Philosophy; Political Science; Psychology; Religious Studies; Science, Technology and Society; Social Work; Sociology; and Spanish. In addition, special options or concentrations are available within some of the major programs:

• Africana Studies
• American Politics
• Communication Media
• Creative Writing
• Film
• International Politics
• Interpersonal, Organizational & Rhetorical Communication
• Language, Writing and Rhetoric
• Law and Justice
• Literature
• Logic, Representation & Reasoning
• Philosophy of Ethics
• Philosophy of Law
• Public Policy
• Public Relations & Organizational Communication
• Teacher Education – option available in English, French, Spanish, and social studies (history)
• Women’s and Gender Studies

Degrees granted include the Bachelor of Arts, Bachelor of Science, Bachelor of Social Work, Master of Arts, Master of Fine Arts, Master of
Science, and Doctor of Philosophy, as well as professional degrees in political science and sociology.

Academic Minors

The College of Humanities and Social Sciences offers 41 minors:

- Africana Studies
- American Literature
- Anthropology
- Arts Studies
- Chinese Studies
- Classical Studies
- Cognitive Science
- Creative Writing
- Criminology
- English
- Ethics
- Film Studies
- Forensic Science
- French
- German
- Health, Medicine & Human Values
- Hindi-Urdu
- History
- International Studies
- Italian Studies
- Japanese
- Japan Studies
- Journalism
- Law and Justice
- Linguistics
- Logic and Methodology
- Middle East Studies
- Native American Studies
- Nonprofit Studies
- Philosophy
- Political Science
- Portuguese Studies
- Psychology
- Religious Studies
- Russian Studies
- Science, Technology and Society
- Social Work
- Sociology
- Spanish
- Technical and Scientific Communication
- Women’s and Gender Studies
- World Literature

Dual Degree Programs

Benjamin Franklin Scholars Program

The Benjamin Franklin Scholars program, sponsored jointly by the College of Engineering and the College of Humanities and Social Sciences, allows a select group of highly motivated students to simultaneously pursue bachelor’s degrees in both engineering and humanities or social sciences, producing students with a broad training uniquely equipping them for the challenges of today’s world. Students in this program can combine any major in the College of Humanities and Social Sciences (plus economics) with any major in the College of Engineering. This program, now entering its twenty-sixth year, has produced men and women who use their engineering training in a broad range of settings and jobs: in industry, in academia, in government, working as engineers, lawyers, physicians, and policy analysts, among others.

There are three entry points into the program. A limited number of newly admitted freshmen are invited to apply to join the program in the April of their senior year of high school, based on SAT scores. During New Student Orientation the summer before the freshmen year, all new entering freshmen are invited to attend an information session about the program and apply to join. Thereafter interested students can seek admission through an individual consultation with the director.

The program has dedicated scholarship money associated with it, and students who have completed the Franklin intro course, have officially declared their Engineering and Humanities and Social Sciences majors and who have a 3.0 or above GPA are generally eligible for scholarship support. The time required to complete both degrees depends on a variety of factors, including incoming AP credit, semester course load, use of summer school, and Humanities and Social Sciences degree sought. The program can be completed in 4-5 years, with five years being typical.

The student led section of the program, the Franklin Council, arranges a wide variety of social, service, and academic events throughout the year.

For more information, contact the director of the program, Dr. Ross Bassett, Department of History, College of Humanities and Social Sciences, ross@ncsu.edu, 919-515-2231, 478 Withers Hall, or visit the Franklin Scholars Program homepage (http://ids.chass.ncsu.edu/bfs).

Thomas Jefferson Scholars Program

The Thomas Jefferson Scholars Program is a joint program of the College of Agriculture and Life Sciences and the College of Humanities and Social Sciences. It is a program that leads participants to two degrees: one concentrating in an area of agriculture or life science and one in an area of humanities or social science. All majors in each college are available, to meet each student’s particular interests and career goals. The purpose of the program is to produce potential leaders in agriculture and the life sciences who have not only technical expertise but also an appreciation for the social, political, and cultural issues that affect decision-making. The program includes special classes and guest lecturers for Jefferson Scholars, travel and other enrichment experiences, and a variety of social and service activities.

Once a student applying for admission to NC State has been accepted, the program invites students of high achievement to apply to the Jefferson Scholars. The application is online, and due by mid-February. Applicants come for an interview in March, and a limited number of entering freshmen are chosen to participate in the Jefferson Scholars Program. Successful participants receive scholarship support after the sophomore year.

For more information, contact either faculty mentor, Dr. Chad Jordan, Plant Biology, College of Agriculture and Life Sciences, 919-515-2222, chad_jordan@ncsu.edu; or Dr William Kimler, History, College of Humanities and Social Sciences, ross@ncsu.edu, 919-515-2231, 478 Withers Hall, or visit the Thomas Jefferson Scholars Program homepage (http://ids.chass.ncsu.edu/bfs).
and close association with faculty members in their major field. Encourage outstanding students to develop their intellectual potential to each course. In addition, all majors must take:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>COM 230</td>
<td>Introduction to Communication Theory</td>
<td>3</td>
</tr>
<tr>
<td>COM 240</td>
<td>Communication Theory</td>
<td>3</td>
</tr>
<tr>
<td>COM 250</td>
<td>Communication and Technology</td>
<td>3</td>
</tr>
</tbody>
</table>

Preferably one-at-a-time and in sequence, and earn a “C-” or better in each course. In addition, all majors must take
COM 110 Public Speaking

and/or

COM 112 Interpersonal Communication

(depending upon their concentration). Students select one of the three departmental concentrations in which they take the remaining credit hours in the major. The concentrations are:

Communication Media
This concentration engages students in the analysis and production of technologically-mediated messages through coursework in media writing and production, media history and criticism, and the study of emerging technologies.

Interpersonal, Organizational, and Rhetorical Communication
This concentration addresses theoretical, rhetorical, and applied approaches to the study of human communication processes and problems within interpersonal relationships, groups and teams, organizations, and public and political discourse.

Public Relations and Organizational Communication
This concentration engages students in the study of communication theories and methods that establish and maintain organizational identity and mutually beneficial relationships with employees, consumers, and other target audiences.

Honors Program
The Communication Honors program allows exceptional undergraduate Communication majors the opportunity to take challenging graduate-level coursework in the Department of Communication. The Communication Department Honors Program requires the completion of three academically challenging courses during a student's senior year. At least one of the three courses must be at the 500-level (graduate course). Other courses may include a 400-level class taken with an honors option (initiated by the student or faculty) or an Independent Study (COM 499) with an Honors option. These three courses will all count toward the 39 hour BA degree in Communication.* Students who satisfy all of the requirements of the Honors Program will have this accomplishment noted on their transcript and be recognized at the departmental graduation ceremony.

In most cases, application to the Departmental Honors Program is submitted during the junior year. All eligible students will be notified and are encouraged to apply. The following criteria must be met by the time the candidate begins honors coursework:

(1) completion of the departmental core courses

(2) completion of COM 110 Public Speaking or COM 112 Interpersonal Communication

(3) completion of an additional 9 hours of Communication courses, including a 300- or 400-level course that involves considerable writing and/or discussion of communication theory

(4) completion of at least 75 hours of university coursework (at least 24 at NCSU)

(5) an overall GPA of at least 3.50

(6) a major GPA of at least 3.50

To apply for admission to the Honors Program, students must submit a copy of their transcript, a letter of intent that discusses their academic goals and interest in the honors program, and a letter of recommendation from either the professor who taught the 300/400 level course mentioned in (3) above or a tenured / tenure-line faculty member who is familiar with the individual’s academic potential.

For more information, contact the Communication Honors Program Director, Dr. Dan DeJoy, ddejoy@ncsu.edu.

Please Note: Students who are eligible for the Honors Program may also be eligible for the Accelerated Bachelor’s/Master’s (ABM) Degree in Communication. Students interested in the ABM must complete the standard application for admission to the Graduate School. Students who complete the honors program in conjunction with the ABM must take three 500-level courses to complete the Honors Program.

Curriculum Notes
Students must enroll in COM 230 Introduction to Communication Theory during their first semester as a Communication major. Admission to the Department of Communication is based upon academic record. Courses in progress at the time of the application deadline will not be considered.

Intra-campus Transfer
Students who wish to change to another major in Humanities and Social Sciences or to add a second major in Humanities and Social Sciences will be eligible to submit an electronic application through CODA (http://www.ncsu.edu/coda/CHASS.html) once they have completed at least 12 letter-graded hours and have a GPA of at least 2.0. Departments will review all applicants on a competitive basis. Candidates who meet the preferred requirements outlined below have a higher probability of being accepted for admission. However, meeting the preferred requirements does not guarantee admission to the desired major.

Preference is given to applicants with a TGPA of 3.0 or higher and to those who have completed ENG 101 with a “B-” or better and COM 200 plus 3 additional hours in COM establishing a COM GPA of at least 2.5. No applications are acceptable from students whose TGPA is below 2.0.

No final grades below “C-” are permitted for courses used to satisfy Departmental graduation requirements. No grades in COM courses below “C-” may be used to satisfy any University graduation requirements.

Internships
COM 496 Communication Internship, the Department of Communication internship course, is open to seniors majoring in Communication who have earned a GPA of at least 3.0 for all COM courses attempted. COM 496 is available for qualified seniors in all three Communication Department concentrations, but it is required of all students enrolled in the Public Relations and Organizational Communication (PR) concentration. If a student in the PR curriculum does not qualify for COM 496 (that is, does not have a minimum 3.0 GPA for all COM courses), he/she cannot graduate in the LCP curriculum. To obtain additional information concerning COM 496, the student should
schedule a conference with the Internship Director, Mr. Dean Phillips, deanworks@nc.rr.com.

**Graduate Programs**

The Department of Communication offers a Masters Degree in Communication. In conjunction with the Department of English, the Department of Communication also offers an interdisciplinary Ph.D. program in Communication, Rhetoric, and Digital Media. For more information, please visit the Graduate School website (http://www.ncsu.edu/grad).

**Department of English**

The Department of English offers introductory and advanced courses in writing, language, literature, and film. The first-year course required of all undergraduate students develops skills in expository writing and in analytical reading. Advanced courses in writing available to all students cover a variety of areas, including journalism, technical and business writing, and creative writing. These courses give students opportunities to pursue special personal and career interests, as do courses in literature, linguistics, rhetoric, and film.

The department offers a Bachelor of Arts major in English with five options:

1. Creative Writing
2. Film
3. Language, Writing, and Rhetoric
4. Literature
5. Teacher Education

**Career Opportunities**

A degree in English provides both liberal education and practical knowledge about the role of writing and language in the everyday world. It leads to careers in such fields as teaching, journalism, advertising, public relations, personnel management, technical writing, business writing, and creative writing. It sharpens the analytical and interpretive skills needed for professional and managerial careers, and it serves as an excellent preparation for students planning to study law or medicine and for those intending to do graduate work in literature, linguistics, film, or rhetoric.

**English Honors Program**

The Honors Program in English provides courses that challenge and inspire English majors to pursue their scholarly interests at an advanced level. Honors students enjoy courses in small, seminar settings, engage in independent study, develop expertise in a variety of research practices, and earn recognition for excellent work beyond ordinary requirements.

For admission, students must have a minimum GPA of 3.25 and must have completed at least three English courses above the freshman level with a minimum GPA of 3.25.

**Internship Program** (http://english.chass.ncsu.edu/undergraduate/internship)

Internships provide the opportunity for on-the-job experience in writing, editing, graphics, and publication under expert supervision in professional settings.

**Study Abroad**

English majors have the opportunity to study abroad in many foreign cities, including London, Oxford, and Prague. For more information, please visit the Study Abroad website (http://studyabroad.ncsu.edu).

**Student Organizations**

- **English Club** The English Club is a student-run organization that is open to all NC State students who have an interest in English.
- **Exposure Film Society** The Exposure Film Society provides the NC State Student Body with a forum for viewing and discussing classic and contemporary films.
- **Sigma Tau Delta** The NCSU Chapter of Sigma Tau Delta, Alpha Pi Theta, recognizes high scholastic achievement and offers opportunities for leadership and service.

**Bachelor of Arts in English**

**Core Curriculum** The undergraduate major in English is built around an 18-hour core that includes one course from each of the following six categories: American Literature, British Literature, World Literature, Film, Linguistics, and Rhetoric. In addition to the 18-hour core, students take 21 hours of course work in one of the five following concentrations.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

**Creative Writing**

The concentration in creative writing (CRW) offers a background in literature and language with an emphasis on writing fiction, poetry, screenplays, and / or non-fiction. The 21-hour Creative Writing concentration includes four creative writing courses, two literature courses, and one English elective. Creative Writing graduates often go on to graduate school for an advanced degree in creative writing, such as the M.F.A. They also often pursue careers in writing, teaching, editing, business, and other fields.

**Film**

The concentration in film (FLM) trains students in the history, analysis, and interpretation of film. The 21-hour LFM concentration includes four film courses and three English electives. Through coursework in film studies, students acquire skills in interpretation, analysis, and criticism; situate films within historical periods; consider the relation of film to literary texts; and study important film genres, directors, and national traditions. They may also become involved in the creative work of screenwriting.

**Language, Writing and Rhetoric**

The concentration in Language, Writing, and Rhetoric (LWR) emphasizes the study of written English in its theoretical, cultural, and practical
Minor in Linguistics

The linguistics minor, available to all students except for English LWR majors, is designed to investigate the structure and function of language as a cognitive and behavioral science. Five courses in designated areas of linguistics are required in the minor. Among students likely to be attracted to this minor are those who expect to pursue graduate study in linguistics, those interested in foreign languages or English as a second language, and those interested in communication sciences.

Minor in Technical and Scientific Communication

A minor in Technical and Scientific Communication is available from the Department of English for NC State students, except English LWR majors, who are interested in supplementing their studies in technical, scientific, or other academic fields with strong writing and communication skills. Students minoring in Technical and Scientific Communication will be introduced to numerous genres including internal and external documents such as proposals, reports, science writing, users guides, reference manuals, and online documentation. Critical perspectives towards the role of communication in the creation of scientific and technical knowledge will be examined. The minor may lead to career opportunities in technical and scientific writing and communication.

Minor in World Literature

In keeping with the university’s mission to provide an international curriculum, the World Literature minor offers NC State students, except for English LLT majors, an opportunity to broaden their perspectives on foreign cultures through the study of literature outside the Anglo-American tradition. Students will also develop critical, analytical, and linguistic skills essential in today’s job market. The minor offers choices from a range of courses in literature, in translation or in the original language, from Europe, Asia, Africa, and Latin America.

Graduate Programs

At the graduate level, the Department of English offers three graduate degrees: a Master of Arts in English, a Master of Science in Technical Communication, and a Master of Fine Arts in Creative Writing. In conjunction with the Department of Communication, the Department of English also offers an interdisciplinary Ph.D. program in Communication, Rhetoric, and Digital Media. For more information, please visit the Graduate School website (http://www.ncsu.edu/grad). A five-course certificate program in Professional Writing, available to students not seeking a degree at NC State, offers preparation in practical writing and editing, including both journalism and technical writing.

Department of Foreign Languages and Literatures

Opportunities

The expansion of international relations makes the knowledge of foreign languages a critical need for today’s professional. The student of foreign languages is not limited to teaching, translating or interpreting. There are careers in politics, diplomacy, commerce, business, agriculture, science, and research in which a thorough knowledge of foreign languages and cultures is crucial for success. The demand for multilingual personnel extends to all fields of human enterprise and will continue to grow in the coming years.
Bachelor of Arts in French, German Studies or Spanish

All the general requirements for Bachelor of Arts degree must be met. Degree designations are B.A. in French Language and Literatures, B.A. in Spanish Language and Literature, B.A. in German Studies, B.A. in French Language and Literature with Teacher Education option, and B.A. in Spanish Language and Literature with Teacher Education Option.

Outstanding students may become members of the Pi Delta Phi, French Honor Society, Sigma Delta Pi, National Hispanic Honor Society, or of Delta Phi Alpha, German Honor Society.

Major in French or Spanish with Teacher Education Option

In collaboration with the College of Education and the Department of Curriculum and Instruction, the Department of Foreign Languages and Literatures offers a program leading to a French or Spanish teaching license in North Carolina, grades K-12.

Programs Abroad

Summer study programs are offered in Austria, France, Italy, Spain, and Peru.

Minors in Foreign Language, Literatures, and Cultures

Minor programs in the Department of Foreign Languages and Literatures include courses in language, literature, and civilization. The minor program requires 15 hours of study in Chinese Studies, Classical Greek, Classical Studies, French, German, Hindi-Urdu, Italian, Japanese, Japanese Studies, Russian, or Spanish.

Undergraduate students majoring in any area of study at NC State are eligible to minor in a foreign language. Students may not, however, major and minor in the same language.

ESL at NC State

The English as a Second Language program serves the academic and professional language needs of international university students. Courses are designed to help both undergraduate and graduate students perfect their language skills. The English Placement Test may be required for new students. Check with the ESL section for details. An ESL licensure program is also available.

Department of History

Withers Hall, Room 350
Phone: (919) 515-2483
Visit the Department of History’s website (http://history.ncsu.edu/)

The Department of History offers three undergraduate majors, a minor, an M.A. in History, an M.A. in Public History and a Ph. D. in Public History (see Graduate Catalog for advanced degrees). The departmental Honors Program provides a guided experience in undergraduate independent research and awards departmental Honors in History upon graduation. Outstanding history students are eligible for membership in Phi Alpha Theta, the professional honors society for historians.

In an ever-changing world, understanding our history becomes all the more necessary. It brings us a sense of the complexity and contingency of events. It provides us with rich and diverse perspectives. It informs us about the prevalence of unintended consequences. The Department of History at NC State brings alive the treasure of human experience and cultures, from the ancient near East to the post-Cold War world, from medieval life to modern science and technology, from the ancient Americas to the modern U.S.

The History Department is a diverse group of scholars covering many areas of specialization. Faculty members have a strong record of publications, grant and fellowship awards, and public outreach. We pride ourselves on outstanding teaching, and we offer small classes that allow a great deal of individual attention. Our faculty advisors offer close contact and personal attention to each student. The History major is a place to get a "small college" education in a big state university.

The department of twenty-nine professors has about three hundred undergraduate majors. To all our majors, we offer small classes, and special fifteen-person seminars as both an introduction to historical methods and as a senior capstone experience. The programs offer a great deal of student choice in courses and electives, allowing the pursuit of either a broad educational experience or a focused study. A student could follow a particular interest in clusters of electives, such as history of race relations, law and society, or the history of science and technology.

History teaches that understanding a situation requires identifying with people who lived in other times and places. History is a discipline whose very method seeks and applies fair and appropriate norms to understand and judge human behavior. Students will learn to exercise independent judgment as well as to tolerate differences.

Opportunities

There are many reasons to major in History. Students learn how to gather the relevant facts and develop the most persuasive explanation. The critical skills learned by history majors can be used in a variety of careers. The major is an excellent preparation for the study of law. Employers tell us they want people with a deeper awareness of the changing world, combined with the ability to read, analyze, and write about its causes and outcomes. Our graduates are lawyers, business-owners, museum directors, doctors, archivists, politicians, consultants, judges, farmers, chefs, military officers, and of course teachers and professors of history. Whether or not they became historians, they use their training in historical thinking as they ask and explain why two communities or peoples failed to co-exist, a merger failed, a disease spread, an idea or faith took hold, or a relationship worked.

Honors Program

The departmental Honors Program invites a small number of highly qualified and motivated students to pursue intensive individually directed work in history. Students are invited to enter the Honors Program (usually in the junior year), Students must take 9 hours of individual, directed study with a faculty mentor, producing an Honors Thesis of original research. These research and writing courses replace some of the advanced electives in the degree programs.

Majors in History

Bachelor of Arts in History

The degree requires 30 hours of history course work (in addition to the 6 hours required of all College of Humanities & Social Sciences majors), including HI 300 Sophomore Seminar in History and HI 491 HI 491
Seminar in History. Breadth distribution requirements at the introductory level include a course in world history, history of Asia or Africa or Latin America, European history, and American history. At least 12 of the 30 hours must be at the Advanced Electives at the 400-level level.

This degree allows 32 hours of free electives for a total of 122 hours.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula), under the Humanities & Social Sciences drop-down list.

Bachelor of Arts in History with a Teacher Educations Concentration

The Teacher Education Concentration is a track to a B.A. in History that includes the specific history and social science courses recommended for eventual Social Studies teachers in North Carolina. Students take the full array of undergraduate requirements, but also can use free electives to begin graduate Education classes. In collaboration with the College of Education, students with a 3.5 GPA may count some of the credits from their senior year for the Master of Arts in Teaching (M.A.T.). This accelerated program is intended to be a five-year track to the M.A.T. degree. The M.A.T. is supervised and granted by the College of Education. Professional education courses, and the student teaching experience in a high school, are part of the graduate portion of the program, leading to eligibility for North Carolina certification to teach Social Studies in secondary schools in North Carolina and most other states. Holders of the M.A.T. are more competitive in the teacher job market.

The degree requires 30 hours of history course work (in addition to the 6 hours required of all College of Humanities & Social Sciences majors), including HI 300 Sophomore Seminar in History and HI 491 Seminar in History. Breadth distribution requirements at the introductory level include both world history surveys, history of Asia or Africa or Latin America, European history, and both American history surveys. The degree requires 21 hours of social science courses.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula), under the Humanities & Social Sciences drop-down list.

Bachelor of Science in History

The importance of science and technology in our society makes a background in science and technology valuable even for humanities majors. The B.S. degree offers a way for students to get both the analytical and writing skills that come from a history major and the technical proficiency that comes with coursework in science and engineering. This combination is very helpful in a wide variety of careers, including law, business, and public policy. This degree is particularly well suited for students transferring into history from a science or engineering major, or double-majoring with a science or engineering.

It requires 24 hours of history course work (in addition to the 6 hours required of all College of Humanities & Social Science majors), including HI 300, HI 491, and at least 4 other courses at the 400 level. Students work with an advisor to design a 15-hour concentration in a single area of science and technology. This degree allows students to integrate a broad base in science and math with a history education.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula), under the Humanities & Social Sciences drop-down list.

Minor in History

The minor requires 18 hours of history, made up of two 200-level history courses (one in recent American or European history and one in pre-modern history or in Asian, African, or Latin American history), and four courses at the 300 or 400 level (at least two of which must be at the 400 level).

IDS prefix courses

Interdisciplinary Studies

The College of Humanities and Social Sciences (CHASS) has a long history of involvement in interdisciplinary teaching and research. In order to better serve the needs of NC State and our society, the College aims to strengthen its current efforts and expand its offering of interdisciplinary programs. We are also committed to making interdisciplinary programs available to diverse and geographically dispersed populations through distance education.

Program Directors and contact information are listed within each Interdisciplinary Studies undergraduate program, which can be accessed below:

• Africana Studies
• Arts Studies: Film, Music, or Visual Arts (major and minor)
• Film Studies (minor)
• Forensic Science (minor)
• Interdisciplinary Studies: Self-Design (major) (http://ids.chass.ncsu.edu/self_design)
• International Studies 8 concentrations (major and minor)
• Middle East Studies (minor)
• Native American Studies (minor)
• Nonprofit Studies (minor)
• Science, Technology and Society
• Women’s and Gender Studies

For more information, please see the CHASS Interdisciplinary Studies website. (link: http://ids.chass.ncsu.edu)

For more information, please see the CHASS Interdisciplinary Studies website, http://ids.chass.ncsu.edu.

Africana Studies Program

Bachelor of Arts in Africana Studies

The Africana Studies curriculum is designed to give students an integrated and critical understanding of the experiences, contributions, and achievements of peoples of African descent throughout the world. The core courses emphasize conceptual and methodological issues within Africana Studies. Students are taught academic skills and encouraged to conduct critical research and analyses designed to understand the relationships between and solutions to the political, social, cultural, and economic developments in Africa and the African Diaspora. The overall goal of the Africana Studies program is to provide students
with competencies to succeed as citizens, workers, and leaders of the
global community.

For more information see the Africana Studies website (http://
ids.chass.ncsu.edu/afs).

**Minor in Africana Studies**

The Minor in Africana Studies provides a comparative and
interdisciplinary study of the Black experience in Africa and the Americas.
Africana Studies courses (AFS) and activities expose students to the
historical and comparative patterns of life, labor, culture, development
and social protest of peoples throughout the African Diaspora. The
Minor is designed to bring together students from diverse backgrounds
who share an interest in the global experience of African people. Three
required courses include African Civilizations AFS 240), an Introduction
to African-American Studies (AFS 241), and Introduction to the African
Diaspora (AFS 342). Two elective courses may be selected from a list of
designated courses in such disciplines as Anthropology, English, History,
Music, Political Science, Psychology, Sociology, and Social Work. Study
Abroad (e.g., Africa, Caribbean) and service learning opportunities are
also available.

**Arts Studies Program**

**Bachelor of Arts in Arts Studies**

The Arts Studies Major offers three areas of specialization within a
curriculum that focuses on the history, interpretation, and production of
the visual and performing arts in aesthetic and cultural context. Students
pursue the academic study of film, music, or visual art. Within each
specialization, they have opportunities to focus on the specific subject
area and to develop connections between and among diverse art forms
and practices, historical periods, and cultures.

Students take 21 hours in foundation courses (15 hours in history and
analysis and 6 hours in production or studio courses), 6 hours in linking
courses (courses that examine the relationship between art and other
areas of inquiry in the humanities, social sciences, and sciences), a 3
hour capstone course, and an advised elective designed support their
particular interests and career objectives. To enroll, students apply at the
CHASS Dean’s Office, 106 Caldwell Hall.

For more information visit the Arts Studies website (http://
ids.chass.ncsu.edu/arts)

**Minor in Arts Studies**

The Minor in Arts Studies is open to all undergraduate majors in the
university. This interdisciplinary Minor is designed to enrich the
student’s university experience, to serve as a foundation for learning
and understanding the arts beyond the university years, and to stimulate
intellectual development in ways that may reinforce or complement the
objectives of the student’s Major. This Minor provides the student with
a fundamental understanding of the historical, theoretical, and practical
disciplines of the arts.

A total of eighteen credit hours must be taken to complete this Minor.
Students interested in the Minor should refer to the Arts Studies courses
listed under “Arts Studies” in the course description section of this
catalog. These courses are described in detail under their departmental
prefixes.

**Film Studies Program**

**Minor in Film Studies**

The Departments of English, Communication, and Foreign Languages
& Literatures offer a Minor in Film Studies. The Minor provides an
introduction to the film medium, some background in cinema history, and
the opportunity for in-depth study of selected topics in genres, directors,
and film styles.

The Minor comprises fifteen hours of course work:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG 282</td>
<td>Introduction to Film</td>
<td>3</td>
</tr>
<tr>
<td>Choose one of the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COM/ENG 364</td>
<td>History of Film to 1940</td>
<td>3</td>
</tr>
<tr>
<td>COM/ENG 374</td>
<td>History of Film From 1940</td>
<td></td>
</tr>
<tr>
<td>Choose three of the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENG 292</td>
<td>Writing About Film</td>
<td>3</td>
</tr>
<tr>
<td>ENG 330</td>
<td>Screenwriting</td>
<td></td>
</tr>
<tr>
<td>ENG 375</td>
<td>African American Cinema</td>
<td></td>
</tr>
<tr>
<td>ENG 378</td>
<td>Women &amp; Film</td>
<td></td>
</tr>
<tr>
<td>ENG 430</td>
<td>Advanced Screenwriting</td>
<td></td>
</tr>
<tr>
<td>ENG 492</td>
<td>Special Topics in Film Styles and Genres</td>
<td></td>
</tr>
<tr>
<td>IDS 496</td>
<td>Topics in Film and Interdisciplinary Studies</td>
<td></td>
</tr>
<tr>
<td>ENG 585</td>
<td>Studies In Film</td>
<td></td>
</tr>
<tr>
<td>ENG 591</td>
<td>Studies in National Cinemas</td>
<td></td>
</tr>
</tbody>
</table>

**International Studies Program**

**Bachelor of Arts in International Studies**

The Bachelor of Arts in International Studies is designed to educate
students within a global context. The program of study requires students
to integrate theoretical knowledge about broad global processes and
methods used to study them with in-depth examination of a particular
world region or major theme in international studies. The curriculum is
designed to expose students to a variety of disciplinary approaches. It
prepares students to pursue advanced studies in diverse academic fields,
and for careers in global corporations, international organizations, and in
the government or non-profit sectors.

For more information, see the International Studies Program website
(http://ids.chass.ncsu.edu/is).

**Minor in International Studies**

The International Studies Minor is offered to all students in the
university who want to add a significant international dimension to their
departmental Majors. This Minor program enables students to explore
international topics, issues and research from cross-cultural, transnational
perspectives. The program will provide some tools that students can
use to understand better the global context of the modern world and
to learn the international dimensions of their chosen fields of study.
Nonprofit Studies Program

Minor in Nonprofit Studies

The interdisciplinary Minor in Nonprofit Studies is designed to prepare undergraduate students for careers in the nonprofit sector, in both paid and volunteer positions. The program provides students with an understanding of the role of the nonprofit sector in society and builds students’ knowledge, skills and abilities in effective nonprofit leadership. Through multiple service-learning experiences and a nonprofit internship requirement, students are offered a variety of hands-on experiences designed to facilitate an understanding of the issues and challenges faced by nonprofit organizations and prepare students for nonprofit leadership positions. The Minor in Nonprofit Studies is a strong complementary course of study for students with Majors offered across the NC State campus including Communication, English, Engineering, History, Political Science, Psychology, Social Work, Parks, Recreation and Tourism, Forestry, Business Management, Art and Design, Education, and more. The Minor in Nonprofit Studies enables students to explore the interconnections between their chosen field and the nonprofit sector.

For more information: nonprofitminor@ncsu.edu, http://nonprofit.chass.ncsu.edu/programs/undergraduate-minor/

Science, Technology, and Society Program

Science, Technology, and Society (STS) is an interdisciplinary field of study that seeks to explore and understand how science and technology shape culture, values, and institutions, and how such factors shape science and technology. Science and technology are closely linked to economics and commerce, politics, policy, and international relations, energy and the environment, health and medicine, and other crucial areas. Further, the In these contexts, the STS program studies basic questions of equity, justice, and sustainability. With these connections in mind, STS examines how science and technology emerge, how they engage with society, how they change through social processes, and how society changes under their influence.

For more information, visit the STS Program website (http://ids.chass.ncsu.edu/sts).

Minor in Science, Technology, and Society

The Minor in Science, Technology, and Society is a fifteen-hour, interdisciplinary Minor providing students an opportunity to appreciate and understand better the roles that science and technology play in the larger sociocultural context. A goal of the Minor is to help students develop the ability to order and integrate the diverse aspects of their educations. Two essential components of this ability are sensitivity to the ethical dimensions of scientific and technological affecting how people may live or want to live and an appreciation of the practical implications of scientific and technical theory. In addition, the Minor in Science, Technology, and Society enables students to increase the breadth of their interests in science and technology.

Honors in Science, Technology, and Society

The Honors Program in STS offers an enriching and challenging educational experience to qualified majors. Admission to the program requires at least a 3.25 overall GPA and 3.25 major GPA, including STS 214 Introduction to Science, Technology, and Society and at least 6 other hours of course work in the major requirements. Honors students must complete the Honors Option in STS 403 Seminar in Science, technology, and Society with a course grade of B+ or better; three hours of course work in the major requirements taken from among graduate courses and independent study courses; and three additional hours of course work in the major requirements taken from among honors courses, honors option courses, graduate courses, and independent study courses. Graduation requires a 3.25 GPA overall and a 3.40 GPA in the major.

Successful completion of the program is noted on the student’s transcript and in the commencement and honors convocation programs.

Women’s and Gender Studies Program

Bachelor of Arts in Women’s and Gender Studies

The Women’s and Gender Studies Major provides NC State students with a rigorous interdisciplinary examination of women’s and gender issues. Because the 30-hour Major encompasses a variety of humanities and social science fields, it leads students to analyze and reinterpret existing data and common assumptions about gender and gender identity from a variety of disciplinary perspectives. This interdisciplinary approach also necessarily foregrounds the complex relationships between gender, class, ethnic and racial structures; acquaints students with the often unacknowledged contributions made by women in various fields of endeavor inside and outside the academy; and grounds students in feminist theories and methodological perspectives, recognizing their substantial contributions to social and public policy analysis. The required one-semester internship in the senior year also encourages students to translate course work and theory into committed and responsible social involvement within the wider community and within nonprofit organizations concerned with social equality.
For more information, please visit the Women’s and Gender Studies website (http://ids.chass.ncsu.edu/wgs) or contact Dr. Deborah Hooker, WGS Director.

**Minor in Women’s and Gender Studies**

Like the Major, the 15 hour Women’s and Gender Studies Minor offers students across the university the opportunity for a rigorous focus on women’s and gender issues, feminist theories, and interdisciplinary perspectives on the intersectional relationships of gender, race, class, and ethnicity. Students are required to take WGS 200, Introduction to Women’s and Gender Studies, and the WGS capstone course, WGS 492, Contemporary Issues in Women’s and Gender Studies. The remaining 9 hours of elective coursework can be tailored to student’s specific interests, e.g., women and gender in science and technology, women and US politics, international gender issues, etc. Students are also eligible to enroll in the one-semester internship, WGS 310, to fulfill part of the Minor requirements.

**Department of Philosophy and Religious Studies**

The disciplines of Philosophy and Religious Studies tackle important questions with rigorous standards, relying on over two millennia of accumulated wisdom.

Philosophy seeks to advance our understanding of ourselves and the nature of reality, mind, knowledge and morality. It is concerned with fundamental questions and critically investigates what other disciplines and other human activities take for granted. Philosophy students at NC State study the writings of great philosophers and recent work on topics such as the relationship between mind and brain, the demands of morality, the justification of political and legal institutions, the relationship between knowledge and reality, and the nature of the logic that structures human language and thought.

Religious Studies does not seek to advance the practice of religion or any particular religion, but to understand religion as a complex and significant human phenomenon. Students majoring in Religious Studies at NC State study the history, texts and practices of both well-known and lesser-known religious traditions as well as a range of theoretical and comparative issues concerning religion, such as the meaning of ritual, the role of gender, the impact of religion in the modern world, and the relationship between religion and conflict.

Both Philosophy and Religious Studies help students to develop their capacity to think critically, constructively and independently, to analyze and solve problems, and to elaborate their ideas and present them in a clear, cogent and well-organized way.

**Opportunities**

The NC State major in Philosophy provides excellent preparation for top graduate programs in Philosophy as well as for professional training in fields as diverse as education, library science, ministry and social work. The major also provides knowledge and skills that are useful for work in many fields, including diplomacy, educating the public, fundraising, journalism, museum projects and public service.

Students majoring in Philosophy or Religious Studies tend to achieve higher scores on objective tests such as the GRE (required for admission to graduate school), the LSAT (required for admission to law school) and the GMAT (required for admission to MBA programs). The majors in Philosophy and Religious Studies are both designed to combine easily with a major in a further discipline that is relevant to a student’s career aspirations. Students who take advantage of this opportunity will enhance their chance of future success.

**Philosophy Honors Program**

The honors program in Philosophy offers an enriching and challenging educational experience to qualified majors. Admission to the program requires completion of nine credits in the major, a 3.66 GPA in the major, and a 3.25 GPA overall. To graduate with Honors in Philosophy, a student must complete a degree in philosophy and in doing so complete the following courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHI 300</td>
<td>Ancient Philosophy</td>
<td>3</td>
</tr>
<tr>
<td>LOG/MA 335</td>
<td>Symbolic Logic</td>
<td>3</td>
</tr>
<tr>
<td>PHI 301</td>
<td>Early Modern Philosophy</td>
<td>3</td>
</tr>
<tr>
<td>PHI 498</td>
<td>Special Topics in Philosophy (taken for the honors thesis, to be evaluated by an honors committee)</td>
<td>3</td>
</tr>
<tr>
<td>At least one other course in the history of philosophy:</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHI 302</td>
<td>19th Century Philosophy</td>
<td></td>
</tr>
<tr>
<td>PHI 310</td>
<td>Existentialism</td>
<td></td>
</tr>
<tr>
<td>PHI 376</td>
<td>History of Ethics</td>
<td></td>
</tr>
<tr>
<td>PHI 401</td>
<td>Kant’s Critique of Pure Reason</td>
<td></td>
</tr>
<tr>
<td>Complete one 3 credit, 400-level PHI course other than PHI 498</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**Total Units:** 18

Graduation requires a 3.66 GPA in the major and a 3.25 GPA overall. Successful completion of the program is noted on the student’s transcript and in the commencement and honors convocation programs.

**Religious Studies Honors Program**

The honors program in Religious Studies guides outstanding majors in independent, critical inquiry of the academic study of religion. Admission to the program requires junior standing, completion of nine hours in the major, and a 3.25 GPA overall and in the major. Honors students must complete at least nine credit hours of honors option course work in Religious Studies (including at least one 400 level course) and write an honors paper as part of an independent study course (REL 498 Special Topics in Religious Studies) which is evaluated by an honors committee.

Graduation requires a 3.25 GPA overall and in the major. Successful completion of the program is noted on the student’s transcript and in the commencement and honors convocation programs.

**Bachelor of Arts in Religious Studies**

The major in Religious Studies consists of 30 credit hours. The courses must include:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>REL 200</td>
<td>Introduction to the Study of Religion</td>
<td>3</td>
</tr>
<tr>
<td>One of the following Non-Western Religious Tradition courses:</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**Bachelor of Arts in Religious Studies**

The major in Religious Studies consists of 30 credit hours. The courses must include:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>REL 200</td>
<td>Introduction to the Study of Religion</td>
<td>3</td>
</tr>
<tr>
<td>One of the following Non-Western Religious Tradition courses:</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>REL 230</td>
<td>South Asian Religious Traditions</td>
<td></td>
</tr>
<tr>
<td>REL 331</td>
<td>The Hindu Tradition</td>
<td></td>
</tr>
<tr>
<td>REL 332</td>
<td>The Buddhist Traditions</td>
<td></td>
</tr>
<tr>
<td>REL 333</td>
<td>Chinese Religions</td>
<td></td>
</tr>
<tr>
<td>REL 334</td>
<td>Japanese Religions</td>
<td></td>
</tr>
<tr>
<td>REL 340</td>
<td>Islam</td>
<td></td>
</tr>
<tr>
<td>REL/HI 407</td>
<td>Islamic History to 1798</td>
<td></td>
</tr>
<tr>
<td>REL/HI 408</td>
<td>Islam in the Modern World</td>
<td></td>
</tr>
</tbody>
</table>

One of the following Western Religious Tradition courses: 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>REL 311</td>
<td>Introduction to the Old Testament</td>
</tr>
<tr>
<td>REL 312</td>
<td>Introduction to the New Testament</td>
</tr>
<tr>
<td>REL 314</td>
<td>Introduction to Intertestamental Literature</td>
</tr>
<tr>
<td>REL 317</td>
<td>Christianity</td>
</tr>
<tr>
<td>REL/HI 320</td>
<td>Religion in American History</td>
</tr>
<tr>
<td>REL 323</td>
<td>Religious Cults, Sects, and Minority Faiths in America</td>
</tr>
<tr>
<td>REL 350</td>
<td>Introduction to Judaism</td>
</tr>
<tr>
<td>REL/HI 402</td>
<td>Early Christianity to the Time of Eusebius</td>
</tr>
<tr>
<td>REL 412</td>
<td>Advanced Readings in the Christian Gospels</td>
</tr>
<tr>
<td>REL 413</td>
<td>The Life and Letters of the Apostle Paul</td>
</tr>
<tr>
<td>REL 423</td>
<td>Religion and Politics in America</td>
</tr>
</tbody>
</table>

One of the following Textual Methods courses: 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>REL 311</td>
<td>Introduction to the Old Testament</td>
</tr>
<tr>
<td>REL 312</td>
<td>Introduction to the New Testament</td>
</tr>
<tr>
<td>REL 314</td>
<td>Introduction to Intertestamental Literature</td>
</tr>
<tr>
<td>REL 412</td>
<td>Advanced Readings in the Christian Gospels</td>
</tr>
<tr>
<td>REL 413</td>
<td>The Life and Letters of the Apostle Paul</td>
</tr>
<tr>
<td>REL 491</td>
<td>Advanced Readings in Theological and Religious Literature</td>
</tr>
</tbody>
</table>

One of the following Historical Methods courses: 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>REL 230</td>
<td>South Asian Religious Traditions</td>
</tr>
<tr>
<td>REL 317</td>
<td>Christianity</td>
</tr>
<tr>
<td>REL/HI 320</td>
<td>Religion in American History</td>
</tr>
<tr>
<td>REL 331</td>
<td>The Hindu Tradition</td>
</tr>
<tr>
<td>REL 332</td>
<td>The Buddhist Traditions</td>
</tr>
<tr>
<td>REL 333</td>
<td>Chinese Religions</td>
</tr>
<tr>
<td>REL 334</td>
<td>Japanese Religions</td>
</tr>
<tr>
<td>REL 340</td>
<td>Islam</td>
</tr>
<tr>
<td>REL 350</td>
<td>Introduction to Judaism</td>
</tr>
<tr>
<td>REL/HI 402</td>
<td>Early Christianity to the Time of Eusebius</td>
</tr>
<tr>
<td>REL/HI 407</td>
<td>Islamic History to 1798</td>
</tr>
<tr>
<td>REL/HI 408</td>
<td>Islam in the Modern World</td>
</tr>
</tbody>
</table>

One of the following Critical/Theoretical Methods courses: 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>REL 323</td>
<td>Religious Cults, Sects, and Minority Faiths in America</td>
</tr>
<tr>
<td>REL 327</td>
<td>Issues in Contemporary Religion</td>
</tr>
<tr>
<td>REL 383</td>
<td>Religion, Globalism, and Justice</td>
</tr>
<tr>
<td>REL 423</td>
<td>Religion and Politics in America</td>
</tr>
<tr>
<td>REL/STS 471</td>
<td>Darwinism and Christianity</td>
</tr>
<tr>
<td>REL/WGS 472</td>
<td>Women and Religion</td>
</tr>
<tr>
<td>REL/WGS 473</td>
<td>Religion, Gender, and Reproductive Technologies</td>
</tr>
<tr>
<td>REL 482</td>
<td>Religion and Conflict</td>
</tr>
<tr>
<td>REL 489</td>
<td>Interpretations of Religion</td>
</tr>
</tbody>
</table>

9 hours of advanced Religious Studies courses (REL 4**) 9

Religious Studies Elective 3

Total Units 30

**Bachelor of Arts in Philosophy**

Candidates for the Bachelor of Arts in Philosophy must complete 30 hours in philosophy, including the three hours in philosophy required for all CHASS students.

Two of the following courses in development of Western philosophical thought courses: 6

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHI 300</td>
<td>Ancient Philosophy</td>
</tr>
<tr>
<td>PHI 301</td>
<td>Early Modern Philosophy</td>
</tr>
<tr>
<td>PHI 302</td>
<td>19th Century Philosophy</td>
</tr>
<tr>
<td>PHI 401</td>
<td>Kant's Critique of Pure Reason</td>
</tr>
</tbody>
</table>

One of the following logic courses: 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOG 201</td>
<td>Logic</td>
</tr>
<tr>
<td>LOG/MA 335</td>
<td>Symbolic Logic</td>
</tr>
<tr>
<td>LOG 435</td>
<td>Advanced Logic &amp; Metamathematics</td>
</tr>
<tr>
<td>LOG 437</td>
<td>Model Theoretic Semantics</td>
</tr>
</tbody>
</table>

One of the following value theory courses: 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHI 309</td>
<td>Contemporary Political Philosophy</td>
</tr>
<tr>
<td>PHI 313</td>
<td>Ethical Problems in the Law</td>
</tr>
<tr>
<td>PHI/STS 325</td>
<td>Bio-Medical Ethics</td>
</tr>
<tr>
<td>PHI 375</td>
<td>Ethics</td>
</tr>
<tr>
<td>PHI 376</td>
<td>History of Ethics</td>
</tr>
<tr>
<td>PHI 420</td>
<td>Global Justice</td>
</tr>
<tr>
<td>PHI 475</td>
<td>Ethical Theory</td>
</tr>
</tbody>
</table>

One of the following contemporary philosophy courses: 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHI 330</td>
<td>Metaphysics</td>
</tr>
<tr>
<td>PHI 331</td>
<td>Philosophy of Language</td>
</tr>
<tr>
<td>PHI 332</td>
<td>Philosophy of Psychology</td>
</tr>
<tr>
<td>PHI 333</td>
<td>Knowledge and Skepticism</td>
</tr>
<tr>
<td>PHI 425</td>
<td>Introduction to Cognitive Science</td>
</tr>
<tr>
<td>PHI 440</td>
<td>The Scientific Method</td>
</tr>
<tr>
<td>PHI 447</td>
<td>Philosophy, Evolution and Human Nature</td>
</tr>
</tbody>
</table>

All three of the following one-credit courses in research writing

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHI 494</td>
<td>Research and Writing in Ethics</td>
</tr>
<tr>
<td>PHI 495</td>
<td>Research and Writing in History of Philosophy</td>
</tr>
<tr>
<td>PHI 496</td>
<td>Research and Writing in Contemporary Philosophy</td>
</tr>
</tbody>
</table>

Four additional LOG or PHI courses (Note that PHI 205 and PHI 210 may not both be used toward this requirement) 12

Total Units 30

**Major in Philosophy with a Concentration in Ethics**

The concentration requires 30 hours in philosophy, including the three hours in philosophy required of all CHASS students.

Two of the following courses in development of Western philosophical thought: 6

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHI 300</td>
<td>Ancient Philosophy</td>
</tr>
</tbody>
</table>
Major in Philosophy with a Concentration in Philosophy of Law

The concentration requires 30 hours, including the three hours of philosophy required of all CHASS students.

PHI 309  Contemporary Political Philosophy  3
PHI 312  Philosophy of Law  3
PHI 313  Ethical Problems in the Law  3

One of the following value theory courses:  3
PHI 375  Ethics
PHI 376  History of Ethics
PHI 475  Ethical Theory

One of the following courses in development of Western philosophical thought:  3
PHI 300  Ancient Philosophy

Bachelor of Science in Philosophy

Candidates for the Bachelor of Science in Philosophy must complete 30 hours in philosophy, including the three hours in philosophy required for all CHASS students.

Two of the following courses in development of Western philosophical thought:  6
PHI 300  Ancient Philosophy
PHI 301  Early Modern Philosophy
PHI 302  19th Century Philosophy
PHI 401  Kant’s Critique of Pure Reason

One of the following logic courses:  3
LOG 201  Logic

One of the following logic or practical reasoning courses:  3
LOG 201  Logic
LOG 435  Advanced Logic & Metamathematics
LOG 437  Model Theoretic Semantics

One of the following value theory courses:  3
PHI 309  Contemporary Political Philosophy
PHI 313  Ethical Problems in the Law
PHI/STS 325  Bio-Medical Ethics

One of the following courses in development of Western philosophical thought:  3
PHI 300  Ancient Philosophy
PHI/PSY 425  Introduction to Cognitive Science
PHI 440  The Scientific Method
PHI 447  Philosophy, Evolution and Human Nature
One of the following philosophy of science: 3
PHI 340  Philosophy of Science
PHI 440  The Scientific Method
PHI 447  Philosophy, Evolution and Human Nature
All three of the following one-credit courses in research and writing: 3
PHI 494  Research and Writing in Ethics
PHI 495  Research and Writing in History of Philosophy
PHI 496  Research and Writing in Contemporary Philosophy
Three additional LOG or PHI courses (note that PHI 205 and PHI 210 may not both be used toward this requirement) 9

**Total Units** 33

**Major in Philosophy with a Concentration in Logic, Representation and Reasoning**

The concentration requires 30 hours, not including the three hours of philosophy required of all CHASS students.

PHI 301  Early Modern Philosophy 3
PHI 375  Ethics 3
One of the following courses in development of Western philosophical thought:
PHI 300  Ancient Philosophy
PHI 302  19th Century Philosophy
PHI 401  Kant's Critique of Pure Reason
Three of the following courses in logic, language and cognitive science:
LOG/MA 335  Symbolic Logic
LOG 435  Advanced Logic & Metamathematics
LOG 437  Model Theoretic Semantics
PHI 331  Philosophy of Language
PHI/PSY 425  Introduction to Cognitive Science
One of the following courses in the philosophy of science: 3
PHI 440  The Scientific Method
PHI 447  Philosophy, Evolution and Human Nature
Two of the following courses in logic and cognitive philosophy: 6
LOG 201  Logic
LOG/MA 335  Symbolic Logic
LOG 435  Advanced Logic & Metamathematics
LOG 437  Model Theoretic Semantics
PHI 330  Metaphysics
PHI 331  Philosophy of Language
PHI 332  Philosophy of Psychology
PHI 333  Knowledge and Skepticism
PHI/PSY 425  Introduction to Cognitive Science
PHI 440  The Scientific Method
PHI 447  Philosophy, Evolution and Human Nature
Both of the following one-credit courses in research and writing: 2
PHI 496  Research and Writing in Contemporary Philosophy

**Total Units** 32

**Minor in Philosophy**

Students who take a Minor in Philosophy are required to complete with a grade of C or better 15 hours of courses in selected fields in philosophy, including a course in the history of philosophy (3 credit hours), a course in normative (ethics and ethics-related) philosophy (3 credit hours), a course other than one in normative philosophy, but not including logic or the history of philosophy (3 credit hours). Please see the Department for course requirements.

**Minor in Religious Studies**

Students who take a Minor in Religious Studies are required to complete with a grade of C or better fifteen hours of courses in selected fields of religious studies. In order to ensure a wide study of the field, students are required to select at least one course in each of the following categories: (A) Historical Methods, (B) Textual Methods, and (C) Critical/Theoretical Methods; and also complete (D) 6 elective hours in REL courses. As part of these requirements, it is expected that at least one of these classes focus on Western religious traditions and at least one on non-Western religious traditions. Please see the Department for course requirements.

**Minor in Cognitive Science**

Students who take a Minor in Cognitive Science must complete 15 hours of courses with a grade of C or better, where at least three of the five participating disciplines are represented: Psychology, Neurobiology, Computer Science, Linguistics, and Philosophy (including Logic). Please see the Department for course requirements.

**Minor in Logic and Methodology**

Students who take a Minor in Logic and Methodology are required to complete with a grade of C- or better 15 hours of courses (with an overall average of 2.0 in these courses). Please see the Department for course requirements.

**Minor in Ethics**

Students who take a Minor in Ethics are required to complete with a grade of C or better 15 hours of courses. Please see the Department for course requirements.

**Minor in Health, Medicine, and Human Values**

Students who take a Minor in Health, Medicine, and Human Values are required to complete with a grade of C- or better 15 hours of courses (with an overall average of 2.0 in these courses). Please see the Department for course requirements.
Department of Psychology

Psychology

Psychology is one of the basic majors in liberal arts and sciences. Psychologists use the methodology of science to study human behavior and experience. A bachelor's degree in psychology forms an excellent foundation for careers in psychology, as well as business and government. It will also enhance life skills such as parenting and human social interaction. Students can also use this degree as an entry into further education leading to an advanced degree in applied or experimental psychology, or to such fields as law, medicine, business or social work.

Curriculum in Psychology

A Psychology degree is oriented toward the student who wants a broad understanding of the types of problems with which psychology is concerned and the ways in which psychologists approach and attempt to solve these problems. Curriculum requirements are sufficiently flexible for students to concentrate, if they wish, in another area of study as well as psychology, and thereby prepare themselves for a variety of careers or professional programs. By wise choice of elective courses, a student can prepare for medical, legal, business, or education graduate training, while at the same time acquire a basic background in the social sciences.

Specific curriculum requirements are available on the Registration and Records website.

Psychology Club

All undergraduate majors are members of the Psychology Club, which provides a number of enrichment activities. There is also an active chapter of Psi Chi, the national psychology honor society, which provides enrichment to the program.

Minor in Psychology

The Department of Psychology offers a minor in psychology to majors in any field except psychology. To complete the minor, eighteen hours of courses are required, six of these hours in the basic science of psychology, and nine in the applied aspects of psychology. PSY 200 Introduction to Psychology is a required prerequisite and the student must have passed this course with a grade of B- or better. PSY 230 is also a required course. To be eligible for the psychology minor, students must have passed BIO 105 Biology in the Modern World/BIO 106 Biology in the Modern World Laboratory with a grade of "C" (not C-) or better. The student must also have an overall GPA of 2.5.

Specific requirements for a minor in Psychology are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Minor in Cognitive Science

The Departments of Psychology and Philosophy and Religion offer an interdisciplinary minor in cognitive science. The minor provides a general introduction to contemporary interdisciplinary research within the framework of the “computer model” mind, and offers the student the opportunity for in-depth study of selected topics of such as the nature of human information processing, and the acquisition and use of machine intelligence.

Students who take a Minor in Cognitive Science must complete 15 hours of courses with a grade of C or better, where at least three of the five participating disciplines are represented: Psychology, Neurobiology, Computer Science, Linguistics, and Philosophy (including Logic). Please see the Department for course requirements.

Specific requirements for a minor in Cognitive Science are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

School of Public and International Affairs

The Department of Political Science, part of the School for Public and International Affairs, offers basic and advanced courses in all major fields of the discipline: American government and politics (local, state, and national), public law and criminal justice, public administration, comparative politics, international relations and global issues, political theory, and methodology of political science. The department affords opportunities for the study of government and administration to students in other curricula and schools.

Graduate courses in public administration and international studies are available to advanced undergraduates. See the listing of graduate degree programs and consult the Graduate Catalog.

The department provides academic credit for internships with political parties and campaigns, lobbyists, non-profits, and all levels of government, including the North Carolina General Assembly Legislative Internship Program. Majors in political science with distinguished academic achievements are annually invited to join the Zeta Epsilon Chapter of Pi Sigma Alpha, the national political science honor society.

Opportunities

A degree in political science is excellent preparation for a number of careers and graduate opportunities. Political science majors study critical issues surrounding such things as international security, public policy, and government practices. They develop real-world skills such as solving problems logically and systematically, working with others in vertically and horizontally organized arrangements, expressing a position and defending it with corroborating evidence, and writing clear and correct prose. They also develop citizenship and leadership competencies that include the personal obligation to participate in public life. Consequently, political science majors are well-positioned for careers in teaching, the legal profession, criminal justice agencies, state and local government, urban planning, the federal bureaucracy, journalism or in any of the organizations that seek to monitor political processes or to influence the content of public policy. Private firms also seek managers and public affairs specialists who have a knowledge of the functioning of the political system and of politics in general.

For more information, see the Political Science website. (http://spia.ncsu.edu)

Honors Program

The honors program includes nine credit hours of specialized coursework designed to challenge academically talented majors and allow them to realize their greatest potential as political science students. Required for admission to the program: 3.25 GPA both overall and in the major, completion of 9 hours of PS coursework, and completion of PS 371 Research Methodology of Political Science. Majors admitted to the
program complete a substantial research project in consultation with a faculty honors adviser (6 credit hours). Also required: either one 500 level PS course or an honors option 400 level political science course (3 credit hours). Successful completion of the program is noted on the student’s transcript, and at commencement.

Curricula

Bachelor of Arts in Political Science

Major requirements are: 19 hours of core courses that cover major political science sub fields (i.e., American government, international relations, theory, public law and policy, and research methods) as well as courses that develop computer competencies and an orientation to the discipline; 15 hours of political science electives, 12 of which must be taken at the 300 level or above, and one of which must be a 400 level senior seminar, which includes a substantial research requirement. Grades of C- or better are required for courses applied towards the major. At graduation, a minimum GPA of 2.0 is required for all political science courses taken. For a semester-by-semester guide to the course requirements for the Bachelor of Arts curriculum, including all of the concentrations described below, see the departmental website (http://spia.ncsu.edu/ps/undergraduate.html).

Students who wish to focus their studies in a specific sub field may elect one of the following concentrations under the Bachelor of Arts program:

American Politics

This concentration develops skills that benefit students interested in graduate and professional school, administrative careers, and business careers that involve government relations and policy. Major requirements are: 21 hours of core courses; 9 hours of courses specifically related to the study of political processes, institutions, political culture, and political events within the American system.

International Politics

This concentration develops skills that benefit students interested in graduate or professional school, careers in government service, international organizations, issue advocacy, and businesses with international interests. Major requirements are: 15 hours of core courses; 12 hours of concentration electives in regional and world politics; 3 hours of concentration electives in any political science sub-field.

Law and Justice

This concentration develops skills that benefit students interested in graduate or professional school (particularly law school) , law enforcement, judicial administration, and careers with agencies involved in the administration of justice. Major requirements are: 18 hours of core courses; 12 hours of emphasis electives in either the justice system or law and theory.

Public Policy

This concentration prepares students for careers with public institutions where they will work with the processes, formulation, implementation, and evaluation of public policy at international, national, state, and local levels. Major requirements are: 15 hours of core courses; 15 hours of concentration electives.

Bachelor of Science in Political Science

Major requirements are 27 hours of political science coursework. At least 6 hours must be taken from each of the following groups: Group A-American politics/or public policy and administration; Group B-

international affairs/comparative politics; and Group C- political theory/scientific methods. At least 18 hours of coursework must be at the 300 level or higher. At least 6 hours of coursework must be at the 400 or 500 level, including one course that is designated as a senior seminar. Grades of C- or better for courses applied towards the major with a minimum GPA of 2.0 for all political science requirements for the Bachelor of Science curriculum, see the Political Science website (http://spia.ncsu.edu/ps/undergraduate.html).

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Minor in Political Science

Minor requirements are 15 hours of political science coursework with grades of C- or better in each course and a cumulative GPA of 2.0 for all political science courses. A minimum of 12 hours must be taken at the 300 level or above, including one 400 level senior seminar. Coursework must cover at least two of the following three groups:

1. American politics/or public policy and administration
2. International affairs/comparative politics
3. Political theory/scientific methods

Minor in Law and Justice

Minor requirements are 15 hours of political science coursework with grades of C- or better in each course and a cumulative GPA of 2.0 for all political science courses. These 15 hours must include: PS 205 Law and Justice; 12 hours of elective courses, at least one of which must be a 400 level seminar or a 500 level graduate course in political science. This minor program is designed for students who have a special interest in the areas of public law, criminal justice and political theory.

Department of Social Work

The Department of Social Work offers the Bachelor of Social Work (BSW) degree, which is accredited by the Council on Social Work Education. Students complete a curriculum based on the liberal arts that incorporates a professional foundation, including social work practice, human behavior and diversity, community social services, social policy, and research methods. Optional courses offer opportunities to study in depth various social work practice areas such as child welfare, aging, health care, addiction recovery, African American families, school social work, people who are homeless, soldiers/veterans/families, and a 7-week study abroad program in Guatemala. Students complete three 40-hour pre-professional placements and a 420-hour field placement in a social service setting. A minor in Social Work is available; an MSW (Master of Social Work) degree is available.

The mission of the Department of Social Work is to prepare students for entry-level generalist professional practice with diverse populations in urban and rural areas of North Carolina. The program uses a framework that advances cultural respect, human rights, and social and economic justice and contributes to the empowerment of individuals, families, groups, and communities that experience oppression and discrimination. The program also prepares students for advanced graduate-level academic work. The curriculum is a liberal arts base that includes English, literature, history, natural science, math and statistics, foreign language, philosophy, social sciences, physical education, diversity, global perspectives, interdisciplinary perspectives, and free electives. Forty-three hours of core social work courses and 3 hours of social work electives complete the 121 hour graduation requirement. Enrollment in
practice and field classes is limited to social work majors, and no credit towards the social work degree is given for student life experiences.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Opportunities

Social work is an exciting, challenging, and dynamic profession. No matter what the political climate or the changing nature of personal or social need, social workers will be in demand. The BSW Program provides students with the knowledgeable, values, and skills to respond competently to:

1. The aspirations and service needs of diverse client populations
2. The contexts that shape the needs of clients and service delivery systems throughout the state.

Social workers are employed in a variety of settings which include health care, mental health, services to the aging, child welfare, public welfare, addictions recovery, public schools, developmental disabilities, and many other public and private settings. In each of these areas there is recognition for professional preparation, and the BSW graduate will be prepared to embark upon a career in his or her chosen field. All states, including North Carolina, have licensing or certification procedures for social work practice. Graduation from the Department of Social Work makes the student eligible for such licensing or certification.

Minor in Social Work

The minor is designed to familiarize students with the social service system, major social welfare programs, and elements of the profession of social work. The student takes four required courses and selects one additional course from elective offerings, which represent the contribution of professional social work in a number of settings.

Student Organizations

Baccalaureate Student Social Work Association (BSSWA) is open to all majors and gives students the chance to interact with other Social Work majors and practitioners in the community to share concerns and ideas and to undertake fund-raising and service projects for the community. It is an organization run by students and aims to help students enhance professional development and promote human dignity.

Phi Alpha Honor Society is national honor society for social work students. A BSW student is eligible for membership after achieving national and local chapter requirements which include having sophomore status, achieving a 3.0 overall grade point average and a 3.25 grade point average in required social work courses, successfully completing the application to the professional sequence, and completing 9 hours of social work courses.

Application to the Professional Sequence

The social work faculty is committed to helping all students evaluate career goals and objectives to ensure that the students meet minimum academic standards; have goals and objectives compatible with the major; and know specifically what the profession of social work is in terms of its philosophy, value base, and fields of practice. Once students are admitted to the BSW Program, either through admission to the university or internal/external transfer, the students complete the application to the professional sequence. The application to the professional sequence process is intended to strengthen the student’s certainty regarding career choice and to enhance the student’s focus and sense of purpose in curriculum planning. Specific components of the application process include:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW 290</td>
<td>The Development of Social Welfare and Social Work in the U.S.</td>
<td>3</td>
</tr>
<tr>
<td>SW 307</td>
<td>Social Welfare Policy: Analysis and Advocacy</td>
<td>3</td>
</tr>
<tr>
<td>SW 310</td>
<td>Human Behavior Theory for Social Work Practice</td>
<td>3</td>
</tr>
<tr>
<td>SW 312</td>
<td>Multicultural Social Work</td>
<td>3</td>
</tr>
</tbody>
</table>

1. Applicant must be a current social work major;
2. Completion with a grade of B- or better in two of the following courses:
3. Completion of the application to the professional sequence
4. Completion of a personal interview with the Department Student Review Committee if requested. The Department of Social Work Student Handbook spells out further details of this procedure, as well as other elements of the department.

Child Welfare Education Collaborative

The NC Child Welfare Education Collaborative strengthens public child welfare services in the state by increasing the number and diversity of well trained and highly committed BSWs and MSWs working in local Departments of Social Services. Any BSW student interested in a course of study leading to employment and leadership in public child welfare is eligible to apply for the program. Candidates for the $3400 /semester service awards (provided during the student’s last two semesters) must have completed the application to the professional sequence and agree to work in child welfare in a county Department of Social Services in North Carolina for up to 1 year following graduation. Further information about the Collaborative Program is available online.

Department of Sociology and Anthropology

The Department of Sociology and Anthropology offers introductory and advanced courses in sociology and anthropology covering the major sub-fields of the two disciplines. It also offers supervised fieldwork and practical experiences required for certain curricula in the department.

Aims of the departmental offerings are to provide majors with academic background and experience useful for many careers in government, business and nonprofit organizations or for pursuing advanced academic work (for a description of the graduate degrees offered by the department, see the Graduate Catalog (http://www.ncsu.edu/grad/catalog)) and to provide service courses to other students.

The department, administered by the College of Humanities and Social Sciences, offers three undergraduate majors: Bachelor of Arts in Sociology, Bachelor of Arts in Criminology, and Bachelor of Arts in General Anthropology.

Honors Program

In this program, outstanding majors pursue an individual program of study involving close working relations with departmental faculty. Twelve credit hours of honors courses will allow students to enhance their expertise in sociology, criminology, and anthropology. Honors courses combine nine
hours of credit in regular classes with a three-credit honors thesis done as an independent study in consultation with a faculty honors adviser.

To be admitted, students must have earned 12 hours in their major and have a 3.25 overall GPA and a 3.25 in the major. To graduate with Sociology/Criminology/Anthropology Honors, the student must have a 3.25 GPA overall and in the major. Successful completion of the program is noted on the student’s transcript diploma and at commencement.

**Bachelor of Arts in Sociology**

Sociology studies the behavior and interaction of people as they operate in society. The groups that people form, such as families, peers, ethnic groups, social classes, and formal organizations, are investigated.

The following departmental requirements must be met by all students majoring in sociology: A minimum of 31 hours in the major field including:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOC 202</td>
<td>Principles of Sociology</td>
<td>3</td>
</tr>
<tr>
<td>SOC 300</td>
<td>Social Research Methods</td>
<td>4</td>
</tr>
<tr>
<td>SOC 400</td>
<td>Theories of Social Structure</td>
<td>3</td>
</tr>
<tr>
<td>or SOC 401</td>
<td>Theories of Social Interaction</td>
<td></td>
</tr>
<tr>
<td>3 additional sociology courses at the 300 level or higher</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>3 additional sociology courses at the 400 level or higher</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>1 additional Sociology elective at any level</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**Total Units** 34

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

**Bachelor of Arts in Anthropology**

The Anthropology major introduces students to anthropology with basic and advanced offerings in the subfields of the discipline: cultural anthropology, biological anthropology, linguistic anthropology, and archaeology. The comparative basis of anthropology is reflected in courses focused on a variety of geographical area and the biological basis of anthropology is explored through a series of bioarchaeology and forensic anthropology courses. Theory and methods are required. An anthropology internship is also offered.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANT 251</td>
<td>Physical Anthropology</td>
<td>3</td>
</tr>
<tr>
<td>ANT 252</td>
<td>Cultural Anthropology</td>
<td>3</td>
</tr>
<tr>
<td>ANT 253</td>
<td>Unearthing the Past: Introduction to World Archaeology</td>
<td>3</td>
</tr>
<tr>
<td>or ANT 254</td>
<td>Language and Culture</td>
<td></td>
</tr>
<tr>
<td>ANT 411</td>
<td>Overview of Anthropological Theory</td>
<td>3</td>
</tr>
<tr>
<td>Research Methods</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>ANT 389</td>
<td>Fundamentals of Archaeological Research</td>
<td></td>
</tr>
<tr>
<td>ANT 416</td>
<td>Research Methods in Cultural Anthropology</td>
<td></td>
</tr>
<tr>
<td>ANT 419</td>
<td>Ethnographic Field Methods</td>
<td></td>
</tr>
<tr>
<td>ANT 429</td>
<td>Advanced Methods in Forensic Anthropology</td>
<td></td>
</tr>
<tr>
<td>1 300-level ANT course</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>1 400-level ANT course</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>ANT General Electives (3 courses at the 300 or 400 level)</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

**Bachelor of Arts in Criminology**

The Criminology degree seeks to develop a professional orientation that will be relevant both to occupational goals and participation as a citizen in community affairs. Courses provide a general background in the causes of crime and the agencies of criminal justice. More specific areas covered deal with deviance, juvenile delinquency, the court system, and correctional facilities. Students complete a 120 hour internship with a criminal justice field agency during their senior year.

<table>
<thead>
<tr>
<th>Course</th>
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</thead>
<tbody>
<tr>
<td>SOC 202</td>
<td>Principles of Sociology</td>
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<td>SOC 300</td>
<td>Social Research Methods</td>
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</tr>
<tr>
<td>SOC 400</td>
<td>Theories of Social Structure</td>
<td>3</td>
</tr>
<tr>
<td>or SOC 401</td>
<td>Theories of Social Interaction</td>
<td></td>
</tr>
<tr>
<td>2 sociology courses at the 300 level or higher</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>3 criminology electives at the 400 level or higher</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>1 criminology-related Political Science course</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>1 additional Sociology elective at any level</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>SOC 413</td>
<td>Criminal Justice Field Work</td>
<td>4</td>
</tr>
<tr>
<td>ST 311</td>
<td>Introduction to Statistics</td>
<td>3</td>
</tr>
</tbody>
</table>

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

**Minor in Anthropology**

A minor in Anthropology focuses on the comparative study of human beings, with emphasis on biology and behavior. A flexible selection of courses (15 credit hours) includes offerings from anthropological sub-disciplines such as cultural anthropology, physical anthropology, archaeology, and linguistics.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

**Minor in Criminology**

The criminology minor emphasizes criminological theory and research. The minor is grounded in sociological theory and methods and allows students flexibility in the choice of specialized criminological study such as juvenile delinquency, sociology of law, formal institutions of social control, community and crime, and data analysis in criminology.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

**Minor in Sociology**

This minor emphasizes sociological theory and research with substantive applications. The minor builds on theory and methodology and allows students flexibility in the choice of sub-specialties such as stratification, race and ethnic relations, agriculture, development, work and organization, or the family.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

**Poole College of Management**

2150 Nelson Hall
Box 8614
Raleigh, NC 27695-8614
Phone: (919) 515-5565
New freshmen enter the college as "Management Undeclared" majors; during their third semester, students declare the degree program they choose to pursue. Transfer students matriculate directly into their chosen degree program.

The **Accounting** program provides a general business foundation with a depth of specialization in accounting issues and skills. Students develop interpersonal, teamwork and problem-solving skills, and learn how to apply technology in the accounting field. The curriculum includes financial and managerial accounting, taxation, business law and ethics, auditing and accounting information systems. Four concentrations are offered: financial analysis, information systems, managerial accounting, and internal auditing. Outstanding students completing the Bachelor of Science in Accounting program may choose to apply directly to the Master of Accounting (MAC) program, earning the graduate degree with just one additional year of coursework. Successful completion of the graduate program qualifies students to sit for the Certified Public Accounting (CPA) exam.

The **Business Administration** curriculum focuses on integrating knowledge of all the core business functions through a strategic management lens, coupled with depth of expertise in one concentration area of specialization. All students take foundation courses in finance, marketing, human resource management, business law, supply chain/operations management, information systems and strategic management, and select a concentration area of focus from one of the following: entrepreneurship, finance, human resource management, information technology, marketing, and operations/supply chain management. The curriculum emphasizes computer skills and the application of information technology, teamwork, problem-solving and ethical and critical thinking for decision making in a global strategic context.

The **Economics** program provides a broad education in the liberal arts with a specialization in economic theory and application. Students can select the Bachelor of Arts in Economics degree, which provides more liberal arts courses, or the Bachelor of Science in Economics, with a greater focus on business, mathematics, statistics, and science. The economics programs are flexible, and with thoughtful advance planning, students can easily pursue an economics degree along with a minor or even a second major in another academic area.

For those interested in advanced studies, the college also offers graduate degrees: Master of Accounting, Master of Economics, Master of Business Administration, Master of Global Innovation Management, Master of Global Luxury Management and Doctorate in Economics.

### Dual Degree International Programs

The Poole College of Management is committed to offering a variety of international opportunities for our students. From specialized Poole-sponsored summer international programs, to semester and full-year study abroad programs, to unique dual-degree options, Poole students are offered a world of choice in international study.

Hamilton Scholars ([http://poole.ncsu.edu/undergraduate/global/alexander-hamilton-scholars](http://poole.ncsu.edu/undergraduate/global/alexander-hamilton-scholars)) is a dual degree program offered collaboratively between the Poole College of Management and the College of Humanities and Social Sciences (CHASS). In four years, students can complete two degrees: one from the Poole College of Management in either Accounting, Business Administration or Economics and the second from CHASS in International Studies. The Hamilton Scholars program includes extracurricular activities and requires at least one study abroad experience. Graduates of the program are prepared to function successfully in cross-cultural corporate settings.
The International Business Dual Degree Program (http://poole.ncsu.edu/undergraduate/global/internationaldualdegrees/internationalbusinessdualdegree) provides an even richer opportunity for international immersion and study. In this program, students spend their first two years studying at NC State University, then the next two years studying at one of our partner universities in Germany, France, or Italy. Students complete two internships: one in each country. Upon completion of the four-year program, students earn a Bachelor of Science in Business Administration from NC State University and a bachelor’s degree in International Business from the partner institution. Graduates of the program are highly-sought for international positions, both domestic and global.

For more information on Poole international dual degree programs, visit the Poole College of Management's website (http://poole.ncsu.edu).

Academic Minors

Students enrolled in other majors at NC State may choose to minor in accounting, business administration, or economics. Visit the "Opportunities for Minors" page on the Poole College of Management's website (http://poole.ncsu.edu/undergraduate/academics/minors) for additional information.

Student Organizations

Numerous student organizations are housed in the Poole College to provide undergraduate students a wide range of exposure to business in practice. Students are encouraged to become active in the clubs and organizations aligned with their chosen major and/or concentration in order to develop networking skills and professional contacts. Student organizations are also a valuable source of service and professional development experiences, and provide undergraduates a wide range of leadership development opportunities. Visit the Poole College of Management's website (http://poole.ncsu.edu/undergraduate/academics/minors) for additional information.

Student Services

The Poole College of Management is committed to providing the support services to enable our students to succeed. Our team of full-time professional advisors provides comprehensive academic advising services to undergraduate students from freshman through senior year; our international programs staff supports student exploration of appropriate global experiences during their academic career; our career development staff is dedicated to helping students pursue internships during their academic program and career positions upon graduation.

Scholarships

Through the generous support of alumni, friends and corporate partners, the Poole College of Management offers a limited number of highly competitive scholarships to our current and incoming students, in addition to any available university-wide awards. Please visit the Poole College of Management's website (http://poole.ncsu.edu/undergraduate/academics/minors) for additional information and a list of additional resources for possible financial support. Students are encouraged to contact the University's Office of Scholarships and Financial Aid for more information and assistance in planning the financing of their college costs.

Admission to the Poole College of Management

Admission to the Poole College of Management is quite competitive. To learn more about admission requirements and how to apply to the Poole College of Management, see the Poole College admission page (http://poole.ncsu.edu/undergraduate/admissions).

Department of Accounting

The accounting program provides education and training to individuals who plan to pursue careers as professional accountants in consulting, business, government, and industry. The Department of Accounting offers Bachelor of Science and Master of Accounting degrees. The Bachelor of Science degree requires the student to specialize in one of four concentrations: information systems, financial analysis, managerial accounting or internal auditing. The Master of Accounting (MAC) degree program produces more specialized accounting professionals and responds to the American Institute of Certified Public Accountants mandated 150-hour education requirement for certification.

The curriculum consists of a general foundation in humanities, social science, science and mathematics; a comprehensive business core; a complete accounting core; and a concentration in a functional accounting area.

Opportunities

The field of accounting deals with identifying, measuring and communicating information to assist individuals and companies in making informed economic decisions. Accounting provides students with excellent career opportunities. Individuals graduating with an accounting degree can expect to be exposed to all aspects of an organization from a broad top-down perspective.

Curriculum and Degree Requirements

All accounting majors are subject to the department’s residency requirement: a minimum of 30 credit hours of course work after being formally admitted to the B.S. degree program in Accounting (or the B.S. in Business Administration). In addition, accounting majors must complete at least 30 hours of major courses and specified accounting courses in residency at NC State.

Minor in Accounting

The Accounting Minor is offered to students interested in gaining a basic knowledge of accounting to supplement another degree, or to prepare for a graduate program in Accounting.

For additional information, view the "Opportunities for Minors" page on the Poole College of Management’s website (http://poole.ncsu.edu/undergraduate/academics/minors).
Department of Business Management & Department of Management, Innovation and Entrepreneurship

Department of Business Management & Department of Management, Innovation and Entrepreneurship

The Bachelor of Science degree in Business Administration is offered jointly by the Departments of Business Management and Management, Innovation and Entrepreneurship. This degree program prepares students for careers in business, consulting, government, or nonprofit organizations as well as for graduate study in business, law, and related fields. The curriculum focuses on strategic integration of the core business functions. All students study finance, marketing, supply chain, human resource management and information technology before declaring a specific concentration for more in-depth study. Concentration areas are listed below:

- Entrepreneurship
- Finance
- Human Resource Management
- Information Technology
- Marketing
- Operations/Supply Chain Management

Opportunities

Graduates in business administration are prepared for a variety of careers in business or industry including new product development, marketing, manufacturing, human resources, IT management, business analysis, banking and finance, consulting, and business development. They have the knowledge and tools to launch new business ideas and succeed in management positions.

Curriculum and Degree Requirements

All business administration majors are subject to the department’s residency requirement: a minimum of 30 credit hours of course work after being formally admitted to the B.S. degree program in Business Administration (or the B.S. in Accounting). In addition, business administration majors must complete at least 30 hours of major courses while in residency at NC State.

Minor in Business Administration

The Business Administration minor is offered to students interested in gaining a basic knowledge of business practice to supplement another degree. As an option, students may complete a focus in Entrepreneurship within the Business Administration minor.

Students must apply for admission to the Business Administration minor program. Enrollment in upper-level business courses is restricted to students enrolled in either the degree or minor program. For information and an application visit the "Opportunities for Minors" page on the Poole College of Management’s website. (http://poole.ncsu.edu)

Department of Economics

The Department of Economics offers both Bachelor of Arts and Bachelor of Science degrees in Economics. An undergraduate program in economics prepares a student for careers in business and government as well as for many graduate and professional degree programs.

Economics students can develop their understanding of economic issues in a variety of areas including financial institutions, international trade and finance, labor and industrial relations, health care economics, environmental and natural resource economics, public finance, and economic history.

A degree in economics provides rigorous analytical training with a broad understanding of the workings of the global economic system. Its flexibility allows students to tailor their education to specific interests and career goals.

Opportunities

An undergraduate degree in economics has long served as the foundation for advanced professional degrees in law and business, graduate study in economics, as well as jobs in business, industry and government.

Curricula and Degree Requirements

The Bachelor of Arts in Economics is a broad and flexible program of study. The major course work for the B.A. in Economics includes courses in economic theory, mathematics and statistics as well as courses in advanced, applied economics. The program provides for substantial flexibility, so students may tailor their studies to their particular interests and long-term goals.

The Bachelor of Science in Economics emphasizes training in analytical methods in economics. It differs from the Bachelor of Arts by placing greater emphasis on courses in mathematics, science, and statistics.

Honors Program

The Honors Program in Economics is designed for academically talented and motivated students who desire a richer educational experience than offered in regular courses. The primary goal of this program is to help students develop the ability to apply economic analysis to a variety of issues at the individual, corporate, and government level.

Class size is kept small in honors sections to accommodate discussion and interaction among students and with the instructor. Students graduating with honors in economics are well prepared for graduate or professional school or for entering the private or public sector job market.

Students enrolled in the University Scholars program, or who have completed 30 hours at NC State with an overall GPA of 3.25 or better, may enroll in economics honors courses.

To be certified as a graduate of the economics honors program, students must have at least a 3.25 major GPA in all economics courses attempted at NC State and an overall GPA of 3.25 or higher. In addition, students must complete specific course requirements.

Questions about the economics honors program should be directed to the Department of Economics faculty.
Minor in Economics
The Minor in Economics is available to undergraduate students majoring in an area other than economics. The Minor in Economics is an excellent complement to many majors within the university, including international studies, political science, statistics, business administration, accounting, and engineering.

For additional information, view the “Opportunities for Minors” page on the Poole College of Management’s website (http://poole.ncsu.edu/undergraduate/academics/minors).

College of Natural Resources
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Visit the College of Natural Resources’ website (http://www.cnr.ncsu.edu)

NC State University College of Natural Resources
Bringing science, technology, policy and people together to work for a healthy and sustainable tomorrow.

Vision
We desire to improve the sustainability of the world’s natural resources and economic and social condition of its people through education, innovation and the discovery and dissemination of new knowledge.

Mission
Our mission is to serve as a leader in our disciplines in North Carolina, the nation and the world. We seek to strengthen natural resource management, enhance environmental quality and conservation values, increase the sustainable yield of forestland good and services, increase the value and competitiveness of the forest products and natural resource-based industries, expand recreation and tourism opportunities, and enhance the health and well being of our citizens through superior professional education, innovative scientific research, and dissemination of credible and timely information.

Values
We value—

• Academic excellence in all of its forms— the scholarships of discovery, teaching, information transfer and scientific integration.
• Both cutting-edge research in fundamental science and translational research to address practical problems in North Carolina, the nation and the world.
• Diversity of disciplines, people, places and ideas
• Our students, staff and faculty and are committed to nurturing all.

We admire— academic and scientific rigor and dedication

We seek— innovative and creative solutions to today’s problems.

We strive— for collegiality and appreciate friendly service.

We aspire— to leadership in all of our disciplines.

We intend— to make the world a better place for this and future generations.

Degree Programs
The College of Natural Resources offers programs of study leading to baccalaureate and graduate degrees in the management and use of natural resources, and also offers courses in these areas to students in other colleges. Nine professional curricula are administered in the college through its Departments of Forestry and Environmental Resources; Parks, Recreation and Tourism Management; and Forest Biomaterials. These programs provide a broad education in the biological, physical, and social sciences as well as a sound cultural and professional background. Baccalaureate degrees prepare students for careers in the fields of fisheries, wildlife, and conservation biology; forest management; natural resources assessment and policy; environmental monitoring, testing and remediation; parks, recreation and tourism management; professional golf management; sport management; paper science and engineering; and sustainable materials and technology.

Graduate degrees offered include Master of Science, Master of Forestry, Master of Fisheries, Wildlife, and Conservation Biology, Master of Natural Resources Administration, Master of Forest Biomaterials, Master of Parks, Recreation and Tourism Management, Master of Geospatial Information Science and Technology, Master of Environmental Assessment, and the Doctor of Philosophy. Graduate degree programs may be tailored to a variety of specialized and interdisciplinary topics related to the teaching and research activities of the college. In addition, graduate certificates in Graphical Information Science and in Environmental Assessment are available to NC State students who wish to develop recognized academic credentials in these areas. Applicants should consult the Graduate Catalog (http://www.ncsu.edu/grad/catalog) for additional information about these programs.

Student Activities
Each department in the college has student curriculum clubs within the degree programs and/or student chapters of the appropriate national professional organizations. All of these organizations provide opportunities for professional development, for interaction with faculty and other students, and for participation in local, regional, and national student and professional activities. Student representatives from each organization and curriculum serve on the College of Natural Resources Council. The Council provides overall coordination for student activities, allocates funds for student activities, and oversees production of the Pinetum, the College of Natural Resources student yearbook.

CNR Ambassadors
The CNR Ambassador Program highlights the “student face” of the college. The group is composed of leaders from each program in the college, following a college-wide nomination and selection process. Their activities include representing the college in many ways, ranging from mentoring freshmen to working with prospective students, through shadowing experiences, phone calls and campus tours. In addition the Ambassadors represent their programs and the college to outside visitors, such as the Board of Trustees, Foundation officers, and others who would like to know about the CNR student experience at NC State.
Facilities and Laboratories

In addition to standard classrooms and teaching laboratories, the College of Natural Resources has a unique complex of indoor and field facilities that are utilized in the academic programs. CNR computer facilities provide access to disciplinary applications such as geographic information systems, remote sensing, process simulation, and management/planning software as well as to the university computer network. Included are a general computer lab, two classrooms incorporating a flexible landscape, plasma screens and laptop computers providing the breadth of teaching/learning approaches, a high-tech “collaboratory” designed especially for student team project work. Also available are several different analytical and biotechnology facilities, a photo interpretation lab, an extensive herbarium, and a wood sample collection. About 95,000 acres of forestland are available for field instruction and research at Chowan Swamp, Bull Neck Swamp, Goodwin Forest, Hill Forest, Hofmann Forest, Hope Valley Forest, Hosley Forest and Schenck Forest. Slocum Camp, the site of the annual forestry and wildlife camps at Hill Forest, contains classrooms, dining facilities, and student and staff housing. Specialized pilot plant laboratories unique to wood and paper science are contained in the Hodges Wood Products Laboratory and the Reuben B. Robertson Pulp and Paper Laboratory. Equipment in the Hodges Laboratory includes computer controlled woodworking machinery, dry kilns, veneer lathe and numerous other items required to convert wood into products. The Robertson Laboratory is a 50,000 sq. ft. facility, which contains laboratories and modern pulping and paper making equipment dedicated to teaching and research activities. Examples of equipment are secondary fiber recycling equipment, a thermo-mechanical pulping unit, a pilot-scale paper machine, process control equipment, paper testing laboratory, and pulping digesters.

Fields of Instruction and Work Experience

All curricula in the college have strong components of hands-on field and laboratory instruction and experience, and all either require or strongly recommend on-the-job work experience. All students are required to complete the equivalent of one or more of the following summer activities: camp, internship, practicum, and work experience. The Forest Management and Fisheries, Wildlife, and Conservation Biology curricula both require summer field experience. Undergraduates enrolled in Parks, Recreation and Tourism Management complete a 9-week internship immediately following the completion of the junior year. All Paper Science majors complete a 12 week internship in an industrial setting approved by the college. Sustainable Materials and Technology students are required to complete a summer internship in the industry. Students in all curricula are encouraged to participate in summer jobs and the cooperative education program to gain work experience.

Outdoor and other practical laboratories are a regular part of some courses. In other courses, field instruction may include longer trips (often on weekends) to privately owned businesses and industries, governmental agencies, state and federal forests, and wildlife refuges.

Honors and Scholars Programs

The College of Natural Resources participates in the University Honors Program, the University Scholars Program, and the Women in Science and Engineering (WISE) Program in which exceptional new students (freshman or transfer) are selected for special courses and activities that provide an expanded educational experience.

The College of Natural Resources also offers a disciplinary honors program, which provides the opportunity for advanced students with outstanding records to enhance the depth of study in their major field. Students with an overall GPA of 3.0 or better and a major GPA of 3.25 or better are invited to participate in the Honor’s Program. Students must have at least 40 hours of credit. Honors students develop more rigorous programs of study, frequently taking advanced courses in mathematics, science, or social science, or graduate courses in the chosen curriculum. With the adviser’s consent honors students may substitute preferred courses for normally required courses in order to develop strength in special interest areas. Honors students are required to undertake a program of independent study, which can involve a research project during their junior or senior year, and they must participate in the senior honors seminar.

Two honor societies in the College of Natural Resources promote and recognize academic excellence: Xi Sigma Pi (for majors within Forestry and Environmental Resources and in Forest Biomaterials) and Rho Phi Lambda (for recreation majors). Advanced undergraduate and graduate students with high academic achievement are invited to become members of these societies. High achieving forest management and natural resources students are also eligible for recognition by two agriculture honor societies, Alpha Zeta and Gamma Sigma Delta. All students are also eligible for recognition by the campus-wide honor societies.

Scholarships

The College of Natural Resources administers a large program of academic scholarships that is separate from the University Merit Awards Program. About 170 academic scholarships (ranging from $1,000 to $10,000 per year), renewable annually, are awarded in several program areas to new, continuing, and transfer students. The scholarships are awarded based on academic excellence and leadership.

Computer Competency

Extensive use of computers and workstations is incorporated throughout all curricula of the College of Natural Resources. Students are expected to use the computer for increasingly complex class assignments and for the preparation of papers and reports. Computing resources are available for student use in the college and elsewhere on campus, but many students find it more convenient to purchase a personal computer. Questions about such purchases should be directed to the Associate Dean for Academic Affairs or the appropriate departmental curriculum coordinator.

International Activities

Students in the College of Natural Resources are exposed to the international dimensions of their programs in a variety of ways. Many faculty members regularly travel abroad and a number are active in major projects in foreign countries, including an international cooperative research project concentrating on Central American and Mexico, faculty exchange programs with Sweden and Finland, and several recent agreements for student exchange programs in Asia and South America. With the faculty’s experiences, the international aspects of many topics are covered in core courses, and several elective undergraduate and graduate courses focus specifically on the international dimensions of natural resource management. In addition, many international students enroll in the college with as many as 21 different countries represented in recent years. There are also in-the-major study abroad opportunities, which are led by CNR faculty, and which range from two-week trips to
five-week summer sessions. Recent study trips have included China, Australia, Namibia, Ghana, Sweden, Costa Rica, and Chile. There is also scholarship support to help students take advantage of international job opportunities.

**Department of Forest Biomaterials**

Sustainable, renewable forest biomaterials such as wood, paper and value-added biomaterials are produced by large and small industries across North Carolina, and throughout the US. These renewable biomaterials are used for construction of sustainable housing, low carbon bioenergy, recyclable pulp and paper products, and value-added chemicals and composites. The future is bright for students with a blend of engineering, materials science, and practical business skills that are highly valued by employers.

The Department of Forest Biomaterials offers two curricula leading to Bachelor of Science degrees - Paper Science and Engineering, and Sustainable Materials and Technology. Both curricula feature small classes, extensive interactions between faculty and students, opportunities for internships, co-ops and undergraduate research, and stress the professional development of all students. Graduates are exceptionally well prepared for rewarding professional careers with large or small companies in the renewable biomaterials industries, suppliers to the industry, or with government agencies.

**Sustainable Materials and Technology**

Perry N. Peralta, Director of Undergraduate Programs

Email:perry_peralta@ncsu.edu

The Sustainable Materials & Technology degree prepares students for 21st century jobs helping businesses and communities reduce their ecological footprint through efficient use of renewable natural materials, such as wood, bamboo and cork, in the manufacture and use of value-added products. You'll gain a strong foundation in environmental science, economics, social sciences, and materials science which prepares you to design, manufacture and sell sustainable bio-based products. This degree is for students interested in a career in a growing field with job flexibility, high placement rates, great starting salaries, a tradition of success and an unlimited future.

Specific curriculum requirements are available at http://oucc.ncsu.edu/semester-display/CNR-15SMTBS-nosubplan-2138.

**Summer Internship**

Graduates of the Sustainable Materials and Technology program enter the real world with hands-on experience gained through internships, lab experiments, and practical coursework. More than one half of students participate in paid undergraduate research and work study opportunities. In addition, students are required to complete a paid summer internship or a semester co-op with a company in the industry. There are many other summer employment opportunities that are available to you beyond the required internship.

**Opportunities**

Graduates of the Sustainable Materials and Technology curriculum have many and varied job opportunities upon graduation with most receiving more than one job offer. Graduates enter the industry as management trainees, sales trainees, process engineers, quality assurance specialist, research & development associates and many others.

**Minor in Sustainable Materials & Technology**

The Department of Forest Biomaterials (FB) offers a minor in Sustainable Materials and Technology (SMT) to all undergraduates enrolled in the University as degree candidates except those in FB. The minor will provide students with a basic understanding of sustainability as applied to materials (e.g., wood, agricultural products, etc.) and the manufacturing processes that are used to convert them into a multitude of different products.

**Requirements**

A minimum of 15 hours is required for completion of the minor, and the minor should be completed no later than the semester in which the student expects to graduate from his/her degree program. Three (3) courses are required as indicated below; other courses are elective. An overall GPA of 2.0 in the minor coursework must be achieved.

**Required Courses (8 semester hours)**

- SMT 201 Sustainable Materials for Green Housing 2
- SMT 310 Introduction to Industrial Ecology 3
- PSE 476 Environmental Life Cycle Analysis 3

**Elective Courses (a minimum of 7 semester hours is required)**

- SMT 231 Sustainable Manufacturing 2
- SMT 230 Sustainability, Global Trade and Forest Products 2
- or NR 350 International Sustainable Resource Use
- SMT 232 Recycling to Create a Sustainable Environment 2
- ET 203 Pollution Prevention 1
- ET 303 Laboratory Safety Systems and Management 1
- ET 410 Toxic Substances and Society 3
- FOR 248 Forest History, Technology and Society 3
- PSE 425 Bioenergy & Biomaterials Engineering 3
- PRT 250 Management of Park and Recreation Facilities 3
- PRT 451 Principles of Recreation Planning and Facility Development 3

**Admission and Certification of Minor**

In both instances, students should contact the minor advisor, Dr. Perry Peralta. Paperwork for certification can be found in 1022 Biltmore Hall and should be completed no later than the registration period for the student’s final semester at NC State.

**Curricula in Paper Science and Engineering**

M. V. Byrd, Director of Undergraduate Programs

The Paper Science and Engineering curriculum prepares students for careers in the paper industry, which ranks as the fifth-largest manufacturing industry in the United States. Science, engineering, and mathematics form the basis for a multidisciplinary approach to understanding the fundamental aspects of materials science and engineering of these complex renewable materials. Students study the technology and engineering of wood pulping processes, chemical and energy recovery systems, and pulp bleaching. In addition, various papermaking operations, such as refining, sizing, coating, and drying are
studied. These topics, along with the chemical and biological modification of wood, papermaking, and the physics of paper based materials form a fundamental set of core courses that all students in the curriculum take.

Two concentrations are available emphasizing the different engineering aspects of pulping and paper making. The Paper Science and Engineering concentration provides an extensive background in the pulp and paper manufacturing processes and elective credit hours for studies in chemistry, marketing, economics, management or other areas of interest to the student. Greater depth in general chemical engineering principles can be obtained from the Chemical Engineering Concentration. Students who have completed the Chemical Engineering Concentration in Paper Science and Engineering can, in cooperation with the College of Engineering and with an additional semester of study, earn a Bachelor of Science in Chemical Engineering as a second degree.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Program Educational Objectives

The Paper Science and Engineering Program at NC State prepares its B.S. graduates for the following professional and career objectives:

1. They are effective engineers and leaders in the paper, chemical process and related industries, applying fundamental principles of science, mathematics, engineering, and economics to solve problems.
2. They communicate well in oral and written form, and they work well with other people in team situations.
3. They make decisions and develop solutions with consideration of the possible effects on others, on the environment, and on the world; they subscribe to established standards for safety and ethical behavior.
4. They are lifelong learners, seeking educational and developmental opportunities for their professional lives.

Opportunities

Graduates of this curriculum find opportunities for challenging careers as process engineers, product development engineers, process control engineers, chemists, technical service engineers, quality control supervisors, and production supervisors. Design and construction engineering companies employ graduates as project engineers, and pulp and paper machinery companies use their education and skills for technical service and sales positions. Opportunities for managerial and executive positions are available to graduates as they gain experience.

The broad and intensive nature of this curriculum makes graduates attractive not only to the pulp and paper industry, but also to a variety of other major chemical process and bio-energy industries. This appeal is especially true for the dual degree in Paper Science & Engineering and Chemical Engineering.

Summer Internship

All Paper Science and Engineering majors are required to work one summer in a pulp or paper manufacturing facility. One hour of academic credit is granted after completion of 12 weeks of this work and presentation of an engineering report of professional quality. In addition, students are urged to work in manufacturing facilities the other two summers, as the work provides valuable practical experience. Departmental advisers assist students in locating summer jobs, which are found throughout the US and abroad.

Many Paper Science & Engineering students work at least one co-op rotation, in which they leave school for one semester and work in the industry. The resulting experience adds significantly to a student’s desirability upon graduation.

Accredited Program

The Paper Science and Engineering program is accredited by the Engineering Accreditation Commission of ABET, Inc.

Regional Program

The Paper Science and Engineering curriculum is a regional program approved by the Southern Regional Education Board as the undergraduate program to serve the Southeast in this field.

Scholarships

Approximately 125 undergraduate academic scholarships are granted annually to new and continuing students by companies comprising the Pulp and Paper Foundation, and by alumni and supporters of the program.

Minor in Paper Science and Engineering

The Paper Science and Engineering Minor is available to all undergraduate students enrolled in the university as degree candidates except Paper Science and Engineering Majors. The minor requires 15 credit hours. Six hours of required courses provide a comprehensive overview of pulping and paper making science and technology, including pulping, bleaching, chemical recovery, recycled fibers, paper making, coating, printing, converting, and paper properties. Nine elective hours may be chosen from areas including wood chemistry, wet end chemistry, unit operations, process design and analysis, project management, paper physics, process control, or to gain more in depth exposure to the basic pulping, bleaching, and paper making process.

The Paper Science and Engineering Minor, with its focus on paper making science and technology, is intended to be especially valuable to students majoring in programs leading to careers in corporate or government positions which would interface with the paper and related industries. Students interested in business, scientific or engineering specialties, which may interface with, or are employed by these industries will find the minor especially useful.

Admissions and Certification of Minor

All undergraduate students enrolled in the university as a degree candidate, other than PSE majors, are eligible for admission to the PSE minor program. The PSE Minor Adviser will serve as adviser and certify completion of the minor. Paperwork for certification must be submitted to the minor adviser no later than the registration period for the student’s final semester at NC State.

The minor must be completed no later than the semester in which the student expects to graduate from his or her degree program.

Contact Person: Dr. Med Byrd, Minor Adviser, 2205 Biltmore Hall, (919) 515-5790.

Department of Forestry and Environmental Resources

The undergraduate program of the Department of Forestry and Environmental Resources prepares students for professional challenges,
personal growth, and a lifetime of service as managers of natural resources. Each curriculum produces well-educated graduates who have the knowledge, skills, flexibility, and attitude needed for successful professional performance. Graduates will be prepared to face the challenges of competing uses of natural resources and the environment, and the pressures for increasing production of goods and services from natural ecosystems while maintaining their quality for future generations.

The Department of Forestry and Environmental Resources strives to enroll and graduate high-quality culturally and ethnically diverse students. Its academic curricula are enriched by out-of-class contacts among students, faculty, and practicing professionals to promote a sense of professionalism and global awareness. Gaining practical experience is encouraged through participation in summer employment, internships, undergraduate research opportunities, study and work abroad, and the cooperative education program.

The department has five Bachelor of Science programs: Forest Management; Natural Resources Ecosystem Assessment; Natural Resources-Policy and Administration; Fisheries, Wildlife, and Conservation Biology, and Environmental Technology and Management. The Forest Management curriculum provides the broad-based forestry education needed for direct employment into positions in a wide variety of forestry or forestry-related organizations. The Natural Resources curricula provide interdisciplinary programs in natural resources management that focus as indicated in the curricula titles. The Fisheries Wildlife and Conservation Biology curriculum provides specialization in ecological principles needed to conserve and manage fisheries and wildlife resources. The Environmental Technology and Management curriculum provides broad-based and applied skills for the assessment and management of society's impact on the environment.

Instruction and practice in communications skills (both writing and speaking) are integrated into all four curricula. Spatial technologies and computer applications are introduced and used throughout technical courses.

Information on department programs may be obtained by contacting Ms. Christi Standley, Coordinator of Undergraduate Programs, Department of Forestry and Environmental Resources, NCSU, Box 8008, Raleigh, NC 27695-8008, Phone (919) 513-2582, E-mail: christi_standley@ncsu.edu.

Scholarships

The Department of Forestry and Environmental Resources annually awards four types of scholarships that are available to freshmen, transfers, and advanced students: Academic, Forestry & Wildlife Summer Camp, Industrial, and Work-Study. About 40 Academic Scholarships varying between $4000 and $7000 are awarded annually in May for the following academic year and are renewable provided that superior progress is made toward a degree. Timber sales from the James L. Goodwin and Hofmann forests and nineteen endowments provide these awards.

Nine scholarships support students attending forestry or wildlife summer camps. Each award provides $500-$1000. Six endowments support these awards.

Three Industrial scholarships are available each year. In addition to cash awards of $2000 - $4000, the Industrial Scholarships provide practical work experience with industrial forestry organizations. Industrial Scholarships are supported by grants. Approximately 18 Work-Study Scholarships are awarded each year, generally to juniors and seniors. Work-Study Scholarships, currently at $4032 each, carry a work requirement, which is usually satisfied by assisting with operational activities on the college forests. This requirement means that recipients must be advanced students with some field skills.

Scholarship applications or questions should be directed to Dr. Richard Braham, Scholarship Coordinator 3003 Biltmore Hall, Phone: (919) 515-7568, Fax: (919) 515-8149, E-mail: richard_braham@ncsu.edu.

Cooperative Education, Internships, and Summer Work Experience

Practical work experience is an important component of the professional degree programs in the Department of Forestry and Environmental Resources. Experience may be gained through participation in the Cooperative Education Program, summer work, and internships. The department has established professional relationships with employers in forestry, fisheries management, wildlife management, environmental technology management and natural resources, and provides placement assistance for the work experience programs. The Fisheries Wildlife and Conservation Biology Program offers summer internships with research faculty and others across the state. The Cooperative Education Program, which requires a minimum 2.5 GPA after at least one year of study (many employers require a higher minimum GPA), involves alternating semesters or summer periods on the job with semesters on campus for classes. A total of 12 months of work experience is required. Students who successfully complete the co-op program are in high demand by employers.

Dual Degree Programs

Students enrolled in one of the department’s degree programs who have a strong interest in another degree topic may obtain a second baccalaureate degree in addition to the primary one. Such dual degree programs may be designed to provide a broader base in a related technical field such as wood products or soil science, or to broaden the student’s knowledge and skills in a supporting field such as business, economics, sociology, or political science. Majoring in dual degree programs requires coordination of the courses required in both curricula and the additional time required to complete them depends on the similarity between the curricula and the use of electives in one to satisfy required courses in the other. One to several extra semesters may be required to complete two degrees but expanded employment opportunities are a definite benefit.

Transfer Students

The Department of Forestry and Environmental Resources accepts NC State students as on-campus transfers, as well as students with good academic records from other accredited colleges and universities. Students at community colleges or other baccalaureate institutions who plan to transfer to one of the department’s degree programs should closely follow the desired curriculum by taking equivalent courses. Only equivalent courses will be credited to the appropriate degree program after enrolling at NC State, and the time required to complete the degree will depend on the courses remaining in the degree track. Students applying for the Forest Management curriculum must have at least 30 credits equivalent to those in the freshman and sophomore years and must transfer in the fall of the sophomore year in order to complete the courses required for summer camp. Formal articulation agreements exist with the four forestry programs at North Carolina community
Colleges and those students do not need to attend Summer Camp. Questions about transfer procedures, admissions criteria, or courses should be directed to Ms. Christi Standley, Coordinator of Undergraduate Programs, Department of Forestry and Environmental Resources, NCSU Box 8008, Raleigh, NC 27695-8008, Phone: (919) 513-2582, E-mail: christi_standley@ncsu.edu.

Curriculum in Forest Management

The curriculum in Forest Management is a professional program accredited by the Society of American Foresters that has long been ranked as one of the best in the country. The Forest Management curriculum satisfies the education requirements to become registered (licensed) forester by the North Carolina State Board of Registration for Foresters. With a rigorous math and science base, the curriculum produces graduates with a broad education in natural sciences, humanities and social sciences, communications skills, technology and the practical knowledge and skills needed for sound management of the multiple resources of natural and managed forest ecosystems. Preparatory courses in the freshman and sophomore years are followed by the nine-week forestry summer camp where the woods knowledge and field skills that are essential for all foresters are acquired. Core courses of the junior and senior years focus on forest ecosystem processes, applied economics, operational practices in forest stand management, measurement and analysis of forest stand components, policy issues in natural resource management and the management decision-making tools and skills needed to develop and implement forest management plans. For information on entrance requirements, contact Chrisie Standley at E-mail: christi_standley@ncsu.edu.

Forestry Summer Camp

An intensive, full-time, nine-week summer camp with training in the Coastal Plain, Piedmont, and Mountain regions of North Carolina is required in the Forest Management curriculum. The camp is based at the college’s Hill Demonstration Forest located in Durham County, NC with trips taken to other regions. Students take summer camp between the sophomore and junior year and earn nine-semester credits in required courses that provide a base of knowledge and skills for the advanced courses in the junior and senior years.

Opportunities

Graduates in Forest Management are in high demand by state and federal land management agencies, forest products companies growing wood as a raw material, investment firms and insurance companies with land ownership portfolios, state forestry and agriculture extension services, the Peace Corps, environmental and wetland consulting firms, wood procurement companies, nursery and landscape management firms, and environmental organizations. After several years of experience, many graduates start their own businesses in forestry and land management consulting. Some graduates continue their education in graduate school to specialize in a wide variety of forestry and related programs.

Minor in Forest Management

The Forest Management minor is open to all undergraduate degree students at NC State, (except majors in Forest Management), who are interested in learning the basics of the structure and functioning of forest ecosystems and the policies and practices of forest management. The minor will be useful to students in related career fields who wish to have a better understanding of the scientific and policy issues involved in the sound stewardship of the nation’s forests. The minor will also be useful to students who may be responsible for management of natural resources or interacting with foresters.

The minor in Forest Management requires a minimum of 15 credit hours, in one of the following options:

Option A

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>FOR 172</td>
<td>Forest System Mapping and Mensuration I</td>
<td>2</td>
</tr>
<tr>
<td>FOR 339</td>
<td>Dendrology</td>
<td>4</td>
</tr>
<tr>
<td>FOR 252</td>
<td>Introduction to Forest Science</td>
<td>3</td>
</tr>
<tr>
<td>Two FOR Electives</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Total Units</td>
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<td>15</td>
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Option B

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOR 172</td>
<td>Forest System Mapping and Mensuration I</td>
<td>2</td>
</tr>
<tr>
<td>FOR 339</td>
<td>Dendrology</td>
<td>4</td>
</tr>
<tr>
<td>Attend Forestry Summer Camp</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Total Units</td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

* Students who are interested in instruction and field experience in forestry technical skills should choose option B.

For additional information, contact Dr. Gary B. Blank, Director of Undergraduate Programs, E-mail: gary_blank@ncsu.edu or Phone: (919) 515-7566.

Minor in Wetland Assessment

The Undergraduate Minor in Wetland Assessment is an interdisciplinary, interdepartmental minor that is designed to provide the requisite knowledge of skills needed for entry-level competence in wetland delineation and assessment. The soils, hydrology, and plant identification courses of the minor build the scientific background and skills needed to understand the structure and functions of wetland ecosystems and to apply assessment protocols. The capstone course, NR 421 Wetland Assessment, Delineation and Regulation focuses on further development of knowledge and skills in applying wetlands assessment, delineation, and regulation procedures. The Undergraduate Minor in Wetland Assessment consists of 17 credit hours. PB 405 Wetland Flora and FOR (NR) 420 are prerequisites of , and therefore, must be completed before enrolling in NR 421. For details about the minor contact Dr. Ryan Emanuel. Email: ryan_emanuel@ncsu.edu.

Curricula in Natural Resources

Two natural resources curricula are offered by the Department of Forestry and Environmental Resources. The curricula produce natural resources professionals with a broad interdisciplinary background coupled with a specific focus in natural resources management. The Natural Resources curricula include a series of common courses to highlight the integrated nature of work by interdisciplinary teams.

The curriculum in Natural Resources Ecosystem Assessment produces graduates who have knowledge and skills to inventory and describe ecosystems characteristics and to evaluate the impacts of management decisions. Ecosystem assessment or environmental impact assessment is an important part of development planning that calls for individuals who understand ecosystem structure and processes; who can identify, measure, inventory, and describe ecosystems; and who can apply standard evaluation and classification systems such as wildlife habitat evaluation procedures and the federal wetland delineation criteria. The
curriculum entails a strong science base, as well as advanced courses in sampling and measurements, vegetation, soils, hydrology, and wildlife and fisheries are added. The 400-level courses also address techniques and issues of natural resource management.

The curriculum in Natural Resources Policy and Administration produces graduates who have knowledge and skills to manage natural resources programs in a variety of settings and organizations with an emphasis on public agencies. The advanced courses of the curriculum provide background in economics, policy, government, public administration, and natural resources management. An economics track begins with introductory microeconomics and culminates with environmental economics and public finance. Courses in government and public administration provide knowledge of how public institutions work.

Courses in forestry, wildlife and fisheries, and outdoor recreation provide techniques of managing natural ecosystems for various uses. A common thread of how public policy on natural resources is influenced and developed runs through many of the courses already noted and culminates in two senior courses that focus on policy. For information on entrance requirements, contact the program coordinator: Dr. George Hess, Department of Forestry and Environmental Resources, NCSU, Box 8008, Raleigh, NC 27695-8002, Phone: (919) 515-7437, Fax: (919) 515-8149, E-mail: george_hess@ncsu.edu. Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Opportunities

Graduates of the Natural Resources Ecosystem Assessment curriculum work in environmental service firms, public agencies, non-governmental organizations, and industries. The U.S. Environmental Protection Agency, the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, the N.C. Division of Water Quality, and county and city governments employ graduates to help manage compliance with county, state, and federal environmental regulations, particularly wetlands and protected species. Non-governmental organizations and private engineering and environmental consulting firms employ graduates to prepare environmental impact statements and assessments, delineate wetlands, and conduct searches for threatened or endangered plant and animal species. The broad background in natural resources provided by this curriculum also provides a strong base for students interested in graduate school or environmental law.

The curriculum in Natural Resources Policy and Administration produces managers and administrators for public agencies and private organizations involved with management, administration, policy-making, planning, preservation, or regulation of natural resources. Examples are the USDI National Park Service, the US Environmental Protection Agency, the US Geological Survey, state and local government agencies, and not-for-profit environmental organizations. Background in government, economics, policy, and natural resource management also provides a strong base for students who wish to pursue a graduate program in natural resources economics and policy or environmental law.

Curriculum in Environmental Technology and Management

Environmental Technology and Management offers a comprehensive teaching and research program, preparing students for careers within the arenas of environmental regulation, environmental site assessment, and environmental health and safety. This curriculum prepares graduates to collect data, analyze and interpret those data, and determine appropriate solutions for sound environmental management. The curriculum focuses on the sciences behind the biological and chemical mechanisms of environmental processes. Students learn how to deal with a range of topics from every day environmental management activities to natural and man-made disasters such as chemical spills, fires, hurricanes, oil spills, and more. Many Environmental Technology courses emphasize hands-on training with state-of-the-art monitoring equipment. An internship to obtain actual working-world experience is required. For information on entrance requirements, contact the program coordinator: Terrie Litzenberger, Department of Forestry and Environmental Resources, NCSU, Box 8008, Raleigh, NC 27695-8008, Phone: (919) 515-7581, Fax: (919) 515-6193, E-mail: terrie_litzenberger@ncsu.edu.

Opportunities

Career opportunities include technical positions with: firms that offer environmental services; manufacturing companies that are required to maintain sophisticated environmental monitoring networks; consulting and audit firms that perform independent environmental audits; and state and federal regulatory agencies. A number of graduates have also pursued graduate degrees. Several professional certifications can be achieved through the major. Students may receive Hazardous Waste Operations and Emergency Response training and are eligible to sit for two professional certification exams: the exam for certification as an Associate Environmental Professional, and the exam Certified Hazardous Materials Manager.

Curricula in Fisheries, Wildlife, and Conservation Biology

The Department of Forestry and Wildlife and Conservation Biology Program facilitates and provides opportunities for student internships, cooperative education and professional society interactions that are extremely valuable in preparation for future employment. The Student Chapter of the Leopold Wildlife Club and the Student Fisheries Society offer students in all levels of study the opportunity to network, to perform community service, and to learn from professionals in their chosen field. For information on entrance requirements, contact the undergraduate program coordinator: Dr. Lara Pacifici, Undergraduate Coordinator, Fisheries, Wildlife, and Conservation Biology Program, Department of Forestry and Environmental Resources, NCSU, Box 7646, Raleigh, NC 27695-7646, Phone: (919) 515-3431, Fax: (919) 515-5110, E-mail: lara_pacifici@ncsu.edu.

Fisheries and Wildlife Summer Program

Four courses comprise the six-week summer session that is required of all fisheries and wildlife majors. These courses, offered in part at Hill Forest, a residential camp about one hour from Campus, provide the
opportunity for intense study and practical application in fisheries and wildlife management. Additionally, one course is offered at Great Smoky Mountains National Park on the border of Tennessee and North Carolina and another course is offered in coastal North Carolina studying marine and estuarine habitats.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

**Minor in Wildlife Science**

The objective of the wildlife sciences minor is to provide students, who might pursue careers in related areas of natural resources management, with basic ecological and management knowledge about wildlife resources. Additionally, the minor will provide students majoring in unrelated fields an appreciation for the value of wildlife resources and the need for sound management. Requirements: 16-17 credit hours:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>FW 221</td>
<td>Conservation of Natural Resources</td>
<td>3</td>
</tr>
<tr>
<td>PB/BIO 360</td>
<td>Ecology</td>
<td>3-4</td>
</tr>
<tr>
<td>or FOR 260</td>
<td>Forest Ecology</td>
<td></td>
</tr>
<tr>
<td>FW 353</td>
<td>Wildlife Management</td>
<td>3</td>
</tr>
<tr>
<td>FW 333</td>
<td>Conservation Biology in Practice</td>
<td></td>
</tr>
<tr>
<td>FW 373</td>
<td>Vertebrate Natural History</td>
<td></td>
</tr>
<tr>
<td>FW 403</td>
<td>Urban Wildlife Management</td>
<td></td>
</tr>
<tr>
<td>FW 404</td>
<td>Forest Wildlife Management</td>
<td></td>
</tr>
<tr>
<td>FW 411</td>
<td>Human Dimensions of Wildlife and Fisheries</td>
<td></td>
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<tr>
<td>FW 444</td>
<td>Mammalogy</td>
<td></td>
</tr>
<tr>
<td>FW 460</td>
<td>International Wildlife Management and Conservation</td>
<td>15-16</td>
</tr>
</tbody>
</table>

**Opportunities**

As increased discretionary time becomes available for large segments of the American population, opportunities for growth in the leisure service professions have increased dramatically. Tourism and sports are two of the world’s largest industries. A recreation and park professional’s goal is to influence people to use their discretionary time wisely and to improve the quality of their lives. This goal is accomplished by providing recreation programs and facilities for people in a variety of settings.

Career opportunities include employment by park and recreation departments operated by county and municipal governments; state agencies, such as state parks; federal government, with agencies such as the National Park Service, U.S. Army Corps of Engineers, and U.S. Forest Service; resorts and country clubs; and sport agencies.

Other major employers include youth and family service organizations, such as the YMCA, YWCA, Boy’s Clubs, and Boy and Girl Scouts. Industries employ recreation directors to head employee recreation programs. Areas with perhaps the greatest growth potential for employment are tourism agencies and commercial recreation establishments, such as resorts, private clubs, theme parks, and convention and conference centers. Sport management is also a growing profession with career opportunities in sports marketing and sales, game day operations, facility management and community athletics.

**Scholarships**

The Department of Parks, Recreation, and Tourism Management annually awards scholarships that are available to freshmen and advanced students. Approximately 12 academic scholarships varying between $500 and $3,000 are awarded in May for the following academic year and are renewable provided that superior progress is made toward a degree.

**Curriculum in Parks, Recreation and Tourism Management**

The curriculum in Parks, Recreation and Tourism Management is a professional program accredited by the National Recreation and Park Association. The curriculum produces graduates with a broad education in natural science, humanities and social science, and communication skills and the professional and technical skills to plan recreation programs and manage facilities, manage parks, and operate tourism services and agencies. General education courses include geology, biology, psychology, sociology, English, mathematics, communication, and economics. A specialized course is required in statistics.

The curriculum is designed to prepare students for a variety of positions in a dynamic and challenging profession. The focus of the curriculum is on management rather than face-to-face leadership. The curriculum provides 35 hours of professional course work that includes recreation philosophy, recreation facility management techniques, fiscal management, supervision, facility and site planning, recreation programming, administration, and evaluation.

In addition to the general education requirements and the core professional requirements, students can attain specialized training through concentration courses. They choose one of the following

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**Department of Parks, Recreation and Tourism Management**

PRTM is committed to educating its students by providing them with the latest knowledge and tools to address society’s most pressing needs. The undergraduate programs focus on ways to promote health and enjoyment in people’s lives as well as contribute to the natural and cultural sustainability of recreation resources in communities. PRTM’s unique undergraduate programs combine relevant class time with hands-on field experiences and service learning. The department strives to enroll and graduate a highly motivated and culturally diverse student body.

The department has an established reputation for providing comprehensive, professional education programs in Professional Golf Management, Parks, Recreation and Tourism Management, and Sport Management. Each degree is designed to produce well educated graduates who have the skills, knowledge, and attitude needed to plan activities and manage parks, recreation, tourism and sport areas and facilities in a range of environments for all ages and lifestyles.
concentrations: tourism and commercial recreation, park and natural resource management, or program management.

Academic studies on campus are supplemented by practical laboratory experiences in the Raleigh area, out-of-state field trips and service learning opportunities, and a 10-week internship with a park, recreation or tourism agency. Cooperative work-study programs are available. Study abroad opportunities are also encouraged.

Concentrations

Park and Natural Resource Recreation (18 hours)

This concentration is well suited for people who enjoy working outdoors, who are interested in environmental protection and conservation, facility planning and development, and for those wanting to make a positive impact on the lives of others and on the natural environment. Concentration courses include ecology, GIS, outdoor recreation management and adventure education. Students are prepared for positions in planning, managing and maintaining parks and other natural resource oriented areas at the federal, state, regional or local levels in settings ranging from primitive to urban.

Tourism and Commercial Recreation (18 hours)

This concentration is for students who enjoy working with people; who are interested in business management, marketing, travel, and event planning; and, for students who want to make a positive impact on the leisure experiences of others. Concentration courses include resort management, accounting, marketing, event planning, and business management. The tourism and commercial recreation concentration prepares students for positions in planning, marketing and managing tourism facilities, attractions, and products. The positions could be with private companies, nonprofit groups or public agencies.

Program Management (18 hours)

Program Management is designed for students interested in designing and delivering recreation programs or events for diverse audiences in a variety of settings. Students take classes in special event programming adventure programming, marketing, community development and interpretive programs. Possible professional positions include recreation program director, event planner, outdoor adventure instructor, youth director and facility manager. Positions could be with public agencies, nonprofit group or private companies.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula) or the PRTM website (http://cnr.ncsu.edu/prtm/current-undergraduates/ug-programs).

Curriculum in Sport Management

NC State University is one of a select few universities across the United States to offer a PGA of America Accredited Bachelor of Science degree in Professional Golf Management. Located in the heart of a great golf state, NC State’s PGM program is uniquely qualified to become one of the best in the nation.

The golf profession today requires expertise in a variety of areas, including turf grass management, retail operations and merchandising, food and beverage management, personnel management, accounting, risk management, marketing, and customer services in addition to golf instruction. A unique interdisciplinary combination of golf management, business, life sciences, turf grass management, food & beverage management, parks, recreation and tourism management courses, with extensive co-op experiences, will help students become leading professionals in the golf industry.

In addition to PGM course requirements, PGM students will complete 16 months of cooperative education at approved golf facilities. PGM students are also required to complete all requirements for levels one, two, and three of the PGA-Professional Golf Management Apprentice Program prior to graduation.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula) or the PGM website (http://cnr.ncsu.edu/pgm).

Curriculum in Sport Management

The Sport Management degree provides students with high quality educational experiences to enable their success as managers in sport and sport related industries and organizations. NC State’s Sport Management program will provide students with a multidisciplinary perspective that includes sound management principles combined with a global understanding of sport and the impact of sport in social, economic, political and technological environments. Sport can be viewed as both an industry and an academic discipline. This program will educate students in the theoretical principles of sport management as well as the application of those principles. The interdisciplinary curriculum, including courses in recreation and accounting, will enable students to develop leadership, communication, evaluation and problem-solving skills in a “real world” environment.

The curriculum provides 38 hours of professional course work that includes recreation philosophy, management techniques and skills, sport finance and economics, sport law, programming, administration, and analysis and evaluation. Students can use the 30 hours of free electives in this program to pursue a minor or design a special track that will meet their career goals. Academic studies on campus are supplemented by a 10-week internship with an approved sport agency.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula) or the PRTM website. (http://cnr.ncsu.edu/prtm/current-undergraduates/ug-programs)

Minor in Parks, Recreation and Tourism Management

The academic minor in Parks, Recreation and Tourism Management is offered to students interested in gaining a basic knowledge of the parks, recreation and tourism fields and an understanding of the importance of leisure and recreation in American society. It is not intended to prepare students for a professional career in parks, recreation, sport, and tourism. Six hours of required courses and nine hours of electives are necessary to complete the minor. The program provides a background in recreation and park management which is useful to students who will assume full-time careers associated with recreation and park services and become involved in the park and recreation field as a volunteer, program leader, or policy making board member with such organizations as the Scouts, Y’s, art advisory councils, and conservation organizations.
Admission
Any undergraduate student enrolled in the university as a degree candidate is eligible for admission to the minor program. The undergraduate curriculum coordinator of Parks, Recreation and Tourism Management will advise students regarding their plan of work and process all necessary records.

Requirements for Admissions and Completion
Students should see the minor adviser, Dr. Candace Goode Vick, for both admission and certification of the minor. She can be reached at (919) 513-3939, or candace_goode@ncsu.edu. The minor must be completed no later than the semester in which the student expects to graduate from his or her degree program.

Online application for the minor should be completed during the registration period for the student’s final semester at NC State.

Requirements
A minimum of 15 hours (5 courses required to complete the minor in Park, Recreation & Tourism Management) Student must take PRT 152 and PRT 358A grade of “C-” or better is required in all courses to be used toward the minor.

College of Sciences
116 Cox Hall
NCSU Box 8201
Raleigh, NC 27695-8201
Phone: (919) 515-7833
Fax: (919) 515-7855
E-mail: sciences@ncsu.edu
sciences.ncsu.edu

The College of Sciences offers programs for students interested in working side-by-side with world-class faculty to address the grand challenges of our time, particularly those related to health, energy, safety and security, and the environment. The college’s programs of study and research are offered at both the undergraduate and graduate levels and lead to many career opportunities. In addition, the college provides core science, statistical and mathematical education support for the entire university. The college consists of six academic departments: Biological Sciences, Chemistry, Mathematics, Physics, Statistics, and Marine, Earth and Atmospheric Sciences. The Center for Research in Scientific Computation, the Center for Quantitative Sciences in Biomedicine, the Bioinformatics Research Center, the State Climate Office, the Center for Marine Sciences and Technology, and the W.M. Keck Center for Behavioral Biology are also associated with the college.

Graduates of the college are in demand and valued for their well-developed analytical thinking and problem-solving skills. They are recruited for technical and administrative positions in industry and laboratories, universities and colleges, non-profit research organizations, and government agencies. A large percentage of the graduates undertake advanced study in medical, law, business, or other professional schools as well as further study leading to master’s and doctoral degrees.

High school students who are interested in mathematics, statistics, biology, medicine, chemistry, geology, marine science, meteorology or physics; fascinated by natural phenomena; and want to advance economic, societal and intellectual prosperity for everyone should consider the career opportunities opened by degrees in the sciences.

Degree Programs
The college offers undergraduate programs of study leading to a Bachelor of Science degree with majors in biological sciences, chemistry, genetics, geology, marine sciences, mathematics, applied mathematics, meteorology, microbiology, natural resources, physics, statistics and zoology and to a Bachelor of Arts degree with majors in chemistry and physics. In some programs, students may choose to highlight their studies with concentrations in compatible disciplines, for example, a financial mathematics concentration in applied mathematics, a marine and coastal resources concentration in a natural resources curriculum, or a human biology concentration in biological sciences.

Many curricula within the college have similar freshman years, enabling a first year student to change from one department to another in the college without loss of time. The Life Sciences First Year Program, a collaborative venture between the College of Agriculture and Life Sciences and the College of Sciences, offers students interested in life sciences majors a common first year curriculum, a peer mentoring program, seminars, a peer class facilitator program, outstanding academic advising, and more to help the students explore the variety of life science majors available at NC State before they decide on a particular major.

Minors are offered in biological sciences, environmental toxicology, genetics, geology, mathematics, meteorology, microbiology, physics, statistics and zoology.

Pre-Medical Sciences
Medical and dental schools as well as many other health-related professional schools have long regarded degree programs in the core biological, physical, earth system and mathematical sciences as excellent pre-professional curricula. Some professional schools prefer the in-depth knowledge gained by this route over those curricula which offer a cursory view of a variety of topics. For further details, contact Dr. Anita Flick, Director of the Health Professions Advising Center.

Dual Degree Programs
Students may wish to earn bachelor’s degrees in two fields within the college. Other students may wish to combine a bachelor’s degree in Sciences with one in another NC State college. With effective planning, a number of courses can satisfy core, general education, or elective requirements simultaneously in both degree programs. For example, many students choose to pursue simultaneous degrees in mathematics and mathematics education or one of the physical, biological or earth system sciences and science education.

Student Activities
In addition to university-wide extracurricular activities and honor organizations, the College of Sciences has clubs and student chapters of professional and honor organizations:

• Alpha Chi Sigma (AXE), a national co-ed professional chemistry fraternity
• American Chemical Society (ACS) Student Affiliates
• American Meteorological Society (AMS) – Student Chapter
• Association for Women in Mathematics (AWM) Student Chapter
• Biology Club
• Broadcast Meteorology Club/NC State Weather Club
• Genetics Club
• Geology Club
• Herpetology Club
• Microbiology Club
• Mu Sigma Rho (a statistics honorary society)
• Phi Lambda Upsilon (PLU) (a national honorary chemical society)
• Pi Mu Epsilon (PME) (a national mathematical honor fraternity)
• Sciences Ambassadors
• Sciences Council
• Sigma Pi Sigma (a physics honor society)
• Society for Industrial and Applied Mathematics (SIAM) Student Chapter
• Society for Undergraduate Mathematics (SUM Club) (a student chapter of the Mathematical Association of America)
• Society of Multicultural Scientists
• Society of Physics Students (SPS)
• Sports Statistics Club
• Statistics Club
• Zoology Club.

Additionally, majors in the college are eligible for induction in the national honor societies Phi Beta Kappa and Phi Kappa Phi.

Honors Programs

All departments in Sciences have active honors programs designed to encourage excellent undergraduates to pursue a program that will challenge their abilities and better prepare them for their post-graduate career. These programs feature a combination of independent research and honors course work, often at the graduate level. Students in an honors program are advised by honors advisers who help students customize their education based on their individual interests, talents and skills and who proactively present opportunities for academic study, research and study abroad. For information on a particular departmental program, please visit the departmental websites.

Facilities

Faculty and students within the college have access to an extensive array of computational and network services for word processing, e-mail, information access from the library and Internet, and the use of numerous specialized software tools. The college provides a large number of computing laboratories for use by undergraduate and graduate majors and is a participant in the university’s campus-wide workstation network. Further, the college maintains a Linux Beowulf cluster for student research and classes. Individual departments utilize workstations in these laboratories and provide additional platforms for work with discipline specific programs; for example instruction or research in mathematics, statistical analysis, satellite data acquisition and analysis, and weather modeling. Students also have access to university facilities for additional workstations, peripherals, file space and services.

Living and Learning Communities

In addition to the variety of student housing options offered by the university, Sciences students have access to several specialized housing programs. Among them is the WISE Village, a living and learning community created for first- and second-year female scientists, mathematicians, statisticians and engineers. The program combines a group-living experience with resident, upper-class mentors who help with the transition to university life.

Sciences students can also join their peers from across the university in the EcoVillage in Bragaw Hall. The program encourages students to go beyond the classroom to lead, serve, create, problem-solve and engage in complex energy, environmental and sustainability issues locally and globally.

For a list of living and learning communities, see http://housing.ncsu.edu/villages.

Internships and Cooperative Education Programs, Field Experience, and Undergraduate Research

The college recognizes the value of career-related work experience to students and encourages its majors to work with the University Career Development Center and the faculty and staff within the college to avail themselves of such opportunities whenever possible. Career-related experience may be gained through a number of activities including internships and cooperative education programs, department-sponsored field programs, summer employment and undergraduate research. Advisers work with students to develop a plan of study that balances a challenging course load with appropriate extracurricular activities.

Students also have opportunities to build their science communications skills through the college’s partnership with the North Carolina Museum of Natural Sciences in downtown Raleigh. Educators at the museum’s Nature Research Center can help students learn to better communicate their work to the public.

Scholarships

College of Sciences majors may be eligible for a variety of freshman and undergraduate college and departmental scholarships in addition to those administered at the university level. The awards are based on a combination of factors, with a strong emphasis on academic excellence. Some scholarships are renewable for up to four years, and some carry opportunities for significant experiential learning and career-related work experience.

Public Science Literacy and Community Outreach

Public science is a major part of the College’s science literacy initiative, which is based on the idea that a growing economy and important societal advances demand a leadership and populace that are scientifically literate. Dr. Holly Menninger, director of public science, coordinates all aspects of the College’s public science efforts, including citizen science, or scientific research conducted by the public; K-12 and informal science education; science communication; and innovation in public science.

The Science House seeks to cultivate and diversify the pool of students pursuing degrees and careers in Science, Technology, Engineering and Mathematics (STEM) fields; to enhance the quality of teaching and learning in STEM education; and to communicate innovative scientific and educational research to the public.

The State Climate Office is a public service center that applies atmospheric science to sensitive sectors in North Carolina. Through
extension, research, and educational programs, the Climate Office works to improve the understanding and use of climate science for North Carolina and the broader southeastern United States.

**Tutorial and Audio-Visual Assistance**

Most of the departments in the college offer students some form of free tutorial assistance, including regularly scheduled review sessions, and the University Tutorial Center offers Supplemental Instruction (SI) for selected sections of chemistry. Several departments provide facilities for students to use supplementary video- or computer-assisted instructional materials.

**Graduate Study**

Doctor of Philosophy and Master of Science degrees are available with majors in applied mathematics, biomathematics, mathematics, chemistry, functional genomics, genetics, operations research, physics, statistics, toxicology, zoology, and marine, earth and atmospheric sciences. The Doctor of Philosophy is also offered in bioinformatics. The Master of Bioinformatics, Master of Biomathematics, Master of Climate Change and Society, Master of Financial Mathematics, Master of Functional Genomics, Master of Genetics, Master of Operations Research, Master of Statistics, Master of Toxicology and Master of Zoology are also offered. The Department of Statistics and the Department of Mathematics offer B.S.-M.S. programs that allow students to enroll in up to 12 credit hours of graduate level course work that may be applied toward the requirements of both the bachelor’s and master’s degrees.

**Department of Biological Sciences**

The Department of Biological Sciences provides educational opportunities to undergraduate and graduate students and conducts world class research in a variety of areas in modern biology. The Undergraduate Programs in the Department of Biological Sciences have the primary mission of providing our diverse population of students with the opportunity and support to successfully complete their major and prepare for their post-baccalaureate life as independent thinkers, lifelong learners, and contributing members of society. Undergraduates begin with comprehensive studies of the structure, function, behavior, and evolution of cells, organisms, populations, and ecosystems and then have the opportunity to select upper division courses that reflect their intellectual interests and career goals. Those who earn a Bachelor of Science degree in Biological Sciences, Genetics, Microbiology or Zoology gain a strong background in biology and in related fields. All incoming freshmen interested in majoring in one of these degree programs will start their studies in the NC State Life Sciences First Year Program (http://www.ncsu.edu/life-sciences-first-year), and will explore these and related degree options during that first year while they take courses relevant to all life science degree programs at NC State. The Department of Biological Sciences also offers minors in Biological Sciences, Genetics, Microbiology, Environmental Toxicology, and Zoology.

Specific curriculum requirements for majors are available on the Registration and Records (http://www.ncsu.edu/registrar/curricula) website. Specific requirements for minors are available on the Office of Undergraduate Courses and Curricula (http://oucc.ncsu.edu/minors) website. See the Graduate Catalog for a listing of graduate degree programs.

**Opportunities**

Students who graduate from the Department of Biological Sciences are well prepared for employment in various government agencies and private industries. Graduates may continue their education with studies leading to advanced degrees in many areas of the biological sciences, including cell biology, ecology, microbiology, genetics, zoology, neurobiology, and biomedical disciplines. Many choose to seek advanced degrees in medicine, dentistry, optometry, veterinary medicine and other health-related fields. Students who plan to seek certification for pre-college teaching may want to pursue a second major in the Department of Science, Technology, Engineering & Mathematics Education.

**Undergraduate Majors**

**Bachelor of Science in Biological Sciences**

There are five different avenues to earning a B.S. in Biological Sciences at NC State. Students studying for a degree in Biological Sciences can opt for a general curriculum (BLS) or can choose to focus in a particular area by selecting one of four areas of concentration: Molecular, Cellular, and Developmental Biology (MCD), Integrative Physiology and Neurobiology (IPN), Human Biology (HB), or Ecology, Evolution, and Conservation Biology (EEC). The MCD curriculum offers students in-depth studies of the molecular and cellular basis of life and the development of multicellular organisms. The IPN curriculum provides a comprehensive grounding in basic principles of physiology and neuroscience, as well as in-depth exposure to the application of these principles in understanding whole-organism function and the ways in which animals (including humans) cope with challenges presented by their environments. The HB curriculum provides training in those areas of science most important to health-related professions as well as relevant aspects of the humanities and social sciences. It is designed to provide students with a solid education in the scientific and humanistic concepts that underlie modern health sciences and related areas of scientific research. The EEC curriculum offers students in-depth studies in areas of biology at the level of the organism, populations, and ecosystems. It is designed for students who have an interest in whole organisms and their biodiversity — what maintains it, what environmental changes affect it, and how to protect it in the face of various challenges.

**Bachelor of Science in Genetics**

The Genetics program offers undergraduate majors classroom training in fundamentals of genetics and other sciences, as well as opportunities for meaningful research experience. The degree in genetics is the only genetics major offered in the UNC system.

The genetics major complements other degree programs in the biological and life sciences at N.C. State, as it prepares students for further graduate study, professional schools (such as medical, dental, veterinary, genetic counseling) or careers in industries whose products are based on biological and agricultural research, including biopharmaceutical and biotechnology companies. Building on the strength of N.C. State as a leader in science and technology, students in the program can easily earn a concurrent minor in any of the other life sciences curricula, as well as other programs such as statistics or biotechnology.

Responsible conduct as a scientist and citizen are emphasized in the genetics coursework, and students will also have opportunities for public service and engagement through participation in the genetics outreach program. Students will be challenged to master their coursework while practicing hands-on problem-solving in both the classroom and active research settings. Genetics students also will be required to read the
primary literature and present papers and their research findings, thus gaining valuable experience in scientific communication.

**Bachelor of Science in Microbiology**

Microbiology is concerned with the growth and development, physiology, classification, ecology, genetics, and other aspects of the life process of an array of microscopic, generally single-celled, organisms and viruses. These organisms frequently serve as model systems for elucidation of fundamental processes that are common to all living cells. Most of the major discoveries that have produced spectacular advances in biology and genomic science during the past decade have resulted from studies of microbial systems. Future developments in biotechnology, production of food and fuel, and human and animal health will rely heavily on understanding microbial processes.

There are 4 avenues to earning a B.S. in Microbiology. Students can opt for a general curriculum (MBIO) or can choose to focus in a particular area by selecting one of three areas of concentration: Microbial Biotechnology (MBIO-MT) or Microbial Research (MBIO-MR) or Microbial Health Sciences (MBIO-HS). These concentrations mirror the three most common career paths of Microbiology majors: work in research laboratories and production facilities, further study in graduate school (at the Masters or Doctoral level), and further study in professional schools such as medical and dental schools.

**Bachelor of Science in Zoology**

The Bachelor of Science in Zoology curriculum concentrates on organismal biology, with an emphasis on animals. Required courses are designed to develop breadth and depth in core areas, providing a strong base for all Zoology majors. Students acquire a knowledge of zoology from the organizational level of molecules and cells to the organizational level of ecosystems, with flexibility in the selection of upper level courses to specialize or remain generalized, according to individual interests and career goals.

**Undergraduate Minors**

*(find details at oucc.ncsu.edu/minors)*

**Minor in Biological Sciences**

The undergraduate minor in Biological Sciences serves to enhance the programs of students whose major fields are outside the biological sciences and who are interested in obtaining either a broad-based perspective in biology or a more focused exposure to a particular field within biology. It is available to all baccalaureate students except those majoring in Animal Science; Biochemistry; Biological Sciences; Fisheries, Wildlife and Conservation Biology; Genetics; Microbiology; Nutrition Science; Plant Biology; Plant and Soil Sciences; Science Education (Biology Concentration); Turfgrass Science; or Zoology.

Required courses (8 hours) provide an overview of the field of biology, then students select additional courses (at least 7 hours) from approved lists within biological sciences that best match their interests. Students also can complete this minor through Distance Education course offerings. Courses will count toward the minor only if they are completed with a C- or better.

**Minor in Environmental Toxicology**

Toxicology is an interdisciplinary field of study that integrates many physical, chemical, and biological principles that help us better protect human and ecological health. The undergraduate minor in Environmental Toxicology is available to all baccalaureate degree students at North Carolina State University. The minor is intended to provide undergraduate students with an understanding of how chemicals and physical agents can adversely affect biological systems and the environment, including the mechanisms of chemically induced toxicity, the fate and effects of chemicals in the environment, and the evaluation of chemical hazards and risks. The minor is especially appropriate (but not limited to) students majoring in the agricultural sciences, life sciences, physical sciences, or science education. The Environmental Toxicology minor requires 15 semester hours including 9 hours of required courses and 6 hours from a group of electives. A grade of C- or better is required for all courses taken to fulfill minor requirements.

**Minor in Genetics**

The undergraduate minor in Genetics provides students with strong preparation in the principles of genetics as well as preparation in ancillary fields such as statistics, biochemistry and microbiology. This minor is appropriate for (but not limited to) students with majors in animal science, biochemistry, biological sciences, crop science, environmental sciences, fisheries and wildlife sciences, food science, forestry, horticultural science, microbiology, plant biology, plant and soil sciences, poultry science, and zoology. The genetics minor requires 18 hours — 12 specified, three restricted electives and three unrestricted electives. A grade of C or better is required for all courses taken to fulfill minor requirements.

**Minor in Microbiology**

The undergraduate minor in Microbiology is available to all baccalaureate degree students at North Carolina State University who are not majoring in microbiology. The minor is especially appropriate for (but not limited to) students majoring in the biological sciences, bio-processing, physical sciences, or science education. The minor requires 15 semester hours including 8 hours of required courses and 7 hours from a group of electives. Any prerequisite courses are in addition to these courses. A grade of C- or better is required for all courses taken to fulfill minor requirements.

**Minor in Zoology**

The objective of the undergraduate minor in Zoology is to provide students with a solid foundation in zoological concepts, including diversity of the animal kingdom, morphology, physiology, evolution, behavior, and ecology. It is available to all baccalaureate students except those majoring in Biochemistry, Biological Sciences (BLS, MCD, IPN, HB, EEC), Environmental Science (Ecology concentration), Microbiology, Plant Biology, or Zoology. Laboratory experiences are an integral part of the minor. Courses will count toward the minor only if they are completed with a grade of C- or better.

**Distance Education Certificate in Microbiology**

The Undergraduate Certificate in Microbiology offers students the opportunity to further their understanding of microorganisms and the roles they play in the world in which we live. The intended audience of this certificate includes degree-seeking undergraduate students at institutions where a Microbiology major or minor is not available, and non-degree students seeking additional experience in microbiology for career advancement or to enhance their applications to professional, graduate, or allied health schools. This certificate may also improve the ability of K-12 science teachers to compete for positions or teach more effectively. Finally, this certificate provides an in-depth understanding of microbiology
for those interested out of personal satisfaction. Degree-seeking students at NCSU and students who have completed or are currently enrolled in a Microbiology degree program (including a minor) are not eligible. The certificate requires 9 credit hours of required courses and 3 credit hours of electives. Courses will count toward the certificate only if they are completed with a grade of C- or better or S.

Department of Chemistry

General Overview

The Chemistry Department consists of approximately 300 undergraduate majors, 125 graduate students, 29 tenure track, 11 non- tenure track faculty, and 23 staff members in a variety of technical, instructional, and clerical support roles. The Department occupies three large buildings, Dabney Hall, Cox Hall and the Fox Undergraduate Laboratory. In addition, several research groups are located on the Centennial Campus.

Undergraduate Degrees. The Chemistry Department offers two undergraduate degree programs to meet the needs of students interested in chemistry: The Bachelor of Science (B.S.) is the degree that meets certification by the American Chemical Society through its Committee on Professional Training. The B.S. degree provides the breadth and depth of experience to give graduates a wide choice of career options, and is especially suited for further study in chemistry graduate school or a career in the chemical industry. The Bachelor of Arts (B.A.) degree has fewer required chemistry courses and less laboratory time than the B.S. It provides more flexibility for students to design a chemistry program with more electives to meet a wider set of career goals or to pursue a double major.

The Chemistry Department typically graduates about 45-55 B.S. and B.A. chemistry majors each year, ranking in the top 50 in total graduates for the 600+ colleges and universities that offer the American Chemical Society accredited degree. Approximately one-half of graduates go to graduate or professional school, including the most elite institutions. The other half of our graduates who gain employment directly upon graduation are equally distributed among careers in the chemical industry, government, and careers outside of chemistry (including business and law).

Honors Program

Second semester sophomores or first semester juniors in the Chemistry B.S. and B.A. programs with an overall GPA of 3.5 or higher are invited to join the Chemistry Honors Program.

Chemistry Honors students must maintain a GPA of at least 3.25 to graduate with honors. In addition, the departmental requirement for students in the Honors Program is the completion of 9 extra credit hours of work NOT required by their degree programs. Between 3-6 credit hours can come from research conducted in laboratories in the Department of Chemistry. Research in other laboratories of molecular sciences may also be considered. However, in the latter case, prior approval is required. A 3-page report and a letter from the supervisor indicating the nature of the work, time spent in the lab, and performances are required at the end (before finals week) of the semester in which the research is conducted. It should be noted that simply working in a research lab does not necessarily meet the requirements of the Honors Program. The nature of the work must be meaningful research. The rest of the credit hour requirements can be met with 500 level or higher courses in chemistry, biochemistry, polymer sciences, materials sciences, biotechnological sciences and pharmacological sciences. Courses in other subject areas may be considered. However, prior approval is required. If you are in doubt as to whether a particular course will count toward the Chemistry Honors Program, please contact Dr. Alex Nevzorov.

Curricula

The B.A. program offers a flexible course of studies for students who do not necessarily plan to become professional chemists but who desire an interdisciplinary program with an emphasis on chemistry. The proper choice of electives will prepare the graduate for any of the following:

- medical, veterinary, or dental school
- work in chemical sales and management
- teaching in secondary schools
- work in environmental science
- graduate school in an allied science.
- This route is also an excellent premedical or predental program.

The B.S. curriculum, accredited by the American Chemical Society, includes a strong, broad background in mathematics, physics, and the liberal arts. The basic areas of organic, physical, inorganic, and analytical chemistry are stressed. Laboratory and classroom work develop the skills, knowledge, and inquiring spirit necessary for a successful career in chemistry. The advised elective credits allow individual diversity at the junior and senior levels. Many undergraduates participate in current departmental research through part-time employment or research projects. The B.S. curriculum prepares the student to enter the job market directly as a chemist or to enter various graduate schools in chemistry or an allied science.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Department of Marine, Earth and Atmospheric Sciences

The Department of MEAS covers a broad range of disciplines with one overarching goal: a deeper understanding of the Earth’s environment. MEAS takes an interdisciplinary approach to studying our planet’s air, earth and water, combining meteorology, earth science, and oceanography in a single department.

This interdisciplinary viewpoint is particularly important today, in light of accelerating global changes and increasing corporate and public interest in environmental health and wise use of natural resources. Many pressing questions require more than narrow training in a single discipline. MEAS graduates can be equipped for tasks as diverse as improving severe storm forecasting; assessing potential effects of oil exploration; modeling global climate trends or coastal flooding; understanding the transport of tree-killing air pollutants from industrial centers to the North Carolina mountains; developing non-polluting technology for mining; investigating global ozone depletion, or devising plans to minimize erosion and pollution of coastlines.

MEAS offers degrees in meteorology, geology, marine sciences, and natural resources. Marine science majors learn how the oceans, solid earth, and atmosphere interact. Marine sciences courses are highly interdisciplinary and are available in chemical oceanography, physical oceanography, biological oceanography, coastal geology, and marine meteorology. Earth science courses encompass the entire earth, from the core, through the crust, to the minerals, sediments, ground water, and...
land forms of the surface. Tools learned allow students to understand and characterize the physical and historical earth. Course work in all areas of geology equips students to reduce potential disasters from geological hazards and to ameliorate the negative impact of human society on the geological resources of the earth. Selection of a paleontology focus produces graduates knowledgeable about the evolution of the earth’s ecosystems. The meteorology program stresses a quantitative understanding of atmospheric structure and processes. It addresses problems such as air pollution, climate changes, and severe weather, such as thunderstorms, tornadoes, winter storms, and hurricanes. Forecasting and climate studies are enhanced by using real-time satellite imagery, radar data products, and state-of-the-art computer technology. MEAS majors in Natural Resources fill a unique need in today’s society as experts who can interpret science for public policy shapers and decision makers. The training MEAS majors receive in economics, political science, policy issues, and management equips them to interact with industry and with regulatory and conservation agencies.

Planet Earth is MEAS’ natural laboratory. While most scientists conduct experiments under controlled conditions designed to replicate some facets of nature, we use ships, submarines, aircraft, satellites, and unattended monitoring instruments to directly and remotely probe the natural environment itself. Computer modeling helps us visualize real-world data and to design cutting edge experiments. Field study is an integral part of MEAS educational programs, enabling students to apply concepts learned in the classroom to projects in the field. Summer field courses take students to the Southwest US or to the North Carolina coast for intensive training in field methods. Shorter field trips are part of classes in all disciplines.

Opportunities

MEAS undergraduate degree programs provide talented students with the foundation of scientific knowledge required for careers in government, industry, or academe. Many students pursue graduate degrees.

Marine Sciences graduates go on to become oceanographers, to manage our coastal resources, model air-sea interaction, and explore global climate change. They conduct pure and applied research, serving as environmental consultants for industry and governmental agencies, policy and management experts for governmental agencies, and environmental science educators. Graduates with a Natural Resources degree are versed in the fundamental processes and interdisciplinary nature of the coastal zone. As scientists, managers, administrators, and regulators, they make decisions regarding use and conservation of coastal and marine resources.

Geology graduates address society’s needs for dealing effectively with earth processes, such as water resources and the stability of land forms. They work for engineering firms, permit-issuing agencies, and industries that rely on geological resources. Historical geologists are familiar with the evolution of earth through time and provide a perspective on potential long-term reactions of the earth systems to change. Those who concentrate in Environmental Geology are trained to assess and monitor geological resources such as ground water. Marine geologists are experts in the complex issues facing industry, municipalities, and residents in the dynamic and ecologically vulnerable coastal zone.

Meteorology graduates enjoy careers in weather forecasting, air quality assessment, development of weather products and services, broadcast communications, and advanced research. Marine meteorologists study ocean-generated weather systems. Their research is yielding practical benefits such as refined prediction of storm surge, which has streamlined evacuation efforts during severe storms along the Carolina coast. Meteorology graduates with an air quality emphasis work for environmental firms, regulatory agencies, and in applied research. Study of air quality and how air pollution is transported and dispersed is a rapidly expanding field in the atmospheric sciences.

MEAS graduates play a key service role for the State of North Carolina, assisting in everything from forecasting severe storms and analyzing the impact of atmospheric pollutants on agriculture and our estuaries, to determining the effects of toxic waste disposal on quality of surface and ground water.

Honors Program

Participants receive enhanced coverage of academic material and are involved in research. Eligibility is based on scholastic achievement. Minimum requirements for invitation are a GPA of 3.5 and success in some coursework within mathematics, chemistry, or physics. Students are reviewed for eligibility after the first semester of the sophomore year and again as first semester juniors. To successfully complete the honors program, a student will complete a minimum of 9 credit hours of special coursework and an independent research project, culminating in a written scientific report and a professional presentation. Students often choose one of the following presentation options:

1. Oral presentation in the department.
2. A poster presentation at the university’s Undergraduate Research Symposium or equivalent professional conference.
3. Presentation at a professional meeting.

Special coursework includes 3 to 6 hours of independent study. The remaining credits are earned in honors sections of undergraduate courses and in advanced (graduate) courses. Students must graduate with a 3.4 grade point average overall.

Undergraduate Research, Cooperative Education, and Internships

Students who attend a research-intensive (“Research I”) university benefit from the opportunity to engage in research as undergraduates and to study with professors whose involvement in research keeps their knowledge and enthusiasm fresh. The faculty members in MEAS are internationally acknowledged research scientists. Examples of past undergraduate research projects include studies of coral reef fish in the Bahamas to understand age, growth, and life history transitions; assessment of Lake Victoria’s impact on the climate of East Africa; examination of the relationship between atmospheric ozone and meteorological parameters as measured with instrumented balloons; experiments on generation of oxygen from moon rocks to supplement a manned moon station; and reconstruction of events during past volcanic eruptions on Hawaii. Outstanding MEAS students can receive career training with pay through the NC State Cooperative Education program, after completing the first year of undergraduate studies. Co-op and internship students have completed assignments with the National Weather Service, US Geological Survey, US Air Force, US Environmental Protection Agency, NC Museum of Natural Sciences, NC State Climate Office, NC Division of Marine Fisheries, NASA, local environmental consulting firms, and other state and federal agencies. Many students co-op or intern at the internationally renowned Research Triangle Park. After graduation, co-op students often are hired full-time by the same companies or agencies.
Facilities

The home base of MEAS is Jordan Hall, an award-winning structure that accommodates regular and teleconference classrooms, teaching laboratories, computing facilities, and offices of faculty and staff. Jordan Hall has several computing laboratories, including the Weather Analysis and Forecasting Laboratory. This laboratory houses 50 workstations providing access to real-time and archived satellite, radar, surface, and upper-air observations plus a wide variety of numerical model fields. From the rooftop Weather Observatory, detailed weather measurements are automatically logged and archived and weather balloons are launched. The State Climate Office is housed in the Research III building on NC State’s Centennial Campus, where many students gain skills in instrumentation, data acquisition, data analysis, and interaction with the public. NC State’s Center for Marine Sciences and Technology on the shore of Bogue Sound, in Morehead City provides classrooms and research laboratories in a coastal setting.

The department maintains an extensive inventory of both laboratory and field research equipment. Specialized equipment in the department supports teaching and research in:

- **Earth Materials**: Electron microprobe, X-ray fluorescence spectrometer, Laser diffraction particle size analyzer, and Gravity corer.
- **Geochemistry**: Elemental analyzer, Isotope ratio mass spectrometer, and Microelectrode oxygen system.
- **Geophysics**: Magnetometer, 24-channel seismic geophone array & 40 kg accelerated weight drop source, 24-channel direct current resistivity meter, Multi-frequency electromagnetic-induction unit, Ground-penetrating radars with 100, 250, 500 MHz antennas, High-resolution sub-bottom profiler, Terrestrial laser scanner, and Differential GPS receivers.
- **Physical Oceanography**: Autonomous glider, Acoustic current Doppler profilers, and Conductivity-temperature-depth recorder.
- **Biological Oceanography**: Underwater acoustic recorders, Water quality instruments, Biotelemetry VRAP buoy system, Research boats, Scuba equipment, Underwater video system, and Flow-cam optical particle counter.

Curricula

The department offers curricula in each of the areas of marine, earth and atmospheric sciences. Each prepares students for employment at graduation or for further professional training. There is one Bachelor of Science (B.S.) curricula in atmospheric sciences: Meteorology. Students in that major can choose to concentrate in Marine Meteorology. Earth sciences house one curriculum: the B.S. in Geology. In the marine sciences, students can choose between two degree programs: the B.S. in Marine Science or the B.S. in Natural Resources. Students in the marine science major choose one of five concentrations:

1. Biological Oceanography
2. Chemistry
3. Geology
4. Meteorology
5. Physics

Students in the B.S. in Natural Resources concentrate in Marine and Coastal Resources.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Minor in Geology

The Department of Marine, Earth and Atmospheric Sciences offers a Minor in Geology to majors in any field except geology. This program provides a means of recognition for students in any field who have a curiosity about the materials, structures and processes of the solid earth.

Requirements

- At least 15 hours of geologic coursework which must include:
  - A gateway course (MEA 100, MEA 101, MEA 120, MEA 140, MEA 150, or MEA 200)
  - MEA 110
  - MEA 202
  - MEA 211
- A grade of "C" or better in all course work used toward minor.

Program Administrator and Contact:

Dr. Karl Wegmann
Department of Marine, Earth and Atmospheric Sciences
2123 Jordan Hall, Box 8208
919.515.0380
kwwegman@ncsu.edu

Minor in Meteorology

The Department of Marine, Earth, and Atmospheric Sciences offers a Minor in Meteorology to majors in any field except meteorology. Admission to the program requires a grade of C or better in the following courses:

- MA 141
- MA 241
- MA 242
- PY 205
- PY 208

Successful completion of the program requires a grade of C- or better in the following courses:

- MEA 213 (MEA 130 may be substituted)
- MEA 214
- MEA 312
- MEA 421

Program Administrator and Contact:

Dr. Matthew Parker
Department of Marine, Earth and Atmospheric Sciences
5149 Jordan Hall, Box 8208
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mdparker@ncsu.edu

Department of Mathematics

The department offers Bachelor of Science degrees in Mathematics and in Applied Mathematics with an optional concentration in Financial Mathematics. These programs provide a core of basic mathematics courses along with flexible choices of electives, which permit both a well-rounded education and preparation for math-related careers. Students may focus their studies in financial mathematics, mathematical
biology, mathematical physics, mathematical statistics, or computational mathematics. Employment objectives can be focused on quantitative careers in business or government, teaching at the secondary level, or graduate study in mathematics and/or related areas.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

**Academic Enrichments**

Many undergraduates in the Mathematics Department participate in research programs with members of our faculty presenting their results in both regional and national meetings. The research projects come from many areas of pure and applied mathematics including chaos theory, the path-space of various surfaces, numerical methods for solid mechanics, and math modeling in the life-sciences, such as orthopedic soft tissues and blood flow in the brain. Other enrichment activities include special topics courses, such as The Mathematics of Ranking and Clustering, and programs away from campus, such as the NSF sponsored Research Experience for Undergraduates, the Budapest Semester in Mathematics, and the Society for Undergraduate Mathematics, a club for all students interested in mathematics, and is a Student Chapter of the Mathematical Association of America.

Talented students are encouraged to consider a 5-year Accelerated Bachelors/Masters Program (ABM). A key feature of the program is counting up to 12 hours of graduate courses to both the BS and MS degrees. Students can choose between the MS in Mathematics, Applied Mathematics, or Financial Mathematics.

**Honors Program**

Students that demonstrate high aptitude in mathematics are invited to participate in the Mathematics Honors Program. The program provides intensive mentoring and preparation for graduate studies. Students are invited to join the program if they are recommended by a teacher in an upper-level math course and have a GPA of 3.5 in math. To complete the program, students must take MA 426 Mathematical Analysis II, at least three graduate level math courses, and do a research project. Math Honors students often study abroad at programs such as the Budapest Semesters in Mathematics or Math in Moscow and participate in funded summer research at other universities.

**Awards**

The department recognizes its superior students with the following annual awards:

- Hubert V. and Mary Alice Park Scholarship, for an outstanding rising junior or senior in mathematics.
- John W. Cell Scholarship, for an outstanding rising junior or senior in mathematics;
- Carey Mumford Scholarship, for an outstanding sophomore, junior, or senior in mathematics.
- Levine-Anderson Award, for the student who has the best performance in the William Lowell Putnam Examination (not restricted to math majors).
- Charles N. Anderson Scholarship, for an outstanding sophomore in mathematics.
- Charles F. Lewis Scholarship, for an outstanding senior who is a double major in mathematics/mathematics education.
- Mrs. Roberts C. Bullock Scholarship, for an outstanding mathematics major with a demonstrated interest in the English language.
- Dr. Rebecca R. Bullock Memorial Scholarship Endowment, for an outstanding mathematics major with a demonstrated interest in the English language.
- Howard A. Petrea Scholarship, for an outstanding junior or senior in mathematics.
- H. Thomas and Sue Banks Scholarship, for an outstanding undergraduate pursuing degrees in one of the departments of the college, with preference for math majors.
- Gordon Family Scholarship, for an outstanding undergraduate majoring in mathematics. Recipients must agree to volunteer one hour a week as a math tutor at the SAS Learning Center at Kentwood.
- Marvin and Mary Chaney Scholarship, for an outstanding undergraduate majoring in mathematics.
- Dr. Daniel Teague and Dr. Jo-Ann Cohen Scholarship, for an outstanding undergraduate in mathematics with an interest in K-12 mathematics education.
- Fulton and Ruby H. Starling Scholarship, for an outstanding undergraduate pursuing degrees in one of the departments of the college, with preference to a student from Robeson County and with preference for math majors.
- James W. Mauney Scholarship, for an outstanding undergraduate majoring in mathematics.

The department also has a chapter of the National Mathematical Honorary Fraternity Pi Mu Epsilon. Membership is open to those students with superior performance in mathematics courses.

**Minor in Mathematics**

The minor program consists of the successful completion with a grade of C- or better of any 15 hours selected from the Department of Mathematics’ list of approved courses. The list includes MA 225 Foundations of Advanced Mathematics as well as any MA courses at the 300, 400, and 500 levels.

**Department of Physics**

Physics is the fundamental science of observation, measurement and description of the natural world. Physicists seek to establish a mathematical description of all physical phenomena, ranging from the interactions of quarks in nuclei to the collisions of galaxies in the universe. Together with scientists in engineering and other physical, biological, and mathematical sciences, physicists collaborate to develop new materials and new insights in all areas of modern science and technology.

**Curricula**

The Physics undergraduate curricula provide a strong background in the fundamentals, and offer course options for deeper studies in areas of interest. Undergraduates have the opportunity to work in research laboratories with faculty in: astrophysics, atomic physics, biological physics, physics education, nuclear and particle physics, synchrotron radiation, near-field optics, and materials physics, solid-state and condensed-matter physics. Undergraduates are frequently co-authors on scientific papers. Physics majors are part of a close-knit community- a small highly motivated group of people who have wide-ranging interests and a passion for solving problems.
Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

**Bachelor of Science in Physics**

This degree equips students with a broad technical background, providing a solid basis for graduate study in physics or related sciences, enrollment in professional schools such as law or medicine, and employment in government or industrial laboratories.

**Bachelor of Arts in Physics**

This degree offers a flexible course of study for students who may not plan to become professional physicists but who desire an interdisciplinary program with a strong emphasis on physics. The proper choice of electives will help to prepare the graduate for professional careers in education, law, business, journalism, or graduate school in an allied science. It is especially suitable as part of a double major or as preparation for high-school teaching.

**Honors Programs**

The Department of Physics Honors Program offers students the opportunity to develop their academic potential by increased involvement and participation in physics study and research. To graduate with physics honors, students must complete three (3) hours of PY 499 Independent Research in Physics and submit a written scientific report based on their results. Students must also complete an additional nine (9) hours of 500-level physics courses. One 400 level physics course (excluding PY 407) taken with the honors contract may be substituted for a 500 level course.

**Minor in Physics**

The Department of Physics offers a minor in physics to majors in any field except physics. To complete the minor, the following physics courses are required:

**Course List**

- PY201 or PY 205 - Mechanics
- PY 202 or PY 208 - Electricity and Magnetism
- PY 203 or PY 407 - Modern Physics

Choose two of the following:

- PY 301 - Introduction to Quantum Mechanics
- PY 328 - Stellar and Galactic Astrophysics
- PY 341 - Spacetime Physics
- PY 401 - Quantum Physics I
- PY 402 - Quantum Physics II
- PY 411 - Mechanics I
- PY 412 - Mechanics II
- PY 413 - Thermal Physics
- PY 414 - Electromagnetism I
- PY 415 - Electromagnetism II

**Department of Statistics**

Statistics is the body of scientific methodology that deals with the logic of experiment and survey design, the efficient collection and presentation of quantitative information, and the formulation of valid and reliable inferences from sample data. The Department of Statistics provides instruction, consultation, and computational services on research projects for other departments of all colleges at North Carolina State University including the Agricultural Research Service. Department staff are engaged in research in statistical theory and methodology. This range of activities furnishes a professional environment for training students in the use of statistical procedures in the physical, biological and social sciences and in industrial research and development.

**Opportunities**

The importance of sound statistical thinking in the design and analysis of quantitative studies is reflected in the abundance of job opportunities for statisticians. Industry relies on statistical methods to control the quality of goods in the process of manufacturing and to determine the acceptability of goods produced. Statistical procedures based on scientific sampling have become basic tools in such diverse fields as weather forecasting, environmental monitoring, opinion polling, crop and livestock estimation, market research, and business trends prediction. The development and testing of new drugs and therapies requires statistical expertise, and advances in genomic science provide tremendous opportunities for statistical work. Because one can improve the efficiency and use of increasingly complex and expensive experiment and survey data, the statistician is in demand wherever quantitative studies are conducted.

**Scholarships and Awards**

The Department of Statistics recognizes the importance of superior academic performance through the awarding of scholarships and certificates of merit. Scholarships are available for the freshman year for the purpose of attracting academically superior students. There are four named departmental scholarships: John L. Wasik Freshman Scholarship, Francis E. McVay Scholarships, Dr. Jackson A. and Viola H. Rigney Scholarship and SAS Institute Scholarships. The North Carolina State University chapter of Mu Sigma Rho, the national statistics honorary fraternity, accepts as members students who have had superior performance in statistics courses. Each year the department recognizes exceptional seniors with awards in the areas of community engagement, academic achievement, and research.

**Honors Program**

The Department of Statistics allows exceptional undergraduate students to design a program of study that typically includes advanced courses not ordinarily taken by statistics majors and one or two semesters of independent study or research. Students in the program complete a minimum of 9 credit hours in courses drawn from at least two of the following three categories: MA 426, or other courses designated as appropriate by the honors adviser, 500-level courses in statistics or mathematics, and 400- or 500-level courses in independent study. Interested students should contact the Honors Adviser in the statistics department for additional information.

**Curricula**

The undergraduate curriculum provides basic training for a career in statistics or for graduate study and leads to the Bachelor of Science in Statistics. In addition to statistics, the curriculum includes study in
mathematics, computer science, and the biological/physical sciences. While fulfilling their major elective requirements, students can either elect a minor or distribute their study across disciplines exploring the application of statistics in other fields such as agriculture and life sciences, computer science, economics and business, industrial engineering, and the social sciences. A cooperative work-study option is also available.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

**Minor in Statistics**

The Department of Statistics offers a minor in statistics to majors in any field except statistics. The importance of statistical reasoning to solve real world problems has been recognized by the business, government, and scientific communities. This minor program will provide students with an opportunity to become competent in the use of statistical methods to summarize information and/or provide answers to policy/research questions. Students completing this program of study will also be provided with experience in statistical computing. Please see the Director of Undergraduate Programs. Please refer to http://oucc.ncsu.edu/minors/statistics for information about a minor in statistics.

**College of Textiles**

1000 Main Campus Drive - NC State University
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Fax: (919) 515-8578
Visit the College of Textiles website (http://www.tx.ncsu.edu/)

Textiles encompasses every aspect of our daily lives with applications in medicine, space, recreation and sports, fashion, personal safety, sustainability, energy, transportation, household and geotextiles. The textile industry continues to become more dynamic with an increased emphasis being placed on the use of new technology. For example, imagine wearing clothes that have electronics incorporated within them that allow them to change colors, monitor your heart rate or track your location; or soldiers wearing uniforms made from nano-fiber that protect them from biological and chemical agents; or artificial arteries, bones, ligaments and skins made from textile substrates and polymers; or getting your apparel custom made in a matter of minutes through body scanning, computer aided design and computer aided manufacturing.

The approximately 10,000 alumni of the College of Textiles hold diverse positions. Graduates of the department of Textile and Apparel, Technology and Management go onto careers including executive management positions for major textile organizations, retail buying, manufacturing management, marketing and sales, corporate management, design, sourcing, supply chain management, quality control and personnel management. Graduates of Textile Engineering, Chemistry and Science go on to careers in diverse industries represented by companies including Nike, North Face, HanesBrands, Under Armour, Duke Hospitals, Bank of America, Patagonia, Abercrombie and Fitch, Milliken & Company, and Technimark. Many graduates of these programs pursue graduate degrees in Polymer Engineering, Chemical Engineering, Chemistry, Textile Chemistry, Textile Engineering, Industrial Engineering, as well as professional degrees in Analytics, Medicine, Dentistry, and Law. These textile graduates enter an exciting arena, where they bring creativity to the design/development and management decision-making aspects to the industry. Graduates are key strategists in managing global textile-related operations. Engineering systems and products for industry, space, medical textiles, apparel, home textiles, transportation and nonwovens provide exciting opportunities.

Opportunities remain excellent, with the college maintaining one of the university’s best career placement records with an average of 90% or better each year. Demand for textile graduates from NC State University is particularly strong, due mainly to the strength of the academic programs and the College’s strong working relationships with industry and government. These programs are offered by two degree granting departments: Textile and Apparel, Technology and Management, and Textile Engineering, Chemistry, and Science.

**Degree Programs**

The College of Textiles offers a broad choice of curricula from which to choose. Bachelor of Science programs in Textile Technology, Fashion and Textile Management, Fashion and Textile Design, Textile Engineering, and Polymer and Color Chemistry are available. These programs allow students to choose from a wide range of courses in addition to required core courses. The textile student’s curriculum includes humanities, social sciences and basic sciences and may include concentrations in business, economics, medical textiles, forensics, industrial engineering, mathematics, physics, chemistry, computer science, or statistics. Dual degree possibilities are open to textile students, usually requiring at least two semesters of additional study.

The dual degree for Textile Engineering and Chemical Engineering meets requirements for bachelor’s degrees in both Textile and Chemical Engineering in only 9 semesters. Students in this dual degree program select the Chemical Processing Concentration of Textile Engineering.

**Facilities**

The College of Textiles consists of nearly 300,000 square feet of modern laboratories, studios, classrooms and offices, with plans to expand in the near future. The College is located on Centennial Campus, which is adjacent to NC State University’s central campus. Centennial Campus is a “technopolis” that combines the university, corporate and government research and development facilities. There is no other campus or research park quite like this 1,334 acre site. The College of Textiles is also across the street from the internationally known James B. Hunt, Jr. Library.

**Scholarships**

The Board of Directors of the North Carolina Textile Foundation and friends of the College of Textiles have established an outstanding freshman scholarship program for incoming freshmen, students transferring into the College of Textiles, and current textile students. The College of Textiles currently has the largest college-based scholarship program at NC State University.

Centennial Scholarships are currently valued at $10,000 per year for in-state and out-of-state students. This scholarship program also offers a $7,500 enrichment fund per recipient for educational enhancement activities. Candidates must be nominated by his or her high school or home school by November 1st, or must self-nominate before November 15th. North Carolina Textile Foundation (NCTF) Scholarships (total value: $20,000) and Textile Prestige Scholarships (total value: $10,000) are also awarded through the Centennial Scholarship Process. Application
deadline for all Textile scholarships is December 1. Restrictions do apply. Contact Kent Hester at (919) 515-6530 for full details.

Exchange Program
Students at NC State have the opportunity to study abroad at universities in North and South America, Europe, Asia, Africa, and Australia/Oceania. Students can study abroad for as short a time period as one week or for as long as an entire academic year. Some financial assistance is available through the College of Textiles for students participating in study abroad opportunities.

Additional information about exchange opportunities for College of Textiles students can be obtained from the College of Textiles website (http://www.tx.ncsu.edu/academics/international-programs) or by contacting Liz Moran, Director of Advising and Admissions, at ecmoran@ncsu.edu or by telephone at (919) 515-0030. www.tx.ncsu.edu/academics/international-programs

Student and Career Services
The Office of Student Services is responsible for career services and scholarship programs of the College of Textiles. The career services office brings together industry recruiters and students for interview sessions for permanent and summer employment. Alumni may also take advantage of the placement office. Job opportunities for summer employment are available for textile students. Placement assistance is available through the college career services office and frequently can be arranged in the student’s home community as well as global locations.

Textiles Online Programs (TOP)
The College of Textiles has a selection of graduate and undergraduate courses offered online each semester. Oncampus students may take these courses with departmental approval. Classes with labs may require the student to enroll in an oncampus lab section. Additional information for online courses can be obtained from the College of Textiles website www.tx.ncsu.edu/academics/distance-education/ or by contacting Teresa Langley, Director of Distance Education, at tlangley@ncsu.edu or by phone at (919) 515-1532.

Department of Textile and Apparel, Technology and Management
The Department of Textile and Apparel, Technology and Management offers Bachelor of Science degrees in Fashion and Textile Management and in Fashion and Textile Design. The degree in Fashion and Textile Management permits the student to specialize in one of two concentrations: Textile Brand Management and Marketing and Fashion Development and Product Management. The B.S. in Fashion and Textile Design degree offers two concentrations in Fashion Design and Textile Design. Each program requires a common series of foundation courses covering the principles, fundamentals, and applications of textile technology and business.

Curricula
The B.S. in Fashion and Textile Management has two concentrations. The Textile Brand Management and Marketing Concentration focuses on studying textile branding strategies, consumer trends, product trends, licensed products, and the global textile marketplace dynamics. The Fashion Development and Product Management Concentration focuses on design and development of fashion products, integrating trend analysis, computer-aided-design, coloration, silhouette selection, pattern making, fabric selection, consumer research, costing, sourcing and quality assessment. Students in both Fashion and Textile Management concentrations may pursue global studies, including study abroad, to further enhance their understanding of global market opportunities.

The B.S. in Fashion and Textile Design offers an excellent opportunity for students to pursue interests in Fashion Design and Textile Design Concentrations with focus on designing innovative, intricate, fashion products utilizing the knowledge taught in Yarn and Fabric Formation Technologies, Computer Aided Design, Drawing and Illustration, etc. To gain global experience in the field, students are encouraged to study abroad for one semester in the junior year in places known for their creativity like France, England, Italy, the Czech Republic, Australia, China and India. The Fashion and Textile Design program prepares graduates to accept positions in the industry related to fashion and textile design.

The Department of Textile and Apparel Technology and Management has state of the art laboratories including the Textile Management Science Laboratory, Digital Design Laboratory, Fashion Studio, Textile Design Studio, Surface Design Studio, Filament and Technology Lab, Specialty Software Computer Lab, and Microscopy and Image Analysis Lab.

Specific curriculum requirements are available on the Registration and Records website (http://www.ncsu.edu/registrar/curricula).

Journal
The department publishes an online electronic journal quarterly, Journal of Textile and Apparel Technology and Management (JTATM), which provides industry, government and academic personnel with the timely dissemination of textile information. With a readership in excess of 10,000 persons (industry, government, and academic professionals), JTATM serves as an effective communication vehicle regarding the latest textile innovations, both management and development, in the field. Faculty and students utilize this resource in coursework and research efforts. Visit the Journal of Textile and Apparel, Technology and Management (http://www.tx.ncsu.edu/jtatm) online!

Department of Textile Engineering, Chemistry and Science
The Department of Textile Engineering, Chemistry, and Science offers Bachelor of Science degrees in Polymer and Color Chemistry, Textile Engineering, and Textile Technology as well as several minors. The department is uniquely interdisciplinary, dedicated to providing instruction in the science, engineering, and technical application of chemistry, color, polymers, bio-medicals, design, and production with regard to fibers and fiber-based materials.

Polymer and Color Chemistry
The B.S. in Polymer and Color Chemistry is a flexible and rigorous program that provides courses in fundamental chemistry, while incorporating some unique areas of applied chemistry in polymers and color chemistry. The applied courses are heavily oriented to the chemistry and technology of polymers, including polymer synthesis, extrusion and characterization. In addition, the color chemistry component of the degree
Textile Technology

The B.S. in Textile Technology provides students with basic knowledge of fiber materials, science and technologies of fiber processing, as well as fiber-based product design and development. The curriculum prepares students in product design and development processes, beginning with understanding of application to material selection to appropriate technologies to utilize.

The Textile Technology degree program offers a well rounded versatile degree, which prepares graduates to collaborate effectively with professionals in a global interdisciplinary environment. After introductory exposure to several of the fundamental aspects of fiber science and textile technology, the student can build additional depth in one of the three concentrations of Medical Textiles, Technical Textiles, and Textile Supply Chain Operations or stay in the general degree which allows students the flexibility of designing their own interest or transferring among colleges of veterinary medicine by its prerequisites.

Minors offered in Textile Engineering, Chemistry and Science

The department offers several minors to students who do not want to double major in one of the degrees but would like to get some of the same experiences.

Minor in Polymer and Color Chemistry

The minor in Polymer and Color Chemistry (http://oucc.ncsu.edu/minors/polymer-and-color-chemistry) is available to majors in any field except Polymer and Color Chemistry. The program is designed to expose students to the technical and scholarly disciplines of polymer chemistry, fiber formation, color physics, dyeing, and chemical modification of fibers and fabrics, and gives them an opportunity to learn how basic disciplines are applied in an industrial environment. Any interested students should contact the Department of Textile Engineering, Chemistry, and Science for information about the minor and its prerequisites.

Minor in Nonwovens

The minor in Nonwovens is available to majors in any field except Textile Technology. Nonwovens is a 20 billion dollar industry just in North Carolina and covers a wide range of products and usages from filtration systems for purifying air, blood and water, various types of wipes, many medical applications, etc. The processing of nonwovens depends on a range of technologies, some adapted from the textile and paper industries, others developed uniquely for nonwovens production. This program will allow the student to take those textile technology classes that deal with nonwoven processes and products as well as exposed to all the equipment.

College of Veterinary Medicine

College of Veterinary Medicine
1060 William Moore Drive
NC State Box 8401
Raleigh, NC 27607
Phone: (919) 513-6500
Student Services Phone: (919) 513-6262
Student Services Fax: (919) 513-6197
E-mail: cvm_dvm@ncsu.edu

Ranked third in the nation among colleges of veterinary medicine by U.S. News & World Report, NC State’s College of Veterinary Medicine is a driving force in veterinary innovation. From our leadership in understanding and defining the interconnections between animal and human health, to groundbreaking research in areas like equine health, and our commitment to training the next generation of veterinary health professionals, we are dedicated to advancing animal and human health from the cellular level through entire ecosystems.
No specific undergraduate degree track is associated with a pre-professional veterinary medicine program. Faculty members from the College of Agriculture and Life Sciences and the College of Sciences serve as advisers to undergraduate students interested in veterinary medicine that are enrolled and pursuing a baccalaureate program usually in a science-related field. Pre-professional course requirements are listed at: http://www.cvm.ncsu.edu/studentservices/admissions.html. After completion of the required courses, students may be eligible to apply for the professional veterinary program. Course requirements may be changed annually and are determined by the Faculty Committee on Admissions in the College of Veterinary Medicine.

All courses listed at: http://www.cvm.ncsu.edu/studentservices/admissions.html should be completed by the time of application to the College of Veterinary Medicine, except for two courses which may be pending completion in the spring semester, term, or quarter, of the year of application.

Department of Clinical Sciences

The Department of Clinical Sciences is dedicated to excellence in educating and training veterinarians and comparative biomedical scientists, furthering health care and wellness through discovery and clinical research, providing outstanding and compassionate medical care to a diverse range of animal patients, effectively engaging animal-owning public, government and industry partners, and providing leadership in integrating biomedical sciences to advance One Health.

Curricula and programs in Clinical Sciences are only available at the graduate level. Please visit the Clinical Sciences website (http://www.cvm.ncsu.edu/docs) for more information.

Department of Molecular Biomedical Sciences

The mission of the Department of Molecular Biomedical Sciences is to provide outstanding instruction and mentoring in the professional veterinary curriculum and graduate programs, and to conduct basic and clinical biomedical research. A wide-range of research efforts are conducted within the Department that span the whole-animal, tissue, cellular, and molecular levels. The Department fosters and encourages interdisciplinary approaches to solving biomedical problems, and seeks collaborations with public- and private-sector research institutions in the Research Triangle and beyond.

Curricula and programs in the Department of Molecular Biomedical Sciences are only available at the graduate level. Please visit the MBS website (http://www.cvm.ncsu.edu/mbs/about.html) for more information.

Department of Population Health and Pathobiology

The mission of the Department of Population Health and Pathobiology is to recruit, train, inspire, and graduate Doctors of Veterinary Medicine of exemplary knowledge, skill, and character. In order to maintain the intellectual and professional climate necessary to accomplish this mission, the department's faculty will advance veterinary medical science through innovative basic and applied research, inspired mentoring of students (undergraduate, professional, residents, and graduate), excellence in clinical and diagnostic services, and innovative extension and engagement activities.

Curricula and programs in the Department of Population Health and Pathobiology are only available at the graduate level. Please visit the PHP website (http://www.cvm.ncsu.edu/dphp) for more information.

Distance Education and Learning Technology Applications (DELTA)

Thomas K. Miller III, Senior Vice Provost for Academic Outreach & Entrepreneurship
Donna Petherbridge, Associate Vice Provost, Instructional Technology Support & Development Services
Rebecca Swanson, Associate Vice Provost, Distance & Distributed Education
Barbara Yde, Business Officer
Kay Zimmerman, Associate Vice Provost, Marketing & Partnership Development

Vision. We seek to improve the quality of education by harnessing technology to provide ready access for all learners. In this way we hope to meet the challenges of a changing society.

Mission. Transformative educational experiences benefit a complex, global society and are key to a quality future. DELTA collaboratively applies expertise in innovative technologies and pedagogies to solve instructional challenges in an efficient, effective and service-oriented environment, with the overarching goal of helping faculty build student success.

DELTA’s role within the Office of the Provost is to foster the integration and support of learning technologies in NC State’s academic programs, both on the campus and at a distance. DELTA coordinates the funding and production of all distance-based credit programs and courses for the university, and promotes the quality of education by extending the reach of the faculty, collaboratively applying expertise in technology and pedagogy in an efficient, effective, and service-oriented environment.

DELTA manages the university’s learning technology infrastructure, including various asynchronous learning management systems (Wolflware, Moodle); Blackboard Collaborate, a tool for synchronous online teaching and learning, and several campus video classrooms. DELTA offers various programs and services that provide training, support, and resources for all instructors teaching and learning with technology. These services may range from developing and/or funding distance education courses and programs, to creating technology resources and providing support for face-to-face instruction, to working with colleges to create specialized, technology-delivered education programs in support of critical constituencies in our state, such as the U.S. military. For more information, please visit DE website (http://distance.ncsu.edu).
Other Academic Departments

In addition to the many degree programs offered by NC State's nine colleges, minors and degrees are available in areas like Health and Exercise Studies and Biotechnology. Check out the links in the sidebar to find out about these offerings!

Biotechnology Program

An undergraduate Minor in Biotechnology is available for all students who have met prerequisites in biology and chemistry. This program is university-wide and combines NCSU's strengths in the life sciences, agriculture, and engineering. The minor is ideal for students who wish to pursue graduate studies in the life sciences, biomedical professional degrees, or work in research and development in industry or government agencies.

The Biotechnology Minor combines cutting-edge, laboratory-intensive coursework with related independent undergraduate research experiences. Examples of advanced laboratory research techniques taught in our program include recombinant DNA technology, RNA interference, PCR, microarray technology, deep sequencing, protein purification, metagenomics, proteomics, and more.

Many curricula offer a great deal of theory about molecular biotechnology, but few allow for the level of hands-on experience that the Biotechnology Program does. For more information about the Biotechnology Minor and the most recent list of our courses, please visit the Biotechnology website (http://biotech.ncsu.edu).

Military Sciences (Air Force ROTC)

Department of Aerospace (Air Force ROTC)

Lieutenant Colonel Jeffrey Onan, Commander and Department Chair

Professors:
Lieutenant Colonel Jeffrey Onan
1Lt Nathanael Farrington

Our faculty of professors are active duty officers from diverse professional backgrounds that enrich the learning environment.

Air Force Reserve Officer Training (AFROTC) Program

The AFROTC program at NCSU is geared toward students who desire to earn a commission as a Second Lieutenant in the U.S. Air Force. However, any student from NCSU or one of our four crosstown colleges who wishes to learn about the U.S. Air Force (USAF) can take any Air Force ROTC course with no obligation or commitment. All students who complete the Aerospace Studies academic program of study with a minimum of 15 hours in aerospace studies are eligible to receive a Aerospace Studies minor.

The four-year AFROTC program that leads to a commission as a U.S. Air Force Officer allows freshmen to enroll in Aerospace Studies courses in the same manner as other college courses for the first two years. It is during this time a student may join the program and become an Air Force ROTC cadet. All cadets must be attending college in “full time” status. Aerospace Studies courses are taken as free electives and cadets incur no military obligation unless they are receiving an AFROTC scholarship. The first two years in the AFROTC program are called the General Military Course (GMC) during which cadets learn the basics of military discipline, followership, and begin preparation for field training. The last two years of AFROTC comprise the Professional Officer Course (POC) where cadets lead each other through a time-tested leadership laboratory training environment that instills both character and leadership skills needed in preparation for life as an active duty officer. The pinnacle training event for AFROTC occurs in the summer between the sophomore (AS200) and junior (AS300) year when a cadet attends intense field training held at Maxwell AFB, Alabama and Camp Shelby, Mississippi.

For exceptionally qualified cadets, the four-year program can be compressed to as little as two and one half years for those who do not complete all four AS100 and AS 200-level courses (AS 121 The Foundation of the United States Air Force I and AS 221 The Evolution of USAF Air and Space Power I are offered in the fall semester, AS 122 The Foundations of the United States Air Force II and AS 222 The Evolution of USAF Air and Space Power II are offered in the spring semester) while enrolled in the Air Force ROTC program. Interested students must contact the Professor of Aerospace Studies to determine eligibility requirements.

Cadets at every level have numerous opportunities to further their knowledge of the Air Force and develop leadership. Throughout the school year, cadets have opportunities to examine all aspects of life in the Air Force and gain leadership experience through Air Force base visits, flying opportunities, and social activities. Additionally, a variety of summer programs allow cadets to visit bases and participate in programs such as the US Air Force Academy Free Fall program, manned glider training, and worldwide cultural immersion programs. POC cadets have similar opportunities, with focus on programs related to the cadet’s desired active duty career area, both in the U.S. and abroad.

Upon university graduation and satisfactory completion of the Air Force ROTC program, a cadet is commissioned a second lieutenant in the USAF and is obligated to serve a minimum of four years on active duty.

Scholarship Opportunities and Stipend

Cadets enrolled in the AFROTC program are encouraged to apply for Air Force ROTC scholarships. Competitive scholarships are awarded by the Air Force and are based primarily on college academic achievement, displayed leadership capabilities and the needs of the Air Force for specific academic degrees in technical and foreign languages. Additionally, special scholarships are awarded to fill critically needed academic majors within the Air Force as long as eligibility is met. AFROTC scholarships pay for tuition, fees, books, and provide cadets a stipend each month during the academic year for miscellaneous expenses. Stipends for AFROTC scholarship cadets vary according to the cadet’s year of academic enrollment in AFROTC.

For example, scholarship freshmen currently receive $300 per month, sophomores $350 per month, juniors $450 per month, and seniors $500 per month. Additionally, cadets who complete field training and are enrolled in the POC receive a stipend regardless of scholarship.
status. All scholarships have minimum academic standards that must be maintained.

**Curriculum**

The AFROTC educational program provides professional preparation for future Air Force officers. Courses in the first two years focus on Air Force missions, organization, military career opportunities, and the history of airpower. The focus in the last two years is on leadership and management, methods for managing conflict, in-depth examination of national security, policy and American defense strategy. A progressive development of communicative skills, oral and written, is integrated into each course. Officership is developed through lessons taught in the classroom environment and then applied in the associated leadership laboratory (only cadets may take leadership lab). In addition, traditional military social functions, base orientation trips, and cadet-centered programs further enhance understanding of the USAF.

**Eligibility**

All full-time freshmen and sophomores with at least a 2.0 cumulative GPA and a desire to seek a commission may enroll in the GMC program without obligation to the Air Force through enrollment in the AS100 (AS 121 The Foundation of the United States Air Force I and AS 122 The Foundations of the United States Air Force II) and AS200 (AS 221 The Evolution of USAF Air and Space Power I and AS 222 The Evolution of USAF Air and Space Power II) blocks of Aerospace Studies curriculum. To enter the POC, cadets must meet physical, medical and academic requirements, and successfully complete field training (typically between your second and third year). In addition, some age, citizenship and background restrictions apply; contact the department for more details. Students desiring to enter the four-year program simply register for the AS100 course (either AS 121 or AS 122 depending on the semester). All students interested should contact the Air Force ROTC office on campus in Broughton Hall 3229, (919) 515-2417, by e-mail at airforce@ncsu.edu or write to: Professor of Aerospace Studies, NC State, Box 7308, Raleigh, NC 27695-7308.

**Organization**

The Air Force ROTC Cadet Corps, nicknamed “Wolfpack Warriors,” is organized as a cadet wing staffed entirely by cadets for leadership development. They are assisted and advised by experienced active duty officers and non-commissioned officers who are assigned as instructors to the detachment. Three collateral organizations, Arnold Air Society, Wolfpack Warrior Booster Club and Honor Guard, support the cadet wing organization as well as the university and community.

**Uniforms**

Uniforms are provided by the federal government and are worn by cadets on the day of Leadership Laboratory (Wednesday) or as specified by cadet corps leadership.

View the NC State Air Force ROTC website (http://www.ncsu.edu/afrotc).

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**Department of Military Science**  
**Army ROTC**

**Mission**

The mission of the Army ROTC Program is to train college men and women to become commissioned officers in sufficient numbers to meet Active Army, Army Reserve and National Guard requirements.

**Program of Instruction**

The Army ROTC program consists of a voluntary Basic Course (freshmen and sophomore level) and a two-year Advanced Course (junior and senior level) that includes a four-week Cadet Leaders Course in the summer prior to the senior year. One may enter the Advanced Course without participating in the Basic Course by any of the following methods:

- **Simultaneous Membership Program (SMP):** Members of Reserve or National Guard units may take advantage of this program and, if accepted, enroll directly into the Advanced Course. SMP participants will be assigned to a unit near NC State or home for part-time monthly officer training and will receive the ROTC Advanced Course subsistence payment of $450 per month for Juniors and $500 for Seniors, plus approximately $200 per month for the one weekend of Reserve or Guard training. In addition, two weeks of Annual Training will be required for which the individual will receive full pay.
- **Prior Service:** Service veterans are eligible for placement into the Advanced Course.
- **Leader’s Training Course (LTC):** Successful completion of the four-week basic summer camp, held at Ft. Knox, Kentucky is an alternative to the Basic Course. Students with strong academic credentials may receive a scholarship after completing this course.
- **Transfer Credit:** Students entering as transfer students from other institutions may receive credit for work completed at other Senior ROTC units.
- **Junior ROTC:** Students who have participated in a Junior ROTC in high school may receive placement credit as determined by the Professor of Military Science.

**Eligibility**

All full-time freshmen and sophomores may enroll in any Military Science Basic Course offering without obligation to the Army. To be eligible for participation in the Advanced Course, applicants must be in good academic standing and demonstrate satisfactory performance in the Basic Course. Additionally, applicants for commissioning must be able to be commissioned by their 30th birthday. An age waiver may be obtained as long as the individual will be commissioned prior to his/her 32nd birthday. A student must have a minimum of two years remaining as a full-time student at either the undergraduate or graduate level.

**Professional Military Education**

There are five Professional Military Education (PME) courses which must be taken or have an approval of a waiver obtained for them. All but one content area (Military History) are automatically met by completion of the university’s General Education Distribution Requirements. PME requirements must be completed or waived prior to commissioning.
Delays for Graduate Study
Qualified ROTC graduates may delay their entry into active service in order to obtain advanced academic degrees. Fellowships for advanced academic study are available to selected ROTC graduates, allowing up to two years of graduate study while receiving full pay and allowances plus payment for tuition, all fees, textbooks, and required supplies.

Financial Aid
Army scholarships of two to four years which pay for tuition, all fees and textbooks are available on a competitive basis to students who are strongly motivated and academically qualified. Students in the Advanced Course who are preparing for commissioning receive a subsistence allowance of $450 per month for Juniors and $500 per month for Seniors (tax free) up to a maximum of $4500. All Advanced Course cadets are paid approximately one-half the basic pay of a second lieutenant while attending the four-week Cadet Summer Training, plus travel allowances to and from camp.

Service Opportunities
Scholarship recipients may serve four years active duty upon commissioning or eight years in the United States Army Reserve or National Guard. Service consists of one weekend drill per month and two weeks annual training.

Program Features
Army ROTC classes are unique, offering instruction and a practical, working knowledge of leadership. Students are challenged early in the ROTC training to enable them to develop sound judgment, the desire to achieve, acceptance of responsibility, personal confidence, and to learn the principles of personnel management. The primary vehicle for this training during the academic year is Leadership Laboratory, where cadet officers and non-commissioned officers conduct instruction under the supervision of the Department of Military Science’s faculty. The intensive Cadet Summer Course is extremely effective in developing an individual emotionally, mentally and physically. All Army ROTC training is focused on preparing the student to meet the challenges of tomorrow’s society, whether in a military or civilian career.

Distinguished Military Students
The University names outstanding Army ROTC students as Distinguished Military Graduates.

Uniforms
Uniforms for contracted Cadets are provided by the federal government.

Departmental Offices
Our Administrative Office is located in Room 2219A Broughton Hall.

Music Department
Price Music Center
Campus Box 7311
Raleigh, NC 27695-7311
Phone: (919) 515-2981
Fax: (919) 515-4204
Email: musicinfo@ncsu.edu

The Music Department is committed to providing broad-based educational opportunities for NC State students through a variety of musical experiences and introductory and upper-level academic courses. Departmental faculty seek to assist students in developing musical insights, musical skills, and the capacity to perceive and respond to music in its historical and cultural contexts.

Opportunities for direct student participation as performers include many choral and instrumental organizations. Membership in any ensemble is open to students with a disciplined interest in music. Auditions are scheduled during summer orientation, at the beginning of each semester, and by appointment with the conductor of the group. For further information, please call (919) 515-2981 or visit the Music Department website (http://www.ncsu.edu/music) for audition information.

The department offers a variety of courses, most of which may be taken to fulfill specific general education program. Any course may be taken as a free elective. A 20-hour music minor is offered for qualified undergraduate students who wish to engage in the serious study of music. Emphases include history, liberal arts, composition, and performance—piano, vocal, or instrumental.

The department also serves as a cultural resource for the university community and the public at large through concerts presented by student musical organizations, music faculty, and visiting artists. Concerts are open to students and the public.

Minor in Music
The Music Department offers a 20-hour minor in Music for qualified undergraduate students who wish to engage in the serious study of music within a curricular framework. This minor is designed to foster creative thought, aesthetic understanding, and artistic self-expression. Students may choose one of four emphases:

1. History
2. Liberal Arts
3. Composition
4. Performance

Core courses include one music theory, aural skills, class piano and a survey of music in Western Civilization. Applications are available in Price Music Center, Room 203. A Bachelor or Arts degree with a focus in Music is available through the Arts Studies Program in the College of Humanities and Social Sciences. For more information about the minors, please visit the Music Department’s website (http://www.ncsu.edu/music) or contact Dr. John Fuller at 919-515-8284 or jafuller@ncsu.edu.

Arts Entrepreneurship
The Music Department also offers a minor in Arts Entrepreneurship, the first of its kind. There are a number of unique aspects to the Arts Entrepreneurship Minor. Based on the concepts of both intellectual and experiential readiness, the Minor helps emerging arts entrepreneurs use a broad knowledge base to create successful arts ventures. Using an innovative classroom experience, a focus on informed decision-making and a cutting-edge curriculum, this is simply the most comprehensive a program on the topic in the country.

For more information please visit the Arts Entrepreneurship website (http://www.ncsu.edu/music/ema), or contact Dr. Gary Beckman at 919-515-1637 or gdbeckma@ncsu.edu.
Department of Naval Science
(Naval ROTC)

Mission
The purpose of the Department of Naval Science is to develop midshipmen and enlisted officer candidates mentally, morally, and physically and to imbue them with the highest ideals of duty, honor, and loyalty in order to commission college graduates as Navy and Marine officers who possess a basic professional background, are motivated toward careers in the naval services, and have a potential for future development in mind and character so as to assume the highest responsibilities of command, citizenship, and government.

4-year NROTC Program
There are two NROTC programs leading to a commission as a Navy or Marine Officer upon graduation: the Scholarship Program and the College Program.

Scholarship Program
The Scholarship Program leads to a commission in the Navy or Marine Corps. For students who receive a Navy/ Marine Corps scholarship, the Navy will pay tuition and fees, provide a $375 book allowance each semester, supply uniforms, and pay a monthly tax-free subsistence allowance (currently $250 to $400 on a graduated scale; refer to the NROTC website (https://www.nrotc.navy.mil) for updates), to help defray the cost of normal board at the university. During the summers between school years, Navy scholarship students receive approximately 4 weeks of at-sea training conducted on ships, submarines, or aviation squadrons.

For select students, training with mobile Explosive Ordnance Disposal (EOD)/SEAL teams is also possible during the summer prior to their senior year. Marine scholarship students participate in a Mountain Warfare Training course between sophomore and junior year and complete Marine Officer Candidate School between their junior and senior year. The minimum active duty obligation following graduation for scholarship students is five years but can vary greatly depending on the warfare community a student commissions into.

College Program
For those students who are interested in a commission and do not desire a scholarship, or for those who are seeking an opportunity to qualify for a scholarship after entering NC State, the College Program is available.

Selection for the College Program is made from students already enrolled at NC State with applications being accepted and considered by the staff of the NROT C unit. Students enrolled in the College Program are provided uniforms and Naval Science textbooks. College Program students compete for selection to continue NROTC as “Advanced Standing” students at the end of their sophomore year. Selection is based on academic and demonstrated professional performance. Those selected for Advanced Standing receive a monthly subsistence allowance during the final two years of the program (refer to the NROTC website (https://www.nrotc.navy.mil) for amounts). College Program midshipmen participate in a single summer training cruise between the junior and senior year. Except for administrative differences, no distinction is made between Scholarship and College Program midshipmen. The minimum active duty commitment following graduation for College Program students is three years but can vary based on the warfare community a student commissions into.

Students in the College Program are eligible to compete for merit based scholarships annually. If selected for a merit based scholarship, the student would begin their next academic year on a full scholarship, identical to the Scholarship Program description above.

Two-Year Programs
The Two-Year Scholarship Program offers an opportunity to participate in NROTC in the final two years of university study. This program is offered only intermittently by the Navy and may or may not be available during any given year.

Applications for this program must be completed by early Spring prior to the starting year. Upon selection, the candidate attends a six-week training course at Newport, Rhode Island, during the summer between the sophomore and junior years so that he or she may receive instruction in the Naval Science subjects normally covered in the first two years at NC State. Participants in this training course receive uniforms, room and board, and officer candidate pay during the summer period and, upon satisfactory completion of training, enter the NROTC program as third year students. The application process can be time consuming. In order to meet the Spring deadline, students are encouraged to contact the Department of Naval Science before December 1 of their sophomore year.

Commissioning and Service
Graduates of the Navy program are commissioned as Ensigns and are selected to serve in one of the Navy’s front line warfare communities (Surface Warfare, Submarine/Nuclear Power, Pilot, Naval Flight Officer, Special Operations/EOD, or Special Warfare/SEAL). Graduates of the Marine program are commissioned as Second Lieutenants and attend the Marine Officer Basic School at Quantico, Virginia where they select their Military Occupational Specialty (MOS).

Curriculum
Due to the increasingly advanced technologies being employed by the Navy and Marine Corps, candidates for Navy Commissions are strongly encouraged to select academic majors in mathematics, engineering, or scientific disciplines. Scholarship midshipmen are required to pursue a major that falls within their awarded scholarship tier level, while College Program midshipmen are free to choose their area of major study.

The NROTC training program emphasizes academics, leadership, military organization, and physical fitness. Required Naval Science courses are fully accredited, taken for free elective credit and include, NS 210 Leadership and Management, NS 225 Navigation, NS 315 Naval Engineering, NS 325 Naval Weapons Systems, NS 330 Evolution of Warfare, NS 415 Naval Operations, NS 420 Naval Leadership and Ethics, and NS 430 Amphibious Warfare. Additional University courses may be required depending upon one’s major, however, all Navy option Scholarship midshipmen must complete:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA 141</td>
<td>4</td>
<td>Calculus I</td>
</tr>
<tr>
<td>MA 241</td>
<td>4</td>
<td>Calculus II</td>
</tr>
<tr>
<td>PY 205</td>
<td>3</td>
<td>Physics for Engineers and Scientists I</td>
</tr>
<tr>
<td>PY 208</td>
<td>3</td>
<td>Physics for Engineers and Scientists II</td>
</tr>
</tbody>
</table>

In addition to the courses taken for University credit, midshipmen attend leadership laboratory and physical training each week. At the completion of the four-year period students will have earned enough credit to apply for a minor in Naval Science.
Midshipmen Life

Academic excellence is emphasized and commensurate participation in the full range of campus extra curricular activities is encouraged. The NROTC unit is organized as a midshipmen battalion to facilitate leadership development. The battalion is staffed entirely by midshipmen under the supervision of staff instructors. Additionally, midshipmen have opportunities to examine all aspects of life in the Navy and Marine Corps and gain leadership experience through field trips, summer cruise, and social activities.

Further information regarding application for and admission into the NC State Naval ROTC may be obtained on campus in Room 4165 Broughton Hall, by writing to the Professor of Naval Science, Box 7310, NC State, Raleigh, North Carolina 27695-7310 or by contacting the unit recruiting officer, LT Jeremy Watson at 919-515-6218.

The Department of Military Science (Army ROTC), the Department of Aerospace Studies (Air Force ROTC), and the Department of Naval Science (Navy ROTC) are separate academic and administrative subdivisions of the institution. Students in the ROTC programs will receive free elective credit for Aerospace Studies (AS), Military Studies (MS), or Naval Science (NS) courses up to the limit of free electives in their curriculum.

Health and Exercise Studies

Carmichael Gymnasium, Room 2000
Tommy Holden, Department Head and Teaching Associate Professor

All North Carolina State University students are required to complete two semesters of Health and Exercise Studies to meet the university General Education Program (GEP). Students must take a Health and Exercise Studies 100-level course in Fitness and Wellness (Fitness and Wellness courses are those found in the HESF 100-level series) and one additional Health and Exercise Studies activity course at the 200 level. An acceptable alternative is to take two classes at the 100 level.

Students may choose a class that offers a familiar skill, or may opt to experience a new activity. Students with disabling conditions will be assisted by the Department of Health and Exercise Studies, Student Health Service, and Disability Services to choose appropriate classes. Only “activity” courses, not elective “lecture” courses, may be used to satisfy the NC State GEP healthy living requirement.

For more information, please visit the Health and Exercise Studies website (http://hes.dasa.ncsu.edu).

Minor in Sports Science

The Department of Health and Exercise Studies offers a 16 credit hour minor in Sports Science, designed for students who desire a greater understanding of the physiological and biomechanical principles of exercise and fitness. The minor provides coursework in anatomy, physiology, nutrition, biomechanical principles, prevention and treatment of athletic injuries, exercise leadership, and health behavior. For additional information, contact Darrin DeReu (919) 513-1057 or dwdereu@ncsu.edu.

Minor in Outdoor Leadership

The Department of Health and Exercise Studies offers a 16 credit hour minor in Outdoor Leadership that is designed for undergraduate students desiring to pursue careers as outdoor leaders of adventure-based programs or for those who wish to enhance their personal development and enjoyment. Students will develop a foundation of essential leadership skills and experience through course work focusing on outdoor skills and leadership training. Students will also have an opportunity to apply theory to practice through a practicum. For additional information, contact Terry Dash (919) 513-1563 or tdsash@ncsu.edu.

Minor in Coaching Education

The Department of Health and Exercise Studies offers a 17 credit hour Minor in Coaching Education designed to prepare students to assume coaching responsibilities with a sound theoretical and practical background. The minor provides students with a foundation of essential coaching skills and concepts as well as the basic principles of coaching philosophy, sport psychology, sport management, and prevention and care of sport related injury. The practical application of sport science, physiology, and kinesiology, as well as strategies involved in coaching specific sports, are also addressed. For additional information, contact David Conner, (919) 513-1557 or daconner@ncsu.edu.

Minor in Health

The Department of Health and Exercise Studies offers a 15 credit hour minor in Health which is designed for undergraduate students wishing to pursue careers in health-related professions and for students wishing to gain in-depth knowledge in various contemporary health-related topics for their personal development. The minor provides students with theories, concepts, and practical skills concerning health behavior and includes a practicum to apply theory to practice. For additional information, contact Christopher Ousley, (919) 515-6912 or csousley@ncsu.edu.
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 Center helps them plan for life after graduation.

Check out the links in the sidebar to see all the ways that NC State can help you succeed!

Bookstores

NC State Bookstores has been the campus authority for textbooks, school supplies, computers and apparel since our founding in 1954. We offer the most extensive collection of officially licensed merchandise available anywhere, featuring apparel from Adidas, Nike, The Game, and more! Proceeds from purchases at the Bookstore are returned to the university for student program support and scholarships.

When you purchase a textbook, computer, shirt, or anything else from the Bookstore, your purchase directly supports the university and its students.

Location

NC State Bookstore’s main location is currently housed on the ground floor of Harrellson Hall, just off the Brickyard behind DH Hill Library. For information regarding the location, please visit the Bookstore website (http://www.ncsu.edu/bookstore). It will move into its new location in Talley Student Union during spring 2015.

The Bookstore also has a location on Centennial Campus. The Pack Shop carries books, school supplies, apparel and snacks. It is located in Wolf Ridge next to On the Oval Culinary Creations.

When you aren’t on campus, shop the Bookstore’s Online store (http://shop.bookstore.ncsu.edu).

Textbooks

Once your course registration is complete, log into MyPack Portal and head over to “View My Booklist.” From there, the Bookstore takes care of the rest. View all of your required and recommended course materials, compare prices with our online shopping tool, and place your order with peace of mind. The Bookstore ensures you’ll have the right books for your courses, and we’ll have them waiting for you at move-in.

Like to shop around? NC State Bookstores prides itself on the value it provides, and it is backed up with pricing transparency. Before making your purchase, use the Bookstore’s online comparison tool to see how it stacks up against the competition; and when you’re ready to sell your books back at the end of the semester, visit the Bookstore’s website (http://shop.bookstore.ncsu.edu) to check their value before bringing them in.

Financial Aid and Scholarship Funds

The Bookstore 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 sponsorships (VA, VR, WIA, Services for the Blind) should make all purchases in the store.

Laptops

Looking for the right laptop to meet the demands of your chosen major? Let the Bookstore outfit you with a business-class computer set up to meet the specific recommendations of your college and the university. Buy from the Bookstore and you’ll have a reliable machine that will last you through four years of studies. You’ll receive full manufacturing warranty coverage on every model we sell, plus the option to purchase additional coverage. On-campus technical support is free of charge to all students through the Office of Information Technology.

Whether you prefer a laptop made by Apple, Lenovo, or Dell, you’ll receive the best deal available for the model you choose. Since buying from the bookstore supports student program support and scholarships, why not buy yours from us? Visit the main Bookstore location or consult the Bookstore’s website (http://www.ncsu.edu/bookstore/welcome.html) for helpful information.

The University Career Development Center

The University Career Development Center’s (CDC) mission is to assist students in developing their career goals and to help them devise strategies for achieving these goals. From first year students to graduate students, CDC services are designed to meet the needs of students across all stages of career development. CDC career counselors 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 student job and experiential learning resource ePACK, allows students to post resumes, apply for Co-op’s, internships, and full-time jobs, sign up for job interviews, and view schedules of career-related events, such as career fairs and employer information sessions. A wealth of career information is available on the Career Development Center’s website (http://careers.ncsu.edu).

The Career Development Center is located in 2100 Pullen Hall.

Centers for Diversity

The 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. In order 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 in order 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.

Goals

- Foster a safe and inclusive environment for students, staff, faculty, and alumni of all genders and sexualities, for individuals exploring their sexual orientation and gender identity/expression, and for allies of the GLBT community.
- Affirm the identities of GLBT and questioning students, staff, faculty, and alumni while also acknowledging and helping to raise awareness about the way the lived experiences of GLBT individuals vary and are influenced by their race, religion, ethnicity, age, ability status, social class, and other social characteristics.
- Collaborate with departments, offices, and organizations across campus to engage members of the NC State community in conversations about issues of identity, diversity, community building, advocacy, and social justice.
- Promote awareness and provide education with respect to the issues faced by GLBT individuals and their allies in order to enable members of the campus community to play an active role in helping to combat sexism, genderism, transphobia, homophobia, biphobia and heterosexism.
- Advise administrators on issues related to GLBT campus climate and advocate for inclusive policies and practices.
- Provide information and resources to help staff and faculty develop GLBT-inclusive curricula.
- Maintain an active and engaged community for GLBT and allied students, staff, faculty, and alumni of NC State while networking with GLBT groups and organizations in the local area and throughout North Carolina.

For more information about our educational workshops, events, student organizations, resources or support services, visit our website (http://oied.ncsu.edu/gltb), call us at 919-513-9742, or stop by the fifth floor of Talley for a visit.

Multicultural Student Affairs

The Department of Multicultural Student Affairs (MSA) researches, designs and implements unique programs that promote the pursuit of academic success, retention and graduation of students, with an emphasis on African American, Native American and Hispanic students. Many of the programs and services expand students’ cultural horizons while honoring their respective cultural experiences. Multicultural Student Affairs works in conjunction with a number of university departments and colleges to conduct programs related to recruitment, orientation, retention and graduation in addition to academic, personal, professional and cultural development, which foster skills and strategies for being successful at NC State. Some of the programs and services include the following: African American Symposium, Native American Symposium, Hispanic/Latino Symposium, Peer Mentor Program, Hispanic/Latino Heritage Month Programming, Native American Heritage Month, Guaranteed 4.0 Academic Boot Camp, Kwanzaa Celebration, Freshman Honors Convocation, annual POW WOW, Student Leadership Development and Student Organization Advising. Target populations for Multicultural Student Affairs are determined by differences in retention and graduation rates for historically underrepresented groups as well as demographic shifts regionally and nationally. Any NC State student can access programs and services through Multicultural Student Affairs. For further information and a complete listing of our offerings, please stop by 1107 Pullen Hall, call (919) 515-3835 or visit the Multicultural Student Affairs website (http://www.ncsu.edu/msa).

The Women's Center

The Women’s Center is a catalyst and resource that advances gender equity and social justice through education, support, and leadership for the campus community. Although we are a “Women’s Center”, we see gender on a continuum and we welcome EVERYONE to the Center. Together with our Office for Equity and Diversity (OIED) partners, we envision and work for a Wolfpack community that champions gender equity and promotes respect for all.

The Chocolate Festival

An event that combines breast cancer awareness and wellness with delicious chocolate sampling and a silent auction. Proceeds benefit the Kay Yow Cancer Fund, breast cancer research and education, and the Women’s Center.

Read to L.E.A.D.: Literacy and Social Justice Youth Development

A semester-long mentorship program between the NCSU Women’s Center and community youth-serving organizations dedicated to improving the literacy of children and engaging mentors and mentees in intentional conversations about diversity and equity. This program provides high-impact learning for the NCSU community to become equity-minded practitioners, critical thinkers, and to make a life-long difference in the lives of low-income children.

Alternative Service Break (ASB) Trips to Atlanta (Fall) & Guatemala (Spring)

In partnership with CSLEPS and Multicultural Student Affairs, The Women's Center offers service-learning trips to Atlanta (civil rights and gender equity), and Guatemala (empowerment of women and girls).

Women of Welch (WOW) Village

In partnership with University Housing, the Women’s Center facilitates a living and learning community residence hall for undergraduate female students that focuses on “transforming sisterhood into social justice” by improving self-awareness and fostering diversity and equity-minded individuals through unique programs, services, and relationship-building.

Interpersonal Violence Advocacy

Mon-Fri 9-5pm, Women’s Center advocates provide confidential support to survivors of sexual and relationship violence including stalking. This includes crisis counseling, financial assistance, academic /housing advocacy, referrals and accompaniment to court, student conduct hearings, and law enforcement agencies. Also includes a campus-wide educational campaigns as well as smaller-group trainings through Don’t Cancel that Class and Survivor Support Space programs.

The Movement & NEXT

The Movement and NEXT are two groups of peer educators working to prevent violence and promote gender equity. After successful completion of a 3-credit hour course (WGS 220) or equivalent training/ experience, students are paid to facilitate workshops on campus and in the community.
Chancellor’s First Year Student Leadership Program

Program identifies and nurtures promising first year students with the goal to improve participants’ self-efficacy, self-knowledge and leadership abilities through information sharing and relationship building. Program convenes regularly at the Chancellor’s residence and includes opportunities to interact and learn from the Chancellor and Mrs. Woodson. Program is a year-long commitment and includes multi-year mentorship and service-learning opportunities.

For more information, please stop by our office, visit the Women’s Center online (http://oied.ncsu.edu/womens-center) or call us at (919) 515-2012.

Counseling Center

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 CC 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. Please see our website for further information.

The Counseling Center is located on the 2nd floor of the Student Health Center, 2815 Cates Avenue. Appointments may be scheduled by coming to the Counseling Center during walk in hours daily as posted on our website. Emergency after-hours assistance is available by calling Campus Police (515-3000) and asking for the Counselor on Call. Additional information about services can be found on the Counseling Center’s website (http://www.ncsu.edu/student_affairs/counseling_center).

Faith Organizations

Chaplains’ Cooperative Ministry (http://chaplains.wordpress.ncsu.edu)

Ann Pearce, Director phone: 919.515.2414
362 Harrelson Hall e-mail: acpearce@ncsu.edu
Campus Box 7295 website: http://chaplains.dasa.ncsu.edu/

The Chaplains’ Cooperative Ministry at NC State is an independent, interfaith organization which both supports individual campus ministries and plans jointly sponsored interfaith programs for students, faculty and staff. Funded solely through member fees, both ordained and non-ordained ministry leaders strive to support inquiry and dialogue with trust at all levels. The office has a temporary location on the third floor of Harrelson Hall. Ministries within member groups support the spiritual and emotional growth of students through scriptural studies, worship, meals, socials, various outings, retreats, mission trips, counseling, service projects, and opportunities for leadership. For more information, visit the CCM website (http://chaplains.dasa.ncsu.edu).

Interfaith Coalition

The Interfaith Coalition is sponsored by the Chaplains’ Cooperative Ministry and is made up of leaders who represent registered religious groups at NC State. All members are proponents of inquiry, dialogue, and truth, and while not denying the truths of their own traditions, willingly cooperate with and support the other members in the development of their communities.

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 D.H. Hill Library is open 24 hours/day in the fall and spring semesters. Branch libraries include: Burlington Textiles Library, Harry B. Lyons Design Library, Natural Resources Library, and William Rand Kenan, Jr. Library of Veterinary Medicine.

The collection contains over 4 million volumes of books, bound journals, and government documents; approximately 63,000 print and electronic serials; over 5.4 million microforms; 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.

The library has approximately 270 public workstations and a full complement of equipment for audio, video, and digital resources. PC and Macintosh laptop computers, digital cameras, camcorders, GPS units, and digital audio players and recorders are available for loan.

The popular Learning Commons in D.H. Hill Library is a technology-equipped space for both individual and group work. The library offers equipment and assistance for working with digital images and other materials. The Libraries has a variety of study spaces for groups and individuals.

The new James B. Hunt, Jr. Library (http://www.ncsu.edu/huntlibrary) on Centennial Campus is more than the 21st-century face of NC State. It’s a place where ideas become reality and bold ambition forges beautiful solutions to global challenges.

The Libraries’ website (http://www.lib.ncsu.edu) provides information about and access to many services, including reference assistance, interlibrary loan, and electronic reserves. Library 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.

Department of Student and Community Standards

The Department of Student & Community Standards houses a series of functions that collectively help solve problems related to students. Within the department is located the Office of Student Conduct (http://studentconduct.ncsu.edu), the Student Behavioral Case Manager (http://studentsofconcern.ncsu.edu), Alcohol and Other Drug Abuse Prevention Education (http://alcohol.dasa.ncsu.edu), and the student Ombudsperson (http://ombuds.dasa.ncsu.edu).

Staff in the Office of Student Conduct work to enforce the Code of Student Conduct, and to support student success by actively trying to
Services will file insurance on behalf of the student for services received off-campus laboratory, physician, hospital or pharmacy. Student Health Pharmacy, as well as expenses incurred when referred to an off-campus laboratory, physician, hospital or pharmacy. Student Health Services will file insurance on behalf of the student for services 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 in partnership with OnSite Dental Services provides comprehensive dental care to students. OnSite Dental 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.

**Staying Healthy and Well:**

A HealthySTATE of mind and body begins with the prevention of disease and reduction of risky behaviors. Our health 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, stress management, healthy sexuality, women's health, men's health and more. Call (919) 515-WELL (9355) for information.

HealthySTATE focuses on creating well balanced students through multiple dimensions of wellness. Students interested in becoming engaged in our student leadership program may come by or call the Health Promotion office located on the second floor of the Student Health Center. Call (919) 515-WELL (9355) for information.

**Required Medical Insurance**

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 on the Student Health Services website (http://healthcenter.ncsu.edu/insurance).

**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.

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**Disability Services Office**

The Disability Services Office (DSO) 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. DSO will maintain appropriate confidentiality of records and communication regarding disability. To receive accommodations and services, please contact the DSO as far in advance as possible. The
DSO office is located on the second floor of the Student Health Services Building, 2815 Cates Avenue, Suite 2221

Phone: voice - (919) 515-7653, TTY - (919) 515-8830, fax: (919) 513-2840

Email: disability@ncsu.edu

Visit Disability Services online (http://dso.dasa.ncsu.edu)

Medical Insurance

NC State University requires all undergraduate students who are taking 6 or more credit hours, and are degree seeking students, to have and show evidence of a creditable health insurance policy or students will automatically be enrolled in and billed for the university-sponsored health insurance plan. This university-sponsored health insurance plan 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 on the Student Health website (http://healthcenter.ncsu.edu/insurance).

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 purpose of the service is to provide education, advice and representation within the scope of the prepaid legal plan. The service’s plan is registered with the North Carolina State Bar, the parameters of which are set by the students at NC State. The service is aimed at helping students resolve their legal problems with as little disruption as possible to their primary educational endeavors. This office promotes preventative law, enabling the students to make educated choices.

Website: studentlegal.dasa.ncsu.edu

Phone: 919.515.7091

Facebook: USLS At NCSU

Transportation

Permit

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. A nine-digit student ID is required; permits are purchased online at the Transportation website (http://www.ncsu.edu/transportation) beginning in early July based on credit hours; first-come, first served. Permits are mailed to the address provided at time of purchase. Freshmen are most likely sold a perimeter/storage lot permit served by the university bus service, Wolfline. Instructions on the homepage above will guide you through the purchase process.

Parking Enforcement

Appropriate parking permits must be displayed between the hours of 7 a.m. - 5 p.m., Monday through Friday (resident areas are enforced until midnight, Monday through Thursday). Permits are not required after 5 p.m. in any unreserved space/lot. Never park in “24-hr. reserved,” accessibility spaces, fire lanes, or “no parking at any time” areas; pay close attention to signs.

Rental Car/Rideshare Options

Transportation offers alternatives to bringing a vehicle to campus through the Wolfline Transit System, GoPass (free local bus pass), Zimride (ride sharing/matching service), and ZipCar (hourly car rental). For more information on alternative transportation, please visit the Wolftrails website (http://www.ncsu.edu/wolftrails).

Wolfline (Buses)

All Wolfline buses are accessible and equipped with the Transit Visualization System (TVS) which allows you to see your real-time bus location online. No fare is required. Service frequency varies, but generally daytime service is available every 10 - 15 minutes (including Saturday/Sunday daytime connection between libraries), as well as evening service until approximately 3 a.m. Wolfline buses operate every day classes are held and during exams. They provide intra-campus service, service to the McKimmon Center, park and ride lots, storage lots and surrounding areas along the routes. There is no bus service on official university holidays. A special holiday/break shuttle service operates the evening before classes resume after holidays and provides continuous shuttle service connecting storage lots and residence halls. Rt. 6 Carter Finley, Rt. 7 Wolflink Shuttle, and Rt. 8 Southeast Loop continue to operate every day that faculty and staff report to work. Please visit the Wolfline website (http://www.ncsu.edu/wolfline) for the most up-to-date information about park and ride lots and locations, and bus routes and schedules. Free parking is provided (no permit required, but no overnight parking) in park and ride lots. For the latest Wolfline news, join the Wolfline Listserv, become a fan of NC State Wolfline Facebook, contact (919) 515-WOLF or the Transportation Office, (919) 515-3424. No pass is needed to ride Wolfline - just stand at a Wolfline bus stop.

City/Regional Buses

The GoPass program allows students to ride city buses, GoRaleigh (formerly CAT) and regional buses, Goriangle (formerly Triangle Transit), for no fare. All that is needed to travel to your favorite Raleigh or Triangle destination is a GoPass swipe card. Order your free GoPass online at the Transportation website beginning in early July. You will need your valid student ID number to complete your online order; your pass will be mailed to you at the address specified at time of order.

Bicycles/Walking

Bicycling is also an inexpensive, healthy and environmentally-friendly way to travel to, from and around campus. Bike racks are conveniently located throughout our three campuses. Students are strongly encouraged to register their bicycles on-line at the website above or at Campus Police and Transportation Offices. For more information on bicycling and walking on campus (including a WalkTimes map), please visit Wolftrails online (http://www.ncsu.edu/wolftrails).

Transportation is located in Administrative Services I, 2721 Sullivan Drive, 7 a.m. - 5 p.m., (919) 515-3424.

University Dining

Relax. Refuel. Recharge! University Dining offers more than 30 locations to eat across campus, including all-you-can-eat dining halls, restaurants,
cafes, ice cream shops and convenience stores, as well as a host of vending machines conveniently located across campus.

We have debuted a number of new dining locations over the past few years, including eight new venues in Talley Student Union and a variety of options in On the Oval on Centennial Campus. There’s never been a better time to dine at State!

University Dining hosts a number of theme meals and monopoly breakers during the year, including our famous All Carolinas Meal, which features items grown or produced in North and South Carolina. Check out our special events calendar (http://www.ncsudining.com/university-dining-events) for more details.

**Nutrition**

University Dining understands the diverse nutritional needs of our campus population. To that end, we pride ourselves on offering a wide variety of options, including vegan and vegetarian as well as gluten- and lactose-free fare. Our website (http://www.ncsudining.com/dining/nutrition) provides nutritional information for all of our restaurants and dining halls, and each dining hall has a nutrition kiosk where visitors can check the daily menu for allergens and other key ingredients.

Our registered dietitian Lisa Eberhart is nationally recognized for her efforts to make NC State one of the best campuses known for its nutrition and wellness programs (http://www.ncsudining.com/campus-dining/healthwellness). She is available to assist with dietary restrictions and to provide nutritional or diet counseling. She also provides a number of learning opportunities throughout the year to help our campus stay fit and informed about how proper nutrition can improve energy levels and academic performance.

**Meal Plans**

While only first-year students living in University Housing are required to participate in a meal plan for two semesters, more than 5000 upper-class students registered for a meal plan last year because we serve great food and offer flexible, affordable options.

Meal plans are built around a Meals Component, which is a set number of meals per week or semester that you can use to access the dining halls or put toward meals at our restaurants. It is augmented by Dining Dollars, which is the “no-rules” part of the plan that gives you extra buying power at our restaurants. You can also use Dining Dollars to make convenience store and vending-machine purchases. Our Freedom Pass plan - our most popular plan - enables students unlimited* access to our dining halls, plus 10 opportunities to visit our restaurants through the meal credit program each week.

We also have an apartment/commuter plan for students who live in on-campus apartments or commute. It features $750 Dining Dollars only and a five percent discount in our restaurants, cafes and dining halls.

**Picking a Plan**

Meal plan information will be mailed to you between May 1 and July 15, depending on when you make your commitment to attend NC State. Sign-up information will also be posted online in mid-April, and you’ll have an opportunity to hear from us and talk one-on-one during orientation this summer.

We recommend you review the plans, then consider your expected travel and eating patterns once you’ve received your residence hall assignment and course schedule. Once you’ve picked a plan, register online 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 30. Be sure to re-evaluate for the spring semester to ensure your plan is still working for you and make any changes by January 31.

**We’re Here for You**

University Dining takes pride in offering quality food and services designed specifically to meet the wants and needs of students. For more information, visit University Dining online (http://www.ncsudining.com/dining) or call 919.515.3090. You can also learn more about us on Facebook (http://www.facebook.com/ncsudining) or sign up (http://visitor.constantcontact.com/manage/optin?v=001tbt0ao0c0v5qjejhpFT7zxd4b3A2d6oFUnJ7g5euludkOoacddBgb6EHeFy7V5yeVzUS0NdNkAqauuOBpWMSnX1x1YwDFWX3Cd5sV5x3q0Ky5nzzwUQ%3D) for University Dining news. We’ll ensure you are current on our events and don’t miss any deadlines.

* Students can enter the dining hall every 30 minutes through the Freedom Pass plan.

**University Recreation**

University Recreation provides quality, innovative and inclusive collegiate recreation programs, services and facilities that inspire healthy, active lifestyles with a commitment to excellence, learning and student success.

NC State students engage in competition and build community through our Club Sports (http://recreation.ncsu.edu/club-sports) program. More than 40 student-lead clubs compete against universities from across the United States in an organized and competitive environment, while developing leadership, service and student engagement. Students can also compete against fellow NC State students in a variety of team sports and individual events through Intramural Sports (http://recreation.ncsu.edu/intramural-sports). All skill levels are welcome and there is no additional fee to participate.

Fitness and Wellness (http://recreation.ncsu.edu/fitness) offers an holistic approach to healthy, active lifestyles. More than 125 group fitness complimentary classes are available during the week in a wide variety of formats. Students who are looking for individualized or specialized programs can utilize Personal Training or Small Group Training. Outreach events are offered throughout the year and focus on a variety of topics relating to health and well-being. Private Swim lessons are also available through our Aquatics (http://recreation.ncsu.edu/aquatics) Program.

Find excitement through Outdoor Adventures (http://recreation.ncsu.edu/outdoor-adventures). This program features diverse trips throughout North Carolina, Tennessee, Virginia and beyond that encourage environmental stewardship and personal growth. NC State students can also rent equipment for their next excursion at the Outdoor Adventures Equipment Rental Center or travel around campus sustainably with the WolfWheels Bike Program. Learn new skills and climb to new heights at the Indoor Climbing wall, comprised of more than 40 unique routes of varying difficulty. The Challenge Course (http://recreation.ncsu.edu/challenge-course), located in Schenck Memorial Forest, provides dynamic and comprehensive team building and leadership development programming through low and high-rope elements.
University Recreation is the largest employer of students on-campus. More than 700 students are employed annually and work in a variety of positions. Students employed by University Recreation develop leadership skills, build a sense of community, and enhance their professional development through experiential learning. We encourage students to attend one of our many recruitment sessions.

Carmichael Complex

With more than 350,000 square feet of indoor recreation and fitness space, Carmichael Complex includes:

- 6 Fitness centers
- 11 Multi-purpose sports courts
- 25 yard Competition-sized pool and dive well
- 50 meter Olympic-sized pool
- 6 Fitness studios
- Indoor climbing wall
- Outdoor fields
- Outdoor basketball and tennis courts

Hours of Operation (http://recreation.ncsu.edu/facilities/facilities-hours)

Where to Find Us

For more information, please visit us online (http://recreation.ncsu.edu) or stop by our offices at Member Services Suite, Carmichael Gym, Room 1000.

(919) 515-7529

Twitter: @ncsurecreation

Instagram: @ncsurecreation

Facebook: NC State University Recreation

WolfPack One Card

Your Wolfpack One Card proves that you are one of us and allows you access to a variety of services on campus:

- Access your meal plan
- Enter your residence hall or other secure areas
- Work out at the gym
- Check out a book at the library
- Create and access your AllCampus debit account to manage on-campus expenses
- Create and access your Wolfpack One Debit MasterCard account for refunds from the cashier’s office and manage on- and off-campus expenses wherever MasterCard is accepted.

New students receive their card during orientation. If you need to get a card or have yours replaced at any other time, stop by the Wolfpack One Card office. It is currently located in the West Dunn Building, but it will move to Talley Student Union in August 2015. For more information, call us at 919.515.3090 or visit http://onecard.ncsu.edu/.
Student Activities

Student Involvement

Student Involvement supports students as they explore meaningful co-curricular experiences by providing resources, advising and programming. Student Involvement supports more than 500 student organizations including Student Government, the Union Activities Board, and all registered student groups.

Web: studentinvolvement.ncsu.edu
Twitter: @NCSUgetinvolved,
Phone: 919.515.2797.

Student Government

Founded in 1921, Student Government (SG) is a student-run organization that serves as the official voice of the student body and attempts to better the student experience at NC State. Both a governing and advocacy group, SG provides opportunities to students with different commitments, interests, abilities, and passions. Students are involved in policy-making, programming, lobbying, community service, and countless other activities.

Like the US government, three branches make up SG:

- **Executive Branch** - assists in implementing policies, creates and implements programs, and executes special projects of the Student Body President
- **Student Senate** - establishes and recommends policies to the University administration and distributes funds to registered student organizations
- **Judicial Branch** - operates fairly independently, hearing cases involving student misconduct, including academic integrity violations

Students have a voice in government through participation in campus-wide elections (by voting or running) or may apply to serve on the judicial branch as well. For more information please visit Student Government’s website (http://students.ncsu.edu).

The Union Activities Board

The Union Activities Board (UAB) is a student-directed programming network of committees that plan and implement a variety of programs for the campus community, including the Films Committee (that schedules films for Campus Cinema), Leisure & Entertainment Committee, Issues & Ideas Committee, the Diversity Activities Board, and the Black Students Board. The Publicity Committee designs and distributes posters, fliers, handbills, and other advertising for UAB events. You can visit them online at the UAB website (http://uab.ncsu.edu), friend them on the UAB Facebook page (http://www.facebook.com/NCStateUAB) or follow them with the UAB Twitter feed (https://twitter.com/#!/UABncsu)!  

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. These fraternal values are summarized by our Community Pillars: Brotherhood, Scholarship, Service, Leadership, and Sisterhood. 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 to 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 13 chapters currently living in Greek Village on campus. The University, in partnership with our fraternities and sororities, has committed to completely 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 5125 Talley Student Union, or call (919) 513-2910.

Website link: fsl.ncsu.edu

Center for Student Leadership, Ethics & Public Service(CSLEPS)

Do good things well.

The Center for Student Leadership, Ethics & Public Service (CSLEPS) provides unique learning opportunities that embody the values of leadership, service, responsible citizenship, and ethics. CSLEPS offers opportunities such as Alternative Service Break (ASB), leadership development workshops and programs, and service initiatives focusing on local, national and global social justice issues. We strive to help students become ethical and effective leaders, activists, volunteers, philanthropists, engaged citizens, researchers, and social innovators. Whether you are a seasoned student leader or just getting started on your service journey, make CSLEPS your home.

Web: csleps.dasa.ncsu.edu
Twitter: @ncstate_csleps
Facebook: CSLEPS - Center for Student Leadership, Ethics & Public Service
Phone: 919.513.0397

ARTS NC STATE

The six visual and performing arts programs of ARTS NC STATE – the Crafts Center, the Dance Program, the Gregg Museum of Art & Design, the Music Department, 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 (http://www.ncsu.edu/arts).
The Crafts Center

Explore your creative side. The Crafts Center provides NC State students with a comprehensive range of offerings including both classes and studio use. We are a place where creative skill and self-expression are fostered through the making and sharing of art and craft. Our facility houses studios supporting pottery, photography, wood, jewelry/metal, fibers, glass, lapidary, art-on-paper and even bike repair. Whether used for personal expression or in support of academic projects, our studios are well-equipped with cutting-edge technology. We are a place for making things.

Professional staff and crafts instructors provide quality technical advice and materials support. Mentorship thrives at the Center. With the intent of enhancing the 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 (http://www.ncsu.edu/crafts) for our upcoming programming, calendar information, map & 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 NCSU Dance Company and the Panoramic Dance Project, are open by audition. A vast array of classes, offered through the Master Class Series and the African Dance Master Class Series, are open to all NC State students, faculty and staff.

The Dance Program provides a rich training ground for choreographers through the study of composition, independent study, and guided choreographic projects. The Dance Program provides a creative environment rich in imagination, reflection, and the embodiment of ideas. 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 and through teacher guided, student choreographed collaborative projects (the Movement Studies Project and the Identity Projects); choreography by alumni; professional and other special projects. Both the NCSU Dance Company and the Panoramic Dance Project are represented on the Fall Concert.

- **NCSU Dance Company Concert:** Nationally acclaimed by the American College Dance Festival Association, the NCSU Dance Company performs a distinguished collection of modern dance for their annual concert. The program 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 performs a diverse range of dance styles, including modern, jazz, hip hop, African and Latin in choreographic work by the director, invited guest artists and student company members.

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

Gregg Museum of Art & Design

The Gregg Museum of Art & Design is NC State’s collecting museum. It houses more than 32,000 examples of contemporary and historical ceramics and textiles, glass, furniture, photography, paintings and sculptures, ethnographic, folk and outsider art, and works on paper from every continent. These holdings augment an ongoing series of changing exhibitions, support university curricula across a wide range of course subjects, and enable direct research with significant objects. The Gregg’s collection, exhibitions, publications and programming provide the NC State community and the public with unique access to work in all these media.

At present, the Gregg Museum is temporarily sited at 516 Brickhaven Drive (near J.C. Raulston Arboretum) while ongoing fundraising and subsequent construction lead toward completion of its new galleries and storage facility near NC State’s Memorial Bell Tower. For updates on the new museum, see the N (http://newgregg.ncsu.edu/node/7)ew Gregg (http://newgregg.ncsu.edu) website.

Meanwhile, its exhibitions are presented in a variety of other venues on campus and in the surrounding community. To locate these, schedule tours or class visits, or to make arrangements to use the permanent collection, please call 919.515.3503 or visit the Gregg Museum online (http://www.ncsu.edu/gregg). Student internships for course credit are offered each semester.

Music Department

The Music Department offers both performing ensembles and academic courses for the music minor program, GEP and elective credit. Four minor emphases are offered: (1) Performance, (2) History, (3) Liberal Arts, and (4) Composition. The Department is also the first in the nation to offer a minor in Arts Entrepreneurship.

Academic courses include the History and Theory of Western Art Music, special topics such as Women in Music and Introduction to African American Music, and Introductory Music Appreciation courses. For full descriptions of the academic courses, consult the Music Department’s (p. 123) page in the NC State University Course Catalog. Contact 919.515.2981 or visit the Music Department’s website (http://www.ncsu.edu/music).

- **Performing Ensembles.** A wide variety of performing ensembles provide opportunities for students to develop both artistically and intellectually through applied music. 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. Performing ensembles receive one academic credit that may be used to satisfy free elective requirements in any academic major. Membership in all ensembles requires an audition with the instructor. See the Music Department’s website (http://www.ncsu.edu/music) 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, Men’s Choir (Singing Statesmen), and Women’s Choir (Vox Accalia). Performance highlights have included concerts every semester, tours and occasional collaborations with other ensembles.
• **NC State Pipes and Drums.** Students may learn to play the bagpipes, an instrument known to many of North Carolina’s earliest settlers, in order to represent the University through this unique and distinctive medium. Pipes, drums, and other equipment are furnished. Beginning pipe and drum lessons are available to students without previous experience.

• **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 are on the same artistic level and require an audition with the conductor.

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

• **Wind Ensemble.** The Wind Ensemble meets both semesters. Students must audition for the ensemble and will be placed according to their ability and interest.

• **Jazz Ensembles.** The jazz program includes Jazz Ensemble I, Jazz Ensemble II and 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. Honors sections of class piano are available for beginning piano students who are music minors, or who qualify by departmental approval. Applied lessons are offered to advanced piano students who have passed an audition and are admitted to the music minor program in piano performance.

• **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.

**NC State Live**

Experience amazing performers from around the world! A typical NC STATE Live season features outstanding 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. Contact: 919.513.3030 or visit the NC State Live website (http://www.ncsu.edu/centerstage).

**University Theatre**

University Theatre is the university’s volunteer student theatre, open to all NC State students. In main-stage shows, the summer TheatreFest, and other special productions, students present theatrical works that tell stories from different perspectives and in varied genres: classics and new works, comedy, drama, musical productions and more.

Participating both on stage and behind the scenes, students become part of the campus theatre community, learning new skills in the costume or scene shops, exploring their creativity in classes and workshops, developing new talents and finding new friends. Student theatre organizations include the honorary theatre fraternity Alpha Psi Omega.

University Theatre offers a minor in theatre, and academic classes open to all students in acting, directing, introduction to theatre, and all areas of technical theatre, including stagecraft, costume, make-up, lighting, and scenic design. Contact: 919.515. 2405 or 919.515.3927 or visit the University Theatre website (http://www.ncsu.edu/theatre).

**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-McIlwee 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 currently located in the main lobby of Thompson Hall. Normal hours of operation are Monday-Friday Noon-6 PM. 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 (http://www.ncsu.edu/ticketcentral).

**Intercollegiate Athletics**

**Go Pack!**

NC State has plenty school spirit - and some wonderful athletics programs (http://www.gopack.com) that make it all worthwhile! The university’s “Wolfpack” athletics teams are nationally recognized and enjoy a tradition of excellence as they compete in the prestigious Atlantic Coast Conference. The men’s basketball team won national championships in 1974 and in 1983 and holds 10 ACC titles. The Pack, under fifth-year head coach Sidney Lowe, won 20 games and advanced to the second round of the National Invitational Tournament in 2009-10. The football team began a new and exciting era in 2007 with head coach Tom O’Brien taking over a storied program that has been the Atlantic Coast Conference champion five times and co-champion twice. NC State has played in 25 bowl games, including seven since the 2000 MICRONPC.COM Bowl.

The Wolfpack women’s cross country team won national championships in 1979 and 1980 along with 21 ACC crowns in 32 years, while the men’s cross country team has won the ACC title 15 times. The women’s basketball team, now under the direction of former University of Tennessee point guard and three-time national champion Kellie Harper, advanced to the 2010 ACC Tournament championship game en route to its second NCAA Tournament appearance in four years. The program reached the NCAA “Final Four” in 1998.

The men’s and women’s soccer teams have both advanced to the NCAA’s “Final Four,” the women in 1988 and 1989, and the men in 1990, while the wrestling team won its 14th ACC championship in 2007. The cheerleading squad has been recognized three times as national champions, and Ms. Wuf was named the top collegiate mascot in the country in 2007. NC State student-athletes have won numerous conference, NCAA and All-America athletic and academic honors, including medals in seven Olympic Games.
The 2008-09 school year saw three NC State student-athletes win individual national championships. On the night of March 21, Darrion Caldwell won the national championship at 149 pounds at the NCAA Wrestling Championships. Less than an hour later, diver Kristen Davies won the national championship in the 10-meter platform diving competition at the NCAA Swimming and Diving Championships. In June, golfer Matt Hill capped a storybook season by winning the NCAA Golf Championship, his eighth tournament win in 12 tries in 2008-09.

The Department of Athletics conducts the university’s intercollegiate athletics program, which includes 23 varsity sports, 12 men’s, 11 women’s. The athletics program is administered by the Director of Athletics, Deborah A. Yow. The Council on Athletics is appointed by the Chancellor and serves in an advisory capacity to the Director of Athletics and the Chancellor.

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.

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.

A facilities development plan costing more than $100 million reached its completion in 2008. The Wolfpack’s football facility, Carter-Finley Stadium, had its permanent seating increased to 55,600 while the state-of-the-art 106,000-square-foot Murphy Football Center was completed in 2003. Vaughn Towers, a 117,000 square-foot structure along the west grandstand of the football stadium, opened for the 2005 season and houses 955 Club-level seats, 51 private luxury suites, a University Suite for the Chancellor, and a state-of-the-art press box that seats up to 112 members of the media. The final phase of the Carter-Finley Stadium renovations, the enclosure of the north end zone, was completed prior to the beginning of the 2006 football season.

The men’s basketball team plays in the RBC Center, which seats 19,700. Reynolds Coliseum (9,500) is used for women’s basketball, wrestling, women’s gymnastics and volleyball competition.

A $5 million renovation of Doak Field at Dail Park (2,500), the university’s baseball stadium, was completed in June 2004, along with construction of the J.W. Isenhour Tennis Center with four indoor courts. Paul Derr Track Stadium (3,000) was redesigned to accommodate the men’s and women’s soccer and a new adjacent women’s softball complex. That facility re-opened in the spring of 2008.

The department’s administrative offices also were renovated during the facilities upgrade. The Case Athletics Center, which formerly was the primary location for the Department’s administrative and coaches’ offices, was converted to student services facility for student-athletes, housing the Academic Support Program for Student-Athletes. The Wolfpack’s athletics administrative offices and coaches’ offices for soccer, track and cross country, and wrestling moved to the Weisiger Brown General Athletics Facility. Coaches offices for women’s basketball, softball and gymnastics are located in Reynolds Coliseum. The football coaching staff’s offices are located on the top floor of the Murphy Football Center at Carter-Finley Stadium. The tennis coaches have their offices at the Wolfpack Tennis Complex. The baseball coaching staff’s offices are at Doak Field at Dail Park.

The fundraising offices of the Wolfpack Club and the athletic department’s marketing and ticket offices are located in the Palasades Building near Carter-Finley Stadium, at 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.

## Campus Facilities

### 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. Showings cost $2.00 for Students with College ID and $3.00 for General Public. There are also many opportunities to see free movies and sneak previews throughout the year. Check out the cinema website at: http://uab.ncsu.edu/films-schedule/

### The Office of Parents & Families Services

The Office of Parents & Families Services provides resources and programming for families of NC State undergraduate students such as Parents' Orientation, Parents & Families Weekend, PACK Parents newsletters, Spring Fling, Siblings Weekend and the Parents' Helpline.

### Facilities

**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).

**Price Music Center (PMC)** is the location for the Music Department 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. The Center contains three large rehearsal halls, practice rooms each with a piano available to any student, a digital piano lab, and offices and classrooms.

**Talley Student Union (TSU)** embarked on its transformation into a world-class student center in the summer of 2011. The 284,000-square-foot renovation and addition will double the square footage of the current center to accommodate a growing population exceeding 34,000 students and will provide a vibrant hub for student activity and campus events.

The addition and renovation will increase and improve space for student organizations and facility services with more meeting and recreational
areas, expanded food services and bookstore, and will be rated LEED Silver Certified.

Using resources from a combination of student fees and auxiliary service contributions, the estimated $120 million project will be completed in two phases. The first will be completed in fall 2013, with the entire project completed by late 2014.

Program offices and service areas that will be found in the Talley Student Union include Arts Development; Campus Activities; Center Stage Performing Arts Series; Center for Student Leadership, Ethics & Public Service; Chaplains’ Cooperative Ministry; Dance Program; Parents & Family Services; Woodward Student Involvement Center; Union Activities Board; University Theatre; Women’s Center; REM offices; Information Desk; Ticket Central; and University Dining administrative and catering offices.

Note: As the Talley Student Union renovation and expansion continues, most of our student programs will temporarily move to swing spaces throughout campus. For up-to-date information about the renovation project, please visit the renovation website (http://campusenterprises.ncsu.edu/new/category/talley-renovation-addition). To find student programs that have relocated, please visit the program website.

Reservations and Events Management (REM). To reserve room in the Talley Student Union, please visit Talley’s website (http://campusenterprises.ncsu.edu/talley-student-union) or contact Reservations and Events Management (REM) at 515-2249.

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.

Located on the ground floor of Thompson Hall, the Crafts Center offers eight technology-rich studios and specializes in classes and workshops in art, pottery, sculpture, weaving, fiber arts, photography, woodworking, glass, jewelry, lapidary, 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 more information on these two programs, please visit the ARTS NC STATE website (http://www.ncsu.edu/arts).

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.

Student Media

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 & Marketing office which coordinates advertising sales, sponsorships and full-service marketing opportunities for all five media. Many staff positions are paid.

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. Visit the Agromeck online (http://www.ncsu.edu/agromeck)!

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, the university’s oldest student newspaper, is published Monday through Friday when school is in session during the fall and spring semesters, and each Thursday during the summer. With a circulation of more than 11,000 daily and funded entirely through advertising income, the Technician has been recognized nationally with a CPSA Crown award and numerous state and national awards for design and photography. The Technician also maintains a significant online presence, including audio and video presentations, and is one of the nation’s most-visited student newspapers online. Visit the Technician’s website (http://www.technicianonline.com) and check it out!

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), NC State’s student radio station, operates at 25,000 watts, for a potential effective audience of more than 1.2 million through its FM signal alone, and its online stream takes its programming to Internet users all over 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).

Student Media’s Business & Marketing 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 N.C.
The Student Media Board of Directors is a way for students to get involved in the management of a large business operation with an annual total budget of nearly $1 million. 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. Find out more about the Student Media Board online (http://www.ncsu.edu/sma).
Academic Policies and Procedures

It's important to be familiar with the policies and procedures that will be relevant to you as a student. NC State wants you to be able to access and understand these procedures as easily as possible, so the list below includes plain-language summaries of some of our most important and useful policies.

If you would like more information, please visit the Policies, Regulations, and Rules website (http://policies.ncsu.edu).

Policies about:

- Equal Opportunity and Non-Discrimination (http://policies.ncsu.edu/policy/pol-04-25-05)
- Getting Your Degree (p. 143)
- Courses and Grading (p. 139)
- Transfer and Exam Credit (p. 153)
- Student Records (p. 150)
- Academic Status (p. 150)
- Student Conduct (p. 152)

Courses and Grading

A good understanding of the policies regarding course credit and grading procedures is vital for successful students. The resources below can help you make sense of what you'll see on your NC State transcript:

- Classification of Students (p. 139)
- Course Load (p. 139)
- Grading (p. 140)
- Credit-Only and Audit (p. 141)
- Repeating Courses (p. 142)

Classification of Students

Undergraduate degree students are classified according to the number of completed credit hours. The required number of hours of each classification is:

<table>
<thead>
<tr>
<th>Classification</th>
<th>Semester Hours of Earned Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshman (FR)</td>
<td>Fewer than 30</td>
</tr>
<tr>
<td>Sophomore (SO)</td>
<td>30 or more, but fewer than 60</td>
</tr>
<tr>
<td>Junior (JR)</td>
<td>60 or more, but fewer than 92</td>
</tr>
<tr>
<td>Senior (SR)</td>
<td>92 or more</td>
</tr>
</tbody>
</table>

Agricultural Institute students are designated as first (01) year if they have earned fewer than 30 semester credits and second (02) year if they have earned 30 or more semester credits.

Unclassified Students (UN) are those working for college credit but not enrolled in a degree-granting program. Unclassified students must meet the same entrance requirements as regular degree students and must meet the same academic requirements to continue. If, at a later date, unclassified students wish to change to regular degree status, their credits will be evaluated in terms of the requirements of their intended curriculum.

The Special Student (SP) classification includes Undergraduate Studies (UGS) and Post-Baccalaureate Studies (PBS) students:

Undergraduate Studies (UGS)

These students are United States citizens who have not obtained a baccalaureate degree and who take courses, but who are not currently admitted to a degree program.

Post Baccalaureate Studies (PBS)

These students are United States citizens who take courses beyond the baccalaureate degree, but who are not currently admitted to a degree program. This classification is closed to international students with the following exceptions: (a) spouses of regularly enrolled NC State degree students; or (b) students enrolled in special programs such as AID or FAO who are approved in advance by the International Student Office and the Graduate School.

To be eligible for NDS, prospective students must:

- have graduated from high school at least one year before beginning enrollment
- be eligible to return to any previous institution(s) attended.
- maintain a minimum cumulative GPA of 2.0 at all times to remain eligible to continue.
- have accumulated less than 30 hours of total credit as a Non-Degree student. NDS students are limited to a total of 30 hours of credit in NDS status. Student with 29 hours attempted will be allowed to register for the next term even if their enrollment in that future term will exceed the 30 hour limit, but they will not be activated for any subsequent terms once they have accumulated or exceeded 30 hours of credit.

All UGS and PBS students must apply for the program online at the NDS website (http://www.ncsu.edu/nds) or through Registration and Records, located in 1000 Harris Hall. Persons found eligible to study as UGS or PBS students are not to assume that they have received formal admission to the university as either undergraduate or graduate degree candidates. To become a degree candidate, formal application must be made through the Undergraduate Admissions Office or the Graduate School. The maximum course load for all UGS and PBS students is eight hours each semester or summer session. They may enroll in any course offered by the university, provided they have satisfied any required prerequisites and space is available. UGS and PBS students must adhere to the standards, policies, rules, and regulations of the university.

Course Load

The maximum course load for undergraduate degree students is 21 credit hours a semester and two courses plus a health and exercise studies course in a summer session. Undergraduate students who wish to register for more than 18 hours during the fall or spring semester must have their advisor complete the Course Load Waiver Form and return it to Registration and Records. Students who wish to register for more than 21 hours during the fall or spring semester must complete a Schedule Revision Form. Schedule Revision Forms are available from the student's classification office.
Grading Scale and Grade Points

<table>
<thead>
<tr>
<th>Grade</th>
<th>Definition</th>
<th>Grade Points per Credit Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>Excellent</td>
<td>4.333</td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>4.000</td>
</tr>
<tr>
<td>A-</td>
<td></td>
<td>3.667</td>
</tr>
<tr>
<td>B+</td>
<td>Good</td>
<td>3.333</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>3.000</td>
</tr>
<tr>
<td>B-</td>
<td></td>
<td>2.667</td>
</tr>
<tr>
<td>C+</td>
<td></td>
<td>2.333</td>
</tr>
<tr>
<td>C</td>
<td>Satisfactory (&quot;Passing&quot; for graduate students)</td>
<td>2.000*</td>
</tr>
<tr>
<td>C-</td>
<td></td>
<td>1.667</td>
</tr>
<tr>
<td>D+</td>
<td>Marginal</td>
<td>1.333</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td>1.000</td>
</tr>
<tr>
<td>D-</td>
<td></td>
<td>.667</td>
</tr>
<tr>
<td>F</td>
<td>Failing</td>
<td>0.000</td>
</tr>
</tbody>
</table>

*For the most current information regarding this regulation, please view the full regulation (http://policies.ncsu.edu/regulation/reg-02-50-03).

Grade Point Average

The number of credit hours attempted in a semester or summer session (for which grades of A, B, C, D (including plus/minus), or F are received) is divided into the total number of grade points earned to arrive at the Grade Point Average (GPA). The Grade Point Average will be calculated to three decimal points to a maximum of 4.000.

For example, if a student takes 16 credit hours, earning an A in two 3-credit courses, a B in one 3-credit course, and a B in one 2-credit course, a C in a 3-credit course, and an F in a 2-credit course, the grade point average would be:

Example GPA Calculation (45)

\[
\text{Grade Points} = (6 \times \text{grade points per credit hour}) + (5 \times \text{grade points per credit hour}) + (3 \times \text{grade points per credit hour}) + (2 \times \text{grade points per credit hour}) + (0 \times \text{grade points per credit hour})
\]

\[
\text{Credit Hours} = 16
\]

\[
\text{GPA} = \frac{\text{Total Grade Points}}{\text{Credit Hours}} = \frac{24 + 15 + 15 + 12 + 0}{16} = 2.813
\]

The minimum course load for full-time undergraduate degree students is 12 credit hours, except in their final semester when a lesser number may be taken if that is all the student needs to fulfill the requirements for a degree. In order to receive financial aid, a student must meet the minimum course load requirements of the appropriate funding agency. In addition, students who drop below 12 credit hours may not be eligible for medical and dental insurance on their parent’s insurance policies. The number of hours for which a student is officially enrolled is that number in which he or she is enrolled for credit at the end of the second week of classes (i.e., the last day to withdraw or drop a course with a refund).

For the most current information regarding this regulation, please view the full regulation (http://policies.ncsu.edu/regulation/reg-02-50-03).

Description of Letter Grades

D - Marginal. This grade is used to recognize that a student’s performance was marginal but clearly better than that of students who receive an F.

F - Failing. This grade is used to indicate that the student has failed the course and will not receive any credit for the course.

S - Satisfactory. This grade is used as a passing grade to be awarded only when the quality of the student’s work is judged to be C- or higher level. It is used as a passing grade for students who are taking free elective courses under the credit-only option, and for courses designated as pass/fail courses for grading purposes. It may also be used for certain courses such as orientation courses, seminars, and research problems, in which regular grades are not appropriate. Students should check with their adviser before changing a course to S/U status as it may affect graduation requirements.

U - Unsatisfactory. This grade is used to indicate that the student is not to receive credit for a credit-only or other course for which the passing grade would be S (Satisfactory).

CR - Credit. This grade is used by the registrar to indicate course credit received by examination or advanced placement as certified by
appropriate departments or colleges. This grade shall be awarded only when the advanced placement testing indicates that the quality of the student’s work in the course would have been expected to be of C- or higher level.

**IN - Incomplete.** This grade is used as a temporary grade. At the discretion of the instructor, students may be given an IN grade for work not completed because of a serious interruption in their work not caused by the student’s negligence. An IN must not be used, however, as a substitute for an F when the student’s performance in the course is deserving of an F. An IN is only appropriate when the student’s records 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 pass the course. Work undertaken to make up the IN grade should be limited to the missed work.

An IN grade must be made up by the end of the next regular semester (not including summer sessions) in which the student is enrolled, provided that this period is not longer than twelve months from the end of the semester or summer session in which the work was due. In the event that the instructor or department offering the course is not able to provide a student with the opportunity to make up the incomplete work by the end of the next regular semester in which the student is enrolled or within twelve months, whichever is shorter, the instructor or department offering the course must notify the Department of Registration and Records of the date of the extended deadline for removing the IN grade.

Any IN grade not removed by the end of the next regular semester in which the student is enrolled or by the end of twelve months, whichever is shorter, or by the extended deadline authorized by the instructor or the department offering the course and recorded by the Department of Registration and Records will automatically become a Failing (F) grade and will count as a course attempted.

Students should not register again for 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.

When a graduating senior received an IN, the following procedures apply:

1. If the course is needed for graduation, the student will not be allowed to graduate until the work has been made up.
2. If the course is not needed for graduation, the college dean must notify, in writing, the Department of Registration and Records either
   (a) That the course and the IN grade are to be deleted from the student’s records
   (b) Or that permission has been given for the IN to remain and that a deadline has been established for the completion of the course. In the event that the course is subsequently not completed satisfactorily, the college dean shall notify, in writing, the Department of Registration and Records that the course and the IN grade should be deleted from the student’s record or that the IN should be changed to F.

**LA - Temporarily Late.** An emergency symbol to be used only when grades cannot be reported on time by the teaching department or the instructor. The LA differs from the IN grade in that the student receiving the LA has completed the work of the course including the examination.

The LA should not be used by a teaching department or the instructor unless it is absolutely necessary. When it is used the following procedure applies:

1. Grade Submission must be entered at the regularly scheduled time with the LA clearly indicated; and
2. A Grade Change Report form must be secured from the Department of Registration and Records, completed, and returned at the earliest possible time and not later than 15 days after the final examination.

The semester grade reports of those students who receive an LA will not be complete. This situation often causes students to be uninform ed as to their academic eligibility and as to the correctness of their schedule for the following semester.

**W- Withdrawal/Late Drop.** Used on student’s grade reports and transcripts to indicate all courses for which they have received official approval to drop or from which they have received official approval to withdraw after the deadlines for dropping.

**Grade Reports**

Grades are posted online when instructors submit them in MyPack Portal or to the Department of Registration and Records. Students may access term grades via MyPack Porta (http://mypack.ncsu.edu) - Requires your Unity ID and password.

Students may come in person to the Department of Registration and Records, 1000 Harris Hall, and request a printed copy of grades for their last enrolled term. The student must show a picture ID to receive grades. Office hours are 8:00 a.m. to 5:00 p.m., Monday through Friday.

**Credit Only and Audit**

**Audits (Undergraduate)**

**AU- Audit.** Given in recognition of successful completion of a course audit.

**NR- No Recognition.** Given for unsuccessful completion of a course audit.

Students wishing to audit a course before or after taking it for credit must have the approval of their advisor and of the department offering the course. Auditors are expected to attend class regularly. The degree to which an auditor must participate in class beyond regular attendance is optional with the instructor; any such requirements should be clearly explained in writing to the auditor at the beginning of the semester. Should the instructor conclude that poor attendance has resulted in an auditor’s gaining little from the course, the instructor should mark NR (no recognition will be given for an audit) on the final grade report. Students who have taken a course for audit may, with their advisor’s approval, enroll in the course for credit during a subsequent semester or summer session. For tuition cost purposes, audits are treated as full credit value. For all other purposes, hours of audit do not count in calculating undergraduate course loads.

**Note:** Veteran’s benefits are governed by Veterans Administration regulation concerning audits. Public Law 94-502 (G.I. Bill) and Public Law 64 (sons and daughters of deceased or disabled veterans) consider only courses being taken for credit when determining a student’s course load for benefit purposes. For information, contact the Veterans Affairs Office, 1000 Harris Hall, (919) 515-3048.
Credit Only Option for Free Elective Courses

Each undergraduate student has the option to count toward graduation requirements a maximum of 12 semester hours in the category of credit-only courses (exclusive of Health and Exercise Studies (HES*) activity courses and other courses authorized to be graded on Satisfactory/Unsatisfactory basis). The student may select as credit-only any course offered by the university except those in Military Science, Naval Science, and Aerospace Studies. Students should check with their advisor before taking a course in their major, minor, General Education Program (GEP) or similar categories in the credit only status to determine if the course will count towards the major, minor, or GEP. The selected courses must be included under the free elective category of the specific curriculum in which the student is enrolled. The student will be responsible for attendance, assignments, and examinations.

The student’s performance in a credit only course will be reported as S (satisfactory grade for credit-only course and given when course work is equivalent to C- or better) or U (no credit grade for credit-only course). The grade for a credit only course will have no effect on the student’s Grade Point Average. The course and its grade will be counted in the cumulative hours attempted. Credit-only courses do not count in the calculation of eligibility for the Semester Dean’s List, which requires either twelve hours or fifteen hours of course work for which grade points are earned.

Non-degree students may take on a credit-only basis any course for which they satisfy prerequisites. Students should be aware that many graduate and professional schools evaluate credit-only courses for which “U” grades were awarded as failing grades.

Repeating Courses

Course Repeat Policy

Students who repeat a course, regardless of the grade previously made, will have both grades counted in their cumulative grade point average. An exception is the Grade Exclusion Policy as described in the section following this one.

• Undergraduate students may be allowed as many semester hours as are appropriate in the departmental curriculum for courses that are titled seminar, special topics, independent study or research (usually numbered 490-499 or 590-599) and cover topics different from those studied when the courses were taken previously. Unless a course satisfies one or the other of the above conditions, the semester hours will be counted only once toward the number of hours required for graduation even though students repeat and pass the course both times.

• With the exception of seminar, special topics, independent research courses as described in the above bullet, the advisor’s approval is required for students to repeat any course previously passed with a C- or better; no approval can be given for a grade of A or B. Nor will it be given when: students wish to repeat a lower division course that they have passed with a grade of C- or better after having successfully completed; students wish to take an introductory course after they have successfully completed an advanced course dealing with similar material.

Undergraduate students may repeat a course for credit once without permission if the previous attempt was completed with a grade of D- or less. Students must have permission from the Dean of their college to attempt a course for credit more than twice.

• 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 uncompleted course.

For the most current information regarding this regulation, please view the full regulation (http://policies.ncsu.edu/regulation/reg-02-20-06).

Undergraduate Grade Exclusion

The undergraduate grade exclusion policy is one of forgiveness that helps NC State undergraduate students maintain good academic standing. Undergraduate students may select up to two NC State courses with posted letter grades of C- or below to be excluded from calculation of their cumulative grade point average. Unsuccessful audits or credit-only attempts are not eligible for exclusion.

Once a grade exclusion is applied to a course, the grade points and the credit hours attempted and earned on the course will be removed from the calculation of the cumulative grade point average and from the calculation of the total hours attempted. The course title and grade for the course will be shown on the official record with a notation to indicate the grade was excluded from the computation of the cumulative grade point average.

Effects

• Grade exclusions will result in a recalculation of academic standing. Use of a grade exclusion does not retroactively change the status of the student’s semester academic honors or result in a refund of tuition or fees.

• Students should be aware that many graduate and professional schools recalculate grade point averages in the process of considering an applicant for admission to such programs. This recalculation may include restoring the grades and cumulative grade point average effects of courses to which a grade exclusion has been applied.

Eligibility

1. Undergraduate students may select up to two NC State courses with posted letter grades of C- or below to be excluded from calculation of their cumulative grade point average. Unsuccessful audits or credit-only attempts are not eligible for exclusion.

2. Grades excluded under previous university regulations (such as First Year Course Repeat or Course Repeat Without Penalty) count toward the maximum two courses allowed for exclusion.

3. Once a grade exclusion is applied to a course, the grade points and the credit hours attempted and earned on the course will be removed from the calculation of the cumulative grade point average and from the calculation of the total hours attempted.

4. The course title and grade for the course will be shown on the official record with a notation to indicate the grade was excluded from the computation of the cumulative grade point average.

5. Excluded courses cannot be used to satisfy degree requirements.

6. Grade exclusions must be posted prior to a student applying for graduation. Grade exclusions cannot be invoked after a baccalaureate degree has been conferred upon the student by NC State.
7. Once a grade exclusion is posted, the student cannot remove the exclusion or change it to another course at a later date.
8. Grade exclusions cannot be applied to courses in which the student was found to have committed academic dishonesty.

Procedures
1. The student must submit an Undergraduate Grade Exclusion form (http://ncsu.parature.com/ics/support/KBAnswer.asp?qID=207&hitOffset=21+20+10+8+7+5+1&docID=492) to the Department Registration and Records.

Getting Your Degree
NC State is committed to providing students with the information they need to complete their degree programs in a timely manner. Please review the resources provided here regarding policies and procedures relevant to obtaining your degree from NC State:

- Academic Advising (p. 143)
- General Education Program Requirements (p. 143)
- Satisfactory Academic Progress (p. 148)
- Adding or Changing Your Program (p. 148)
- Graduation Requirements (p. 149)

Academic Advising
Most regularly enrolled students are assigned for academic advising to a faculty member who is normally a member of the department, which is, or is most likely to become, the student’s major department. Students who are admitted into programs such as the First Year College, the Transition Program, etc. will be advised by professional advisors in those programs who will aid the students in the process of selecting an appropriate major.

Responsibilities of the Coordinator of Advising
Each college or department has a coordinator of advising and teaching who is responsible for: assigning, training, and supervising faculty and professional advisors; providing up-to-date, printed course and curriculum information for advisors and students; reassigning to another advisor any student who requests reassignment, assisting any student who wants to major in the coordinator’s area of study, but is ineligible at the time to transfer into it. Students in this category keep their advisor in the department in which they are enrolled, but consult additionally with the coordinator of advising and teaching for the department offering the curriculum in which they wish to enroll. Whenever appropriate, the coordinator will advise students that they should consider alternative curricula and refer the students to Academic Advising Services (http://advising.ncsu.edu).

General Education Program
General Education at NC State provides the opportunity for a broad and informed understanding of the world, offering our students the foundation for rich and productive lives. General Education is valuable for students because logical and creative thinking are fundamental to improving the human condition; because a respect for the value of diversity and an understanding of human history and cultures are essential to true citizenship; because the development of global knowledge has become increasingly important in response to international interdependence; because knowledge of science and the ability to apply scientific reasoning provide the basis for an appreciation of the workings of the universe and the richness, variety, and ecological interconnectedness of the world around us; because well-considered moral, philosophical, aesthetic, and intellectual convictions are necessary for contributing to human thought and achievement; because effective communication is central to productive engagement in academic, professional, and civic communities; because an ability to understand and evaluate the interaction among science, technology, and society is important in a world that is changing through technological innovation and scientific discovery; and because the development of attitudes and skills for a healthy life is essential to social, mental, and physical well-being. For the most current information available, please see the GEP website (http://oucc.ncsu.edu/ged-reqs).

Special Note: If a student changes a General Education course except for HES courses from a letter grade to credit-only (S/U), then the course will not satisfy the GEP requirements. Consult your academic advisor if you have questions.
Mathematical Sciences

**Rationale:**
A logical approach to problem solving is important for successful functioning in society. It is also important that students be able to formulate models, be critical consumers of quantitative information, communicate mathematically and solve problems.

**Objectives for courses in the category of Mathematical Sciences:**
Each course in the Mathematical Sciences category will provide instruction and guidance that help students to:

1. improve and refine mathematical problem-solving abilities; and
2. develop logical reasoning skills.

**Mathematical Sciences Requirement: (6 credit hours)**
A total of six credit hours from the university approved GEP Mathematical Sciences course list. At least one course must have an MA or ST prefix.

Natural Sciences

**Rationale:**
The natural sciences pursue basic questions about the workings of the universe, and the richness, variety and interconnectedness of the world around us. Students today are exposed to an increasing volume of information, from a large variety of sources, in diverse and changing formats. Training in the natural sciences is essential to help students develop skills to distinguish between testable and un-testable ideas, recognize scientifically valid tests of theories, and understand how information relates to those tests. By studying the natural sciences, students learn to reason both inductively and deductively, develop and test scientific hypotheses, and understand the value and limitations of scientific studies. The development and application of new technologies require scientifically literate citizens who can understand technological issues and evaluate the role of science in society’s debate of those issues.

**Objectives for courses in the category of Natural Sciences:**
Each course in the Natural Sciences category will provide instruction and guidance that help students to:

1. Use the methods and processes of science in testing hypotheses, solving problems and making decisions; and
2. Make inferences from and articulate scientific concepts, principles, laws, and theories, and apply this knowledge to problem solving.

**Natural Sciences Requirement: (7 credit hours)**
A total of seven credit hours from the university approved GEP Natural Sciences course list including at least one laboratory course or course with a laboratory.

Humanities

**Rationale:**
The humanities comprise the subjects and disciplines that use various models of rational inquiry to understand human human nature and experience, organization and change in human societies, the nature of the world, and rational inquiry itself. An education in the humanities and social sciences requires reading significant works, gaining an exposure to a variety of methodologies, and learning to apply these in written exposition. An education in the basic humanistic disciplines is necessary to become a citizen with a broad knowledge of human cultures and with well-considered moral, philosophical, aesthetic, and intellectual convictions.

**Objectives for courses in the category of Humanities:**
Each course in the Humanities category will provide instruction and guidance that help students to:

1. Engage in the human experience through the interpretation of human culture; and
2. Become aware of the act of interpretation itself as a critical form of knowing in the humanities; and
3. Make academic arguments about the human experience using reasons and evidence for supporting those reasons that are appropriate to the humanities.

**Humanities Requirement: (6 credit hours)**
A total of six credit hours from the university approved GEP Humanities course list. The selected courses must be from two different disciplines.

Social Sciences

**Rationale:**
The study of social sciences enables students to understand individual and collective human behavior by exploring meaning within a variety of social, cultural, political, and economic contexts, analyzing the structures within which human goals are established and human choices are made, and applying theoretical and empirical models to specific cases.

**Objectives for courses in the category of Social Sciences:**
Each course in Social Sciences category will provide instruction and guidance that help students to:

1. Examine at least one of the following: human behavior, culture, mental processes, oorganizational processes, or institutional processes; and
2. Demonstrate how social scientific methods may be applied to the study of human behavior, culture, mental processes, organizational processes, or institutional processes; and
3. Use theories or concepts of the social sciences to analyze and explain theoretical and/or real-world problems, including the underlying origins of such problems.

**Social Sciences Requirement: (6 credit hours)**
A total of six credit hours from the university approved GEP Social Sciences course list. The selected courses must be from two different disciplines.

Introduction to Writing

**Rationale:**
Writing is a powerful way of understanding ourselves and the world in which we live. It is through writing that the various disciplines and professions define the knowledge and methodologies that characterize them. Mastery of writing and information skills is central to engaging in the productive life of academic and professional communities.

**Objectives for courses in the category of Introduction to Writing:**
Each course in this category will provide instruction and guidance that help students to:

1. Write effectively in specific situations, which may include various academic, professional, or civic situations, and
2. Understand and respond appropriately to the critical elements that shape written communication situations, such as audience, purpose, and genre, and
3. Demonstrate critical and evaluative thinking skills in locating, analyzing, synthesizing, and using information in written communication.

Introduction to Writing Requirements: (ENG 101 - 4 credit hours)
A total of four credit hours of English (ENG) 101 are required to fulfill this category. Successful completion of ENG 101 requires a grade of C- or better and is required for graduation.

Health and Exercise Studies

Rationale:
The development of attitudes and skills for a healthy life is essential to a university student's education. In addition to developing and gaining an appreciation of health-related fitness and wellness concepts and fundamental motor skills, student participation in physical activities and sport significantly decreases major health risks, reduces stress from the pressures of academic life, and improves general social and mental well-being.

Objectives for courses in the category of Health and Exercise Studies:
Each course in the Health and Exercise Studies category will provide instruction and guidance that help students to:

1. Acquire the fundamentals of health-related fitness, encompassing cardio-respiratory and cardiovascular endurance, muscular strength and endurance, muscular flexibility and body composition; and
2. Apply knowledge of the fundamentals of health-related fitness toward developing, maintaining, and sustaining an active and healthy lifestyle; and
3. Acquire or enhance the basic motor skills and skill-related competencies, concepts, and strategies used in physical activities and sport; and
4. Gain a thorough working knowledge, appreciation, and understanding of the spirit and rules, history, safety, and etiquette of physical activities and sport.

Health and Exercise Studies Requirement: (2 credit hours)
A total of two credit hours/two courses including one Fitness and Wellness course from the university approved GEP Health and Exercise Studies course list. (Fitness and Wellness courses are those found in the HES 100-level series). Students have the option of taking HES courses on a credit-only (S/U) basis and still have the courses satisfy the GEP requirements.

Interdisciplinary Perspectives

Rationale:
Interdisciplinary study provides students with the opportunity to synthesize knowledge and skills, to make connections between fields of study, to consider more than one disciplinary approach or methodology, and to bring to bear the insights from two or more disciplines in examining and/or responding to complex problems.

Objectives for courses in the category of Interdisciplinary Perspectives:
Each course in Interdisciplinary Perspectives will provide instruction and guidance that help students to:

1. Distinguish between the distinct approaches of two or more disciplines; and
2. Identify and apply authentic connections between two or more disciplines; and
3. Explore and synthesize the approaches or views of the two or more disciplines.

Interdisciplinary Perspectives Requirement: (5 credit hours)
A minimum of five credit hours from the university approved GEP Interdisciplinary Perspectives course list.

Additional Breadth

Rationale:
One purpose of the General Education Program is to introduce students to a variety of disciplines. To this end, students are required to successfully complete a course from a general education category list that represents an approach to scholarship that is clearly distinct from the primary approach of their major.

Additional Breadth Requirement: (3 credit hours)
A total of three credit hours in the Additional Breadth category must be selected from the university approved GEP course lists that represent an approach to scholarship that is clearly distinct from the primary approach of the Major. These two approaches are distinguished for GEP purposes as “Humanities/Social Sciences/Visual and Performing Arts” or the “Mathematics/Natural Sciences/Engineering.” Note: At this time, there is no Engineering course list.

Visual and Performing Arts

The Visual and Performing Arts category is part of the Additional Breadth Requirement.

Rationale:
The Visual and Performing Arts constitute a separate, unique, and independent mode of inquiry distinct from both the Humanities and Social Sciences and the Science, Technology, Engineering, and Mathematics disciplines. Being conversant in the symbolic languages of the Arts is as important as familiarity with other modes of inquiry. Many of the most profound expressions of meaning and value are embodied in the arts, and developing sensitivity and responsiveness to these through visual and performing arts courses encourages students’ aesthetic sensitivities, critical judgment, and creativity. Courses in the arts also provide students with an understanding of the cultural and historical dimensions of artistic expression.

Objectives for courses in the category of Visual and Performing Arts:
Each course in Visual and Performing Arts category will provide instruction and guidance that help students to:

1. deepen their understanding of aesthetic, cultural, and historical dimensions of artistic traditions; and
2. strengthen their ability to interpret and make critical judgments about the arts through the analysis of structure, form, and style of specific works; and
3. strengthen their ability to create, recreate, or evaluate art based upon techniques and standards appropriate to the genre.

**U.S. Diversity co-requisite**

**Rationale:**
The study of diversity in the United States provides students the opportunity to consider questions of difference and culture, identity and community, privilege and oppression, and power and responsibility in our nation, and to gain an understanding of how these issues affect both individuals and communities.

**Objectives for courses in the category of U.S. Diversity:**
Each course in U.S. Diversity will provide instruction and guidance that help students to achieve at least 2 of the following:

1. Analyze how religious, gender, ethnic, racial, class, sexual orientation, disability, and/or age identities are shaped by cultural and societal influences;
2. Categorize and compare historical, social, political, and/or economic processes producing diversity, equality, and structured inequalities in the U.S.;
3. Interpret and evaluate social actions by religious, gender, ethnic, racial, class, sexual orientation, disability, and/or age groups affecting equality and social justice in the U.S.;
4. Examine interactions between people from different religious, gender, ethnic, racial, class, sexual orientation, disability, and/or age groups in the U.S.

**U.S. Diversity Requirement: (1 course, 0 additional credit hours)**
Choose one course from the university approved GEP U.S. Diversity course list. Courses on additional GEP course lists that satisfy the U.S. Diversity co-requisite will have a “USD” co-requisite indicator next to the course.

**Global Knowledge co-requisite**

**Rationale:**
Global knowledge is necessary for students to understand the world and their place in it. The global knowledge requirement provides students the opportunity to explore the complex interrelationships among nations, to gain a deeper appreciation of other cultures and peoples, and to evaluate the impact of U.S. culture and policy on the rest of the world.

**Objectives for courses in the category of Global Knowledge:**
Each course in Global Knowledge will provide instruction and guidance that help students to achieve goal #1 plus at least one of #2, #3, or #4.

1. Identify and examine distinguishing characteristics, including ideas, values, images, cultural artifacts, economic structures, technological or scientific developments, and/or attitudes of people in a society or culture outside the United States.
2. Explain how these distinguishing characteristics relate to their cultural and/or historical contexts in the non-U.S. society.
3. Explain how these distinguishing characteristics change in response to internal and external pressures on the non-U.S. society.

**Global Knowledge Requirement: (1 course, 0 additional credit hours)**
Choose one course from the university approved GEP Global Knowledge course list or complete an NC State course taken Study Abroad. Courses on additional GEP course lists that satisfy the Global Knowledge co-requisite will have a “GK” co-requisite indicator next to the course.

**Foreign Language Proficiency**

**Rationale:**
In a sense, languages are keys to the world. The continuous expansion of international relations makes the knowledge of foreign languages increasingly significant. In learning a foreign language and studying its literature and cultures, students acquire a body of knowledge about how humans think, view the world, express themselves, and communicate with one another. Language learning also expands one’s ability to create and discover new meaning in one’s own language and culture. Knowledge of the linguistic structures of a second language helps students to understand their own language better. Likewise, an awareness of contrasting cultural concepts sensitizes students to the differences between their own culture and others. Such awareness has become increasingly important as the communities of the world have become more interconnected and interdependent. The needs of our global society require that more citizens have access to other languages and cultures in order to cooperate in the process of improving the quality of human life.

**Foreign Language Proficiency Requirement**
To fulfill the GEP Foreign language requirement, the student must have proficiency at the FL* 102 level. This can be demonstrated by completing two years of high school study of the same language with a grade better than a C- in each of the two years, or a passing grade at the FL* 102 level, or by placement into the FL* 201 by examination. Additional requirements for the major have been established by some Colleges and programs.

**Technology Fluency**

**Rationale:**
Today’s graduate must achieve technology fluency appropriate to the needs of his/her discipline, including technologies for problem solving, empirical inquiry and research. Students will demonstrate critical thinking skills, analytical skills, proficiency and ethical use of the technology within the discipline, which includes responding to and readily adapting to change in those technologies.

**Technology Fluency Requirement:** Instruction in technologies appropriate to the discipline will be included and assessed within each curriculum.

**Communication In The Major (Advanced Communication)**

**Rationale and Requirement:**
Writing and speaking are fundamental to all disciplinary and scholarly work, also serving as powerful ways of learning and evaluating learning in the disciplines. Each undergraduate curriculum must be designed and taught so that the Major enhances students’ learning through writing and
speaking activities and helps students to communicate competently for academic and professional contexts. Because effective communication in these contexts often demands proficiency in the use of information technologies and resources, students must gain a basic understanding of how information is identified, organized, and accessed, in both the print and digital environments.

**Objectives:**
Each undergraduate curriculum must be designed to provide instruction and ample opportunities for guided practice that enable students to:

1. Learn more deeply and effectively through the use of writing and speaking activities, and
2. Master the kinds of writing and speaking that are appropriate to their academic or professional majors, and
3. Use information technologies and search strategies appropriate to their academic or professional majors to identify and access information and then to evaluate, synthesize, and incorporate that information effectively in their writing and speaking.

**GEP Thematic Track Option**

**Rationale:**
The purpose of thematic tracks is to encourage students to connect knowledge from different disciplinary areas while focusing on a unifying theme or topic. It is well suited to students who have an interest in a particular topic and who would benefit by exploring that topic from multiple disciplinary perspectives. Students will be credited with no more than one thematic track.

All students have two options for thematic tracks within the General Education Program (GEP). A student may:

1. Choose a thematic track that has been approved by the Council on Undergraduate Education (CUE). Completion of one approved thematic track will be noted in the student’s official transcript upon graduation provided that the student selects the thematic track prior to completion of degree requirements.
2. Create a thematic track of their own choice. In this case, the thematic track will not be noted in the student’s transcript. Choose to complete the GEP without a thematic track.

**Objective for a thematic track:** Thematic tracks will provide educational experiences that help students to use critical thinking skills to connect multiple disciplinary perspectives around a common topic or theme.

**Requirement for completion of a Thematic Track: (12 credit hours)**
Choose a total of twelve credit hours in the thematic track category as a combination of four courses or more (12 credit hours) - which are linked by a common theme or topic. At least one course must come from the university approved GEP Mathematical Sciences/Natural Sciences/Engineering listings; at least one course must come from the GEP Humanities/Social Sciences/Visual and Performing Arts lists. The remaining courses are also to be chosen from the approved GEP lists.

**Written Communication Competency**

(For more information about this competency, expectations, and assessment, click here [http://assessment.dasa.ncsu.edu/sites/assessment.dasa.ncsu.edu/files/WrittenCommunicationDefinition%20May%202012.pdf])

**Definition:** Written communication is the purposeful development, expression, and revision of ideas in writing for specific audiences. Effective written communication follows appropriate genre conventions and may include a combination of text and other media.

**Oral Communication Competency**

(For more information about this competency, expectations, and assessment, click here [http://assessment.dasa.ncsu.edu/sites/assessment.dasa.ncsu.edu/files/Oral%20Communication%202012.pdf])

**Definition:** For the purposes of the GEP, the oral communication competency involves the ability to ethically and responsibly use verbal and nonverbal communication for clear expression of ideas and collaborative processes; engage in active listening; build, express, and justify a claim; and adapt messages to varying situations and contexts.

**Critical thinking:**

(For more information about this competency, expectations, and assessment, click here [http://accreditation.ncsu.edu/critical-creative-thinking-definations])

**Definition:** Critical thinking is the active, persistent, and careful consideration of a belief or form of knowledge, the grounds that support it, and the conclusions that follow. It involves analyzing and evaluating one’s own thinking and that of others. In the context of college teaching and learning, critical thinking deliberately and actively engages students in:

- Raising vital questions and problems and formulating these clearly and precisely;
- Gathering and assessing relevant information, and using abstract ideas to interpret it effectively;
- Reaching well-reasoned conclusions and solutions and testing them against relevant criteria and standards;
- Openly considering alternative systems of thought; and
- Effectively communicating to others the analysis of and proposed solutions to complex challenges.

**General Education Competencies**

These general education competencies were identified by a panel of faculty representing all colleges who reviewed the NC State general education objectives, the Association of American Colleges and Universities’ Liberal Education and America’s Promise (LEAP) initiative, OIRP survey results, and the general education competencies adopted by peer institutions. Proposed competencies were vetted with the Council on Undergraduate Education, the Academic Policy Committee of the Faculty Senate as well as the full Faculty Senate, and each of NC State’s undergraduate colleges’ associate deans for academic affairs. As a result of this process, five competencies were selected and approved by the Provost. Once adopted, the five competencies were formally defined by a representative group of sixteen senior faculty members who teach general education courses.

They are defined as follows:

- **Critical thinking:**
  - (For more information about this competency, expectations, and assessment, click here [http://accreditation.ncsu.edu/critical-creative-thinking-definations])
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    - Raising vital questions and problems and formulating these clearly and precisely;
    - Gathering and assessing relevant information, and using abstract ideas to interpret it effectively;
    - Reaching well-reasoned conclusions and solutions and testing them against relevant criteria and standards;
    - Openly considering alternative systems of thought; and
    - Effectively communicating to others the analysis of and proposed solutions to complex challenges.

**Written Communication Competency**

(For more information about this competency, expectations, and assessment, click here [http://assessment.dasa.ncsu.edu/sites/assessment.dasa.ncsu.edu/files/WrittenCommunicationDefinition%20May%202012.pdf])

**Definition:** Written communication is the purposeful development, expression, and revision of ideas in writing for specific audiences. Effective written communication follows appropriate genre conventions and may include a combination of text and other media.

**Oral Communication Competency**

(For more information about this competency, expectations, and assessment, click here [http://assessment.dasa.ncsu.edu/sites/assessment.dasa.ncsu.edu/files/Oral%20Communication%202012.pdf])

**Definition:** For the purposes of the GEP, the oral communication competency involves the ability to ethically and responsibly use verbal and nonverbal communication for clear expression of ideas and collaborative processes; engage in active listening; build, express, and justify a claim; and adapt messages to varying situations and contexts.

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- Gathering and assessing relevant information, and using abstract ideas to interpret it effectively;
- Reaching well-reasoned conclusions and solutions and testing them against relevant criteria and standards;
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They are defined as follows:
Creative thinking:
(For more information about this competency, expectations, and assessment, click here [http://accreditation.ncsu.edu/critical-creative-thinking-definitions/])

Definition: Creative thinking is the generation of new ideas within or across domains of knowledge, drawing upon or intentionally breaking with established symbolic rules and procedures. It usually involves the behaviors of preparation, incubation, insight, evaluation, elaboration, and communication. In the context of college teaching and learning, creative thinking deliberately and actively engages students in:

• Bringing together existing ideas into new configurations;
• Developing new properties or possibilities for something that already exists; and
• Discovering or imagining something entirely new.

Quantitative Literacy
(For more information about this competency, expectations, and assessment, click here [http://assessment.dasa.ncsu.edu/sites/assessment.dasa.ncsu.edu/files/QL%20Final%20Rubric.pdf/])

Definition (AAC&U)*: "also known as Numeracy or Quantitative Reasoning (QR)- is a ‘habit of mind,’ competency, and comfort in working with numerical data. Individuals with strong QL skills possess the ability to reason and solve quantitative problems from a wide array of authentic contexts and everyday life situations. They understand and can create sophisticated arguments supported by quantitative evidence and they can clearly communicate those arguments in a variety of formats (using words, tables, graphs, mathematical equations, etc. as appropriate) (Rhodes, 2010).


References


Satisfactory Academic Progress

Beginning with the 2015 fall term, all undergraduate students, regardless of when they first enrolled in NC State University, will be subject to the new Satisfactory Academic Progress regulation [http://policies.ncsu.edu/regulation/reg-02-05-03]. The first evaluation of SAP will take place in May 2016.

Progress Toward Degree (PTD)

To make satisfactory PTD, students:

• must be in a degree granting major before entering their fifth term (fall or spring);
• are encouraged to maintain continuous enrollment in a minimum of 15 hours toward a degree every fall and spring term.

Satisfactory Academic Progress (SAP)

Satisfactory academic progress (SAP) will be evaluated for all students, including part-time students, at the end of each academic year (May). Students admitted mid-year (January) and those who attend only one term for the year will also be evaluated in May each year.

Satisfactory academic progress is measured by meeting the following three standards:

• Pace of Completion: Students must pass at least 2/3 of all hours attempted each academic year (summer term – spring term). Attempted hours include all hours enrolled for credit as of census date plus hours added after census. Hours dropped after census, withdrawn or excluded through Grade Exclusion (REG 02.20.16 [http://policies.ncsu.edu/regulation/reg-02-20-16]) also count as attempted hours.
• Maximum Timeframe: Students must graduate before attempting more than 150% of the hours required for their degree program (e.g. 180 hours for a 120 hour degree program).
• Degree Status: Students must have an academic standing that allows for continued enrollment.

Progress Deficiency

• Students failing to make satisfactory academic progress will have a Progress Deficiency hold placed on their record preventing enrollment and will have future term enrollments (summer, fall or spring) canceled.
• Students meeting SAP, but not the PTD requirements, may be placed on Progress Deficiency by their College. Colleges may define reasonable progress as: completing courses required for the student’s major in a timely manner, maintaining the expected GPA for the major, or making timely progress toward degree completion.
• Students placed on Progress Deficiency may submit an appeal to retain their schedule and continue enrollment in the next term. (For information about appeals, see RUL 02.66.01 Readmission of Former and Suspended Students [http://policies.ncsu.edu/rule/rul-02-66-01] )
• Students with successful appeals will be placed on Progress Probation for one term (summer, fall or spring) and will be required to meet the satisfactory academic progress standards described above.

Adding or Changing a Program

Double Degrees

Students who have satisfactorily completed the requirements for more than one bachelor’s degree may, upon the recommendation of their deans, be awarded two bachelor’s degrees at the same or at different commencement exercises. To earn two degrees, students register in one school or department and, with the cooperation of the second school or department, work out their program to cover the requirements for both.

Intra-Campus Transfers (Plan Change) Regulation

In order to apply to change to major, a student must either:
1. Have attempted fewer than twelve credit hours at NC State, and meet the admissions requirements of the new curriculum.

   OR

2. Have attempted twelve or more hours at NC State, and have satisfied the transfer requirements for a specific major, as listed on the CODA website (http://ncsu.edu/coda).

Procedures for Intra-Campus Transfers

Undergraduate students wishing to change from one plan (curriculum) to another should:

1. Visit the CODA website (http://ncsu.edu/coda) to check requirements for their intended major.

2. If requirements are met, submit an online application for the major.

Please Note: Colleges may follow different application cycles and deadlines. Please be sure that the college is currently accepting applications before submitting a CODA.

From the standpoint of advising, pre-registration, and adding and dropping courses, the student is considered to be in the new plan at the beginning of the semester for which the CODA was filed. (See also “Readmission of Former and Suspended Degree Students” and “University Policies and College/Departmental Policies”)

For the most current information regarding this regulation, please view the complete regulation (http://policies.ncsu.edu/regulation/reg-02-65-03).

Graduation Requirements

Students are eligible for graduation when they have completed satisfactorily all the academic requirements of their degree program as specified by their major department, their college, and the university.

NC State requires that, in addition to other university, college, and departmental requirements, all students must have a grade point average of at least 2.000, based on all courses attempted at NC State, in order to be eligible to receive a baccalaureate degree.

Minimum Hours Required for Graduation

Minimum credit hours required in a baccalaureate curriculum that has not been designated a five-year program range from 120 to 128. These are shown for each curriculum. Students may take more hours than the required minimum.

Length of Time to Graduation

The normal and expected length of time to graduation is four years (eight semesters) provided the student completes an average of slightly more than 16 credit hours each semester (for most curricula) and/or attends one or more summer sessions.

By action of the N.C. General Assembly, effective with the 1994 Fall Semester, new students entering any of the campuses of the University of North Carolina system (including NC State), will be assessed a 50 percent tuition surcharge once they have attempted more than 140 degree credit hours. (Degree programs at NC State require 120-128 hours or less for graduation.) Courses taken in summer school at any UNC-System campus do not count towards the 140-hour limitation. Questions about this policy should be directed to the Department of Registration and Records, (919) 515-2572.

In order to make continuous progress toward graduation, students are encouraged to take full advantage of the university's advising and support services. Effective career decision-making and early, deliberate, long-range semester-by-semester planning of courses and careful selection of extra-curricular commitments can provide direction and motivation necessary for effective use of time towards graduation.

Additional factors that may assure a student's continuous progress toward graduation include good academic performance in first year and basic prerequisite courses, advanced placement for introductory courses, and enrollment in summer sessions. Students are discouraged from taking unrealistic course loads as a means to accelerate their progress toward graduation as this may result in poor academic performance.

Students may take more than eight semesters to complete an undergraduate program at NC State. In some cases this is the result of effective decision-making on the part of the student for such things as participation in cooperative education or study abroad programs; a decision to be a part-time student with a reduced course load for reasons of health, necessary outside employment, or parental responsibilities; or attempting dual degrees, double majors, or academic minors. Discuss these situations options with your advisor.

In other cases the length of time to graduation may be prolonged beyond the eighth semester as a result of incomplete or inadequate secondary school background requiring some additional compensatory, developmental, or prerequisite courses. Poor academic performance in the freshman year or early semesters, or late changes in curriculum could also impact time to graduation.

Semester-by-Semester Displays

The requirements for curricula throughout this section are set forth in semester-by-semester displays. One purpose for these displays is to illustrate how certain sequences of courses and prerequisites may be scheduled. Another purpose is to reflect whether courses are normally offered in the fall or the spring semester. Otherwise, the semester-by-semester displays are merely advisory and not mandatory. The typical semester schedule shown in the displays may not be the appropriate one for some students. Students are required to consult with their faculty advisors prior to registration each semester. Semester-by-semester displays are available on the Office of Undergraduate Courses and Curricula website (http://oucc.ncsu.edu/semester-semester-plans).

Limited D Grades

Some colleges and departments have established limitations on the use of D grades in certain courses or categories of courses for satisfying graduation requirements. Check with your advisor if you have any questions.

Grade Point Average in Major

Some departments have established graduation requirements of a grade point average of 2.000 on all courses attempted in the major at NC State or a minimum letter grade requirement in some or all major courses. Such a requirement is in addition to the university grade point average total requirement of 2.000 for all courses attempted at NC State. Students are encouraged to inquire about specific requirements in majors of interest.
Residence Requirements
To be eligible for a bachelor’s degree, a student must be enrolled in a degree program at NC State, must have completed at least 25 percent of credit hours required for graduation through courses offered by NC State, and must have earned at least 30 of the last 45 hours of credit through NC State courses. In no case shall the proportion of credit hours taken at NC State and applied towards a bachelor’s degree be less than 25 percent. Individual departments and/or colleges may have additional residence requirements. Be sure to ask your advisor about any special requirements.

Note: The College of Engineering has a policy that transfer students normally must earn at least 48 of their last 60 credit hours at NC State while enrolled as degree candidates. The College of Management has a policy that Accounting and Business Management majors normally must earn at least 30 credit hours while officially enrolled as a degree candidate in either the ACC or BUS curriculum. Students in the Economics majors (EC/ECS) must earn at least 1/2 of their required economic credits while enrolled in the EC or ECS curriculum. Check with your advisor to see if such additional requirements apply to your major.

Student Records

Transcripts of Academic Records
An official transcript is issued only at the authorization or written request of the student concerned. A transcript is a complete copy of a student’s academic record at the time that it is issued. It contains all course work, including undergraduate, graduate and/or non-degree, taken while enrolled at NC State University. NC State will NOT issue a partial transcript. The university will automatically send all course work when a transcript is requested.

For more information on how to obtain an official transcript, please visit the Department of Registration and Records (http://registrar.ncsu.edu) website.

Change of Name, Address, or Telephone
It is the student’s responsibility to notify the Department of Registration and Records of any changes in name, address, or telephone. Failure to do so may prevent prompt delivery of important university correspondence and correct notification of hometown newspapers of honors received. International students are required by law to notify the university of any change or correction in name or address within 10 days. Updating address changes in MyPack Portal system fulfills international students’ federal requirements for maintaining status in SEVIS.

Name changes can only be completed in person at Registration and Records, 1000 Harris Hall by providing a picture ID and proof of the name change (i.e. driver’s license, social security card) or by written authorization along with proof.

Changes of address or telephone can be completed in MyPack Portal (http://mypack.ncsu.edu) > Main Menu > Student Self Service > Student Center, under Personal Information.

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

Student Status and Honors

Below are plain-language explanations of academic honors and academic status, as well as information about withdrawal from the university.

- Academic Honors (p. 150)
- Academic Status (p. 151)
- Readmission (p. 151)
- Withdrawal (p. 152)

Academic Honors

Academic Honors

High ranking students in their freshman year are eligible for membership in Phi Eta Sigma and Alpha Lambda Delta. Both of these national scholastic honoraries require a 3.5 semester grade point average or better during the first semester or a cumulative average of 3.5 for both semesters during the freshman year. Juniors ranking in the top three percent of their class, seniors ranking in the top six percent of their class, and outstanding graduate students are eligible for election to membership in Phi Kappa Phi, the university’s most prestigious campus-wide scholastic honor society. Outstanding undergraduate and graduate students majoring in the arts and sciences are also eligible for election to membership in Phi Beta Kappa.

Semester Dean’s List. A full-time undergraduate student who earns a semester average of 3.5 or better on 12 to 14 hours of course work for which grade points are earned or a semester average of 3.250 or better on 15 or more hours of course work for which grade points are earned will be placed on the Dean’s List for that semester. Students are not eligible for the Dean’s List in any semester in which they receive an F or IN grade. When IN grades are resolved, however, students who are otherwise eligible shall be added retroactively to the Dean’s List for that semester. This option does not apply if a course with an "F" grade is withdrawn or forgiven. Dean’s List recognition shall be noted on the student’s semester grade report and permanent academic record.

Graduation with Honors. Undergraduate degree honor designations are:

- Cum Laude - for GPA 3.25 through 3.499
- Magna Cum Laude - for GPA 3.5 through 3.749
- Summa Cum Laude - for GPA 3.75 and above

To be eligible for degree honor designations students must have completed at least two semesters and at least 30 credit hours at NC State.

Valedictorian, Salutatorian, and Highest Ranking Scholar in a College. To be eligible for consideration as valedictorian, salutatorian, or highest ranking scholar in a college, an undergraduate student must have received at least 100 academic credits at NC State (including credit by examination, advanced placement credit, and S/U courses). These 100 credits may include no more than 20 transfer credits through programs officially sponsored by NC State. Specifically, these programs are Cooperating Raleigh Colleges, National Student Exchange, International Student Exchange, NC State sponsored study abroad programs, and the affiliated hospital programs in Medical Technology. All students whose accumulated grade point averages, based on all courses attempted at NC State, make them eligible for one of these honors, shall be so
recognized. That is, in the case of ties, more than one student will receive the honor. However in the case of ties for valedictorian, no salutatorian will be recognized.

For the most current information regarding this regulation, please view the full regulation (http://policies.ncsu.edu/regulation/reg-02-30-01).

### Academic Status

Beginning with the 2015 Fall term, all undergraduate students, regardless of when they first enrolled in NC State University, will be subject to new Continuation of Undergraduate Enrollment Regulation, which governs Academic Status and Suspension.

### Academic Status and Continuation Criteria

Academic status will be calculated at the end of every fall, spring and summer term according to the rules below:

**Good Standing:** Students must maintain a cumulative GPA of at least 2.0 or be on Academic Warning or Academic Probation status in order to continue enrollment. Students are considered to be in Good Standing if they are eligible to continue enrollment.

**Academic Warning:**

Students with
- a cumulative GPA less than 2.0 and a grade point deficit* of 15 or less will be placed on Academic Warning and allowed to continue enrollment.
- a cumulative GPA above 2.0 and a term GPA of at least 1.0 will be placed on Academic Warning and allowed to continue enrollment.
- Students on Academic Warning must maintain a term GPA of at least 2.0 for every fall, spring and summer term of enrollment, until they achieve a cumulative GPA of at least 2.0.

**Academic Suspension:**

Who can be suspended?

- Students with a cumulative GPA less than 2.0 and a grade point deficit* greater than 15 at the end of any term will be placed on Academic Suspension.
- Students on Academic Warning or Probation, who fail to maintain a term GPA of at least 2.0 for every subsequent fall, spring or summer term or fail to achieve a cumulative GPA of at least 2.0, will be placed on Academic Suspension.

What are the options for a suspended student?

- Students on Academic Suspension with a grade point deficit* of 15 or less may choose to enroll in NC State summer terms in an effort to improve their status.
  - Suspended students enrolled for summer will have their suspension deferred and their fall schedule maintained until the end of their summer enrollment.
  - Students on suspension deferral for summer must raise their cumulative GPA to at least 2.0 or pass at least 6 hours with a cumulative summer GPA of 2.0. Failure to do so will result in the student being returned to Academic Suspension status.
  - Students on Academic Suspension may submit an appeal to continue enrollment for the next term. (See RUL 02.66.01 Readmission of

For the most current information regarding these regulations, please view the full regulation (http://policies.ncsu.edu/regulation/reg-02-05-01).

### Readmission

An undergraduate student who does not enroll for any fall or spring term must apply for readmission to continue their degree studies. Readmission is not guaranteed and is subject to available capacity in the student’s college and major.

Students applying for readmission must be eligible to return to NC State and to any institutions attended during their break in enrollment. Readmission applications should be submitted prior to the start of enrollment for each term. Students should consult the Registrar’s website for application and enrollment dates.

A non-refundable application processing fee must accompany all applications.

### Readmission for Students Eligible to Continue

Readmitted students who were eligible to continue at the time of leaving and who have a cumulative grade point average (GPA) less than 2.0 will be placed on Academic Warning and subject to approved continuation
Withdrawal

Appeals for Students Ineligible to Continue

Students on Academic Suspension or Progress Deficiency may appeal for readmission by the deadlines published on the Registrar’s Website (http://registrar.ncsu.edu/academic-resources/readmission).

Withdrawal

Withdrawal from the University

Students who wish to drop all the courses for which they are registered must withdraw from the university for the remainder of the semester or summer session in which they are enrolled. Students who have registered and prepaid are considered to be registered and must be officially withdrawn, unless they have notified the university prior to the beginning of the first day of classes that they wish to have their registration cancelled.

The procedure for withdrawing is different in several ways from the procedure for dropping one or some but not all courses. First, the procedure is not initiated in the academic department or college. Second, a Schedule Revision Form is not used. Third, it is highly recommended, but not required, that students considering withdrawal consult their faculty advisor or department coordinator of advising. The withdrawal process is as follows.

Degree candidates and Unclassified students initiate the official withdrawal process with the Counseling Center (http://healthcenter.ncsu.edu/counseling-center/services/academic-counseling/withdrawal), (919) 515-2423. Parental approval to withdraw may be required for single students who are under eighteen.

Non-Degree Studies students withdraw through Student Self Service in MyPack Portal. NDS students may contact Registration and Records at (919) 515-2572 if they have any questions about this process.

International students who wish to withdraw from the university must meet with an Office of International Scholar and Student Services advisor to effect a withdrawal in SEVIS before withdrawing from the university in order to protect their immigration status. International students who are contemplating a withdrawal must call OIS, (919) 515-2961 for an appointment.

Undergraduate and graduate degree students may receive late withdrawals through the Counseling Center under three conditions:

1. Certification by an appropriate medical professional of serious disruption in academic functioning for medical reasons. Such medical petitions are subject to review by a university physician and by the Counseling Center.
2. Certification by the Counseling Center of serious disruption in academic functioning because of an emotional problem or crisis. It is important to verify that (a) there has been a significant decrease in the student’s usual level of psychological functioning and (b) that regaining that previous level of functioning will involve a process of sufficient academic disruption to make continuing as a student unreasonable. In this case a “hold” may often be placed on the student’s readmission pending certification by the Counseling Center and/or independent psychologist/psychiatrist that the student has regained and can be expected to maintain that usual level of psychological competence.
3. Verification by the office of the student’s college dean that a decision has been reached in accordance with that college’s policies and procedures that a documented hardship of any kind which, responsibly handled, resulted in it being unreasonable to insist that the student continue. The hardship should normally have been reasonably unforeseeable.

Courses for which students are officially enrolled are recorded on the transcript without grades or grade points but with a notation of “W” to indicated approval to withdraw after the withdrawal deadline.

Student Conduct

Code of Student Conduct

All students who enroll at NC State are required to adhere to the Code of Student Conduct. "This Code of Student Conduct establishes the expectations for student conduct in the University community. The Code, therefore, proscribes the types of behavior that adversely affects the University community, and the resulting actions that may be taken to both educate students about behavioral expectations and to protect NC State’s community. This Code and its accompanying Student Disciplinary Procedures describe the process to be followed when a student has been charged with a violation of the Code". Academic and Non-Academic Misconduct, both on and off campus are addressed in the Code. Students will receive sanctions that may range from a warning to expulsion from the University. For more information contact the Office of Student Conduct at (919) 515-2963 or access the code through the Office of Student Conduct’s website (http://www.ncsu.edu/student_conduct).
Transfer and Exam Credit

Credit by Examination

Undergraduate students currently registered at NC State (degree, unclassified, or non-degree) may request an examination for course credit in a course whether enrolled in that course or not, under the conditions described below. Students must initiate a request with their advisor (except when a teaching department awards credit based upon group testing for placement purposes). Should the advisor approve, the student must arrange for the examination with the department offering the course. The department may administer the examination in any manner pertinent to the materials of the course. Departments are encouraged to offer credit by examination in all courses but have the prerogative of excluding certain courses, which are demonstrably unsuited for credit by examination.

The academic standards for credit by examination will be commensurate with the academic standards for the course. If a student's performance on the examination is judged to be of "C-" or higher quality, the department will notify the Department of Registration and Records on a Grade Change Report that the student has received Credit by Examination for the course. The Department of Registration and Records will enter the appropriate number of credit hours on the student's permanent academic record. Credits earned through Credit by Examination are not used in the computation of a student's grade point average.

The Department of Registration and Records will post course credit by examination to a student's permanent academic record only if that student is currently registered at NC State. However, if the course credit by examination would enable a student to complete the requirements for a degree, that student would not have to be registered in order to receive the credit.

If a student fails to achieve "C-" or higher quality work on an attempted credit by examination, no action is required other than the department's notifying the student. However, that student is not eligible for another such examination in the same course.

Once a student has failed a course or has completed credit or audit for more than fifty percent of a course, the student may not attempt credit by examination for that course. Under unusual circumstances, exceptions may be made upon the written recommendation of the student's advisor and the approval of the department offering the course. A student who receives credit by examination in a course in which that student is currently enrolled must officially drop that course no later than mid-semester.

Credit by Examination Through Independent Studies

Persons who are not currently enrolled on campus and who have gained through study or experience, knowledge of the content of undergraduate credit courses offered through Independent Studies may (with the approval of the Independent Studies staff and the academic department offering a course) receive credit for that course by special examination. Students may request approval to attempt credit by examination by completing and submitting a form available from Independent Studies.

Transfer Credit

Transcripts of college course credit for new transfer students and for NC State students who have taken course work at another institution are evaluated by the Office of Undergraduate Admissions in consultation with the deans of the NC State colleges to determine how the work applies to fulfilling the graduation requirements of each student's intended major. Only courses where the student receives a grade of C or better will be considered for transfer credit. Students admitted to an NC State undergraduate degree program who wish to take courses at another institution must obtain prior endorsement from their academic department and prior written approval from their college's associate dean (or dean's office) in order to insure that the transfer credits will apply toward specific graduation requirements. Transfer credit is not recorded on former students' permanent records until after they have been readmitted and have re-enrolled at NC State. Do not assume that transfer courses will be accepted. Speak to your advisor.

Credit accepted for transfer from another institution is shown only as credit hours and is not included in the computation of the grade point average. You can see a list of courses and how they transfer to NC State from other institutions on the Undergraduate Admissions website (http://admissions.ncsu.edu/apply/admission-review/transfer-admission-review-process/#transfercredits). Please note this website speaks only to the general transferability of the course work. How transfer credit applies to a student's degree is determined by his/her academic department and college associate dean's office. Also, speak to your advisor about transfer credits.

For the most current information regarding this regulation, please view the full regulation (http://policies.ncsu.edu/regulation/reg-02-10-03).
Continuing Education

McKimmon Center for Extension and Continuing Education (MCE&CE) (http://www.mckimmon.ncsu.edu)

Alice S. Warren, Vice Provost for Continuing Education

As a key component of Extension, Engagement, and Economic Development, the McKimmon Center for Extension and Continuing Education (MCE&CE) facilitates and enhances access to the academic resources of the campus by a wide range of audiences. Units within MCE&CE provide professional expertise in the identification of educational needs and the development of relevant programming in collaboration with the faculty, departments, colleges and external constituents; in the management and implementation of noncredit offerings; in the operation of a full-services, state-of-the-art conference facility; in the delivery of technical assistance and applied research; and in the evaluation and outcome assessment of programs and services delivered.

Specifically, the McKimmon Center for Extension and Continuing Education

- develops and delivers noncredit continuing education programs to meet the professional development or training needs of business/industry, governmental agencies and nonprofit organizations and communities
- offers customized programs for diverse clients
- stimulates interest in the development and delivery of relevant noncredit distance education offerings
- identifies opportunities for joint initiatives and assists in measuring learning outcomes and impacts
- provides a wide array of software-specific and certification courses for individuals and organizations
- operates the McKimmon Conference and Training Center which is a large, flexible facility that hosts educational meetings for groups ranging in size from 5 to 1,200
- provides opportunities for lifelong enrichment for people over the age of 50 through a robust learning-in-retirement program
- conducts program evaluation and outcomes research, survey research, technology application and customized consulting services for federal/state/local governmental agencies and nonprofit organizations
- performs a key role in the public schools statewide testing and accountability program.serves as the campus provider of Continuing Education Units (CEUs) that are earned through participation in approved noncredit courses
- coordinates and manages the annual Connecting-in-North Carolina (CINC) tour for faculty and key administrators to enhance the three-fold mission of our land-grant institution
- affords opportunities for students in collaboration with the University Honors Program and Service Learning Program

The McKimmon Conference and Training Center (http://www.mckimmon.ncsu.edu/mckimmon)

Chip Futrell, Director

Greg Emma, Assistant Director
Phone: 919.515.2277

The McKimmon Conference and Training Center provides meeting facilities, audiovisual equipment and support services for adult education programs. Administrative services are available to organizations that need assistance in planning and implementing conferences, short courses and other educational activities. Catering coordination is also available in the planning and successful implementation of banquets and related functions. The center accommodates small meeting groups as well as large national and international conferences. There are 18 meeting rooms that can be arranged in several different styles. These styles include, but are not limited to: classroom, theater, round tables and conference-style. Rooms range in size and can accommodate groups of 36 to 1200. Ceiling mounted projectors, drop-down screens and wireless internet are available in all rooms. Live streaming and videoconferencing are available to help you reach a bigger audience, or archive the recorded class online for students to review.

Technology Training Solutions

Chip Futrell, Director

Holly Sullenger, Assistant Director
Phone: 919.515.8163

Since 1989, NC State University's Technology Training Solutions (formerly the Computer Training Unit) has been a leading provider for the technology training needs of the Triangle. Technology Training Solutions (TTS) operates out of the McKimmon Center, utilizing four dedicated, state-of-the-art labs and instructors that are experts in their field. New classes are introduced three times per year, allowing adult learners in North Carolina to be amply prepared for future technology needs.

Whether an individual is looking for a single class to become familiarized with software or is committed to multiple weeks of certification training, TTS can address all technology training needs. TTS also provides customized corporate training both at the McKimmon Center and at client sites.

Visit NC State University’s Technology Training Solutions website today for a complete course schedule and certification information. TTS also has a social media presence and can be followed on FaceBook, Twitter, Pinterest, LinkedIn, and Google+

O (http://www.mckimmon.ncsu.edu/cpe)ffice of Professional Development

Chip Futrell, Director

Kerrie Cave, Lead Program Coordinator
Phone: 919.515.2261

NC State University’s Office of Professional Development (OPD) is a unit of the office of Continuing and Professional Education. Dedicated to the development and delivery of non-degree professional training courses, OPD provides you with a broad range of quality educational opportunities in a flexible, comfortable, and affordable learning environment.
OPD offers a variety of experiences, including conferences, seminars, and in-house/on-site training, to assist you in your professional development and your work. Most courses can be brought to your workplace or other location of your choosing, including dedicated training for your organization here at the McKimmon Center on NC State's campus. Courses can be customized so you and your employees receive training tailored to your specific needs.

OPD can help you manage your next educational event with conference management services, including

- Expert planning that saves time
- Integrated marketing services that cost less and get results
- Registration management of the utmost accuracy
- Financial management that keeps you in control, yet manages your money with greatest accountability
- Complete program staffing that lets you focus on the big picture

What makes OPD's conference management services unique:

- OPD's services are a la carte; you only pay for what we do. It's less expensive for you to hire OPD as needed than hire a full-time employee.
- Hiring OPD enables you to offer more programs. While you're focusing on content, we're taking care of the details.
- OPD can manage your event regardless of its location.
- OPD has helped clients to generate millions in revenue over the years.
- We can produce and mail conference brochures and postcards for some of the lowest prices available.
- OPD's clients and partners benefit from our annual print bids, which in turn, keep your costs down.
- You will benefit from the expertise of 10 Certified Program Planners.

Whether your event is a conference, workshop, meeting, or symposium with a local or international audience, whether it is held on campus or at a remote location, OPD is your perfect partner to get the job done.
The Graduate School

The Graduate School
1000 Main Campus Drive, Box 7102
Raleigh, NC 27695

The Graduate School is committed to transforming graduate education at NC State -- to prepare our best and brightest students as true leaders, ready to tackle the critical issues that challenge our state, nation, and world. We support advanced study and original 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, as well as many exciting interdisciplinary programs.

NC State currently offers over 160 master’s degrees, more than 60 doctoral degrees and is nationally recognized as a leader in science, technology, engineering, and mathematics. Additionally, we offer a full range of degree options -- degrees, certificates, and minors -- in traditional disciplines as well as many areas of emerging disciplines, including biomedical engineering, biotechnology, genomics, geographical imaging science, nanotechnology, and natural resources. The Graduate School also offers a Professional Science Master’s (http://www.ncsu.edu/grad/professional-education), interdisciplinary programs that tailor education to meet employers’ needs.

The Graduate School is also proud to sponsor the Preparing Future Leaders (http://www.ncsu.edu/grad/preparing-future-leaders) (PFL) program, an initiative designed to establish a foundation for professional development for graduate students and postdoctoral students. The PFL program encompasses three crucial themes -- career skills, teaching and mentoring, and responsible conduct of research and scholarship.

For a list of graduate degrees, details on the programs, and admissions information, please consult the Graduate Catalog (http://www.ncsu.edu/grad/catalog).
Other Offices

North Carolina Japan Center
J.W. Baugh, 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 North Carolina Department of Commerce to attract Japanese businesses to the state. 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 study abroad scholarships for summer language study and full year exchange programs in Japan. For more information, please contact John Baugh at (919) 515-3450 or visit the North Carolina Japan Center’s website (http://www.ncsu.edu/japan).

Office of Information Technology
M.I. Hoit, Vice Chancellor for Information Technology and Chief Information Officer

K.G. Horne, Director, Business Services
E.D. Sills, Director, Shared Services
G.W. Sparks, Director, Communication Technologies
G.T. Hazlehurst, Director, Enterprise Application Services
J.L. Black, Director, Infrastructure, Systems and Operations
S.N. Martin, Director, Outreach, Communications and Consulting
M.S. Bell, Director, Security and Compliance
S. West, Director, Technology Support Services

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 Internet access for students living in campus housing
- Telephone and cable TV services, 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
- Google Apps @ NC State, the university’s official provider of Web-based email and calendaring services and numerous collaborative tools
- 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 (http://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 more than 125 student computing labs on campus, with more than 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 (http://oit.ncsu.edu) website and updated annually.

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

- OIT (http://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 Online Help database (http://help.ncsu.edu)

Office of Professional Development
Chip Futrell, Interim Director
Website: www.ContinuingEducation.ncsu.edu;
Phone: (919) 515-2261

The Office of Professional Development (OPD) develops, promotes, and coordinates noncredit seminars, certificate programs, and conferences to a broad market on a wide range of topics. Program areas include: GMAT, GRE and LSAT test preparation; accounting and taxation; agriculture; communications; education; engineering; English as a second language; environmental; management; textiles; and general interest. Events
management services are available to help both campus and non-campus groups more efficiently and productively administer educational seminars, workshops, and conferences.

**Office of Research, Innovation and Economic Development**

Mladen A. Vouk, Interim Vice Chancellor for Research
Vacant, Associate Vice Chancellor for Research Development
Jeff Cheek, Associate Vice Chancellor for Research Administration
Vacant, Director of Planning and Communications
Jonathan Horowitz, Assistant Vice Chancellor for Research Development
Dennis Kekas, Associate Vice Chancellor for Partnerships and Economic Development
Matt Peterson, Director, Federal Research Affairs
Kelly Sexton, Director, Office of Technology Transfer

The Office of Research, Innovation and Economic Development supports the University’s researchers and helps translate their discoveries to the marketplace, creating economic and social impact. The Vice Chancellor acts as the principal liaison representative between sponsoring entities, (federal, state, foundations, industry) and the university; assists faculty, department heads, and deans in identifying support for research programs, preparing and processing proposals, negotiating contracts, grants and cooperative agreements and developing intercollegiate and interinstitutional research programs and projects including Centennial Campus; manages the technology transfer activities of the university, facilitates industry and governmental partnerships, administers the allocation of faculty research development funds; manages university compliance of state and federal laws, and policies; advises the Provost and Chancellor on the coordination of intercollegiate and interinstitutional research programs and facilities; and provides information and advocacy on all research, innovation, and economic development activities.

The Research Development Office facilitates the realization of strategic research objectives by enhancing collaborative research and laying the foundation for sustainable research growth. Multi-disciplinary projects corresponding to the University’s focused research initiatives are nurtured and supported; funding opportunities for faculty and researchers are made available in a centralized and easy-to-access portal; and support for large-scale projects is provided through strategy development, technical writing, budget creation and site visit support.

**Centennial Campus** provides a rich, collaborative environment for corporate, governmental and non-profit partners who want to tap into NC State’s recognized expertise in such areas as cybersecurity, comparative medicine, advanced materials, biomedical engineering, innovative education, nanofiber technology, serious gaming, distributive energy, and many other fields.

**Federal Relations** serves as a primary liaison between NC State and the federal government, public policy makers and national organizations on issues related to higher education, research funding, and matters affecting students, faculty, and staff.

**Sponsored Programs & Regulatory Compliance Services (SPARCS)** provides services to facilitate the submission of proposals, negotiation of agreements, and the administration of internally and externally funded projects. SPARCS also provides services involving subagreements supported by funding provided to North Carolina State University. All aspects of the externally sponsored research and scholarship enterprise, including the pre-award management and the non-fiscal post-award management, fall under the leadership of SPARCS personnel, including regulatory compliance and research integrity matters.

**The Office of Technology Transfer.** With more than 100 active startup companies and 270 commercialized products, NC State brings real-world solutions to the marketplace. The Office of Technology Transfer plays a crucial role in this mission by protecting and promoting University research discoveries and intellectual property, working with and guiding industry partners, recognizing faculty innovation, and promoting acceleration of startup companies.

**University Advancement**

Brian C. Sischo, Vice Chancellor for University Advancement
Brad C. Bohlander, Associate Vice Chancellor for University Communications
Kushal Dasgupta, Associate Vice Chancellor for Advancement Services
Lisa Dyer, Executive Assistant to the Vice Chancellor
E. Taylor Jeffreys, Assistant Vice Chancellor for Finance & Administration
Ralph E. “Benny” Suggs, Associate Vice Chancellor for Alumni Relations & Interim Associate Vice Chancellor for University Development
Christina Walker, Director of Principal Gifts

The Office of University Advancement at NC State strives to enhance the perception of and knowledge about the university’s programs and accomplishments: to provide alumni, students, and friends with programs and services that instill loyalty and pride; to secure resources which will enhance the academic quality of the institution; to be good stewards of its endowments and advance the growth of investment at NC State; to promote advocacy of the university and to effectively integrate advancement efforts across the university’s divisions, colleges, programs and affiliated foundations. The office oversees a division that includes development, alumni relations, university communications, and advancement services. Visit the University Advancement website (http://giving.ncsu.edu/about-us) for more information.

**Advancement Services** supports all components of University Advancement, as well as other units involved in advancement activities throughout NC State, through management of the primary prospect/donor/alumni/friend database, conducting donor research, processing and receiving private pledges, gifts and grants, generating official fundraising activity reports, managing prospect management and tracking systems, providing donor stewardship and endowment reporting, and developing and coordinating all development communications. 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 of the furtherance of the entire advancement services profession.

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). To book space in the Park Alumni Center for events, contact Wendy Dorman at the State Club at wendy@thestateclub.org (http://mailto:wendy@thestateclub.org).

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.

The Office of University Communications 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
University Administration

History of North Carolina State University

When North Carolina State University was founded in 1887, the school 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.

A new generation of progressive thinkers founded the college, known then as the North Carolina College of Agriculture and Mechanic Arts. No organization did more to advance the cause of this new institution than the Watauga Club (http://www.ncsu.edu/watauga), a reform-minded group of lawyers, teachers, doctors and businessmen in Raleigh — all of them younger than 30. Watauga Club member Charles W. Dabney, who wrote the legislation creating the new institution, exemplified the changes sweeping the South in the 1880s. The son of a Calvinist theologian who professed skepticism of modern science, Dabney earned a Ph.D. in chemistry and built a reputation as one of the foremost agricultural scientists in the nation.

Today we honor NC State’s founders — men like Dabney, William J. Peele and Walter Hines Page — not just for their vision, but also because they lived at a time when considerable foresight, skill and courage were required to rally public support for higher education.

Growth and Extension

NC State was established under the auspices of the federal 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 (http://www.ces.ncsu.edu) at NC State.

New Name, New Focus

By the 1920s, State College (as the school was now 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 imposed economic challenges on 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.

Postwar Boom

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 science and mathematics, 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 People’s University

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

Known as the “People’s University,” NC State has developed into a vital educational and economic resource, with more than 34,000 students and 7,000 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, 125 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.

University of North Carolina Board of Governors

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W. Louis Bisette, Jr., Vice Chairman
Joan Templeton Perry, M.D., Secretary
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Course Descriptions Overview

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 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.

Descriptions

AA - Advanced Analytics Courses

AA 501 Analytics Foundations 3.
Corequisite: AA 670.
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.

AA 502 Analytics Methods and Applications I 6.
Prerequisite: AA 501 and AA 670; Corequisite: AA 504.
This course equips the student 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.

AA 503 Analytics Methods and Applications II 6.
Prerequisite: AA 502; Corequisite: AA 505.
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.

AA 504 Analytics Practicum I 6.
Prerequisite: AA 501 and AA 670; Corequisite: AA 502.
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.

AA 505 Analytics Practicum II 6.
Prerequisite: AA 504; Corequisite: AA 503.
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.

AA 591 Special Topics in Advanced Analytics 1-6.
Special Topics in Advanced Analytics.

AA 691 Special Topics in Advanced Analytics 1-6.
Special Topics in Advanced Analytics.

ACC - Accounting Courses

ACC 200 Introduction to Managerial Accounting 3.
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.

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.

Prerequisite: ACC 210 with a C+ or better.
Prerequisite: ACC 310 with grade of C- or better.

ACC 330 An Introduction To Income Taxation 3.
Prerequisite: ACC 210 with a grade of C- or better.
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.

ACC 340 Accounting Information Systems 3.
Prerequisite: ACC 200 and ACC 210 with a grade of C- or better.
Introduction to the importance of accounting and computer-based controls in an organization's enterprise systems. Focus on business processes, entity-wide information systems controls and security, database modeling and design focused on accounting, and contemporary issues involved in providing assurance services for systems reliability.

ACC 410 Governmental and Nonprofit Accounting 3.
Prerequisite: ACC 210.
Accounting for state and local governments, including budgeting, audit issues, and financial analysis. Accounting for nonprofit organizations, including colleges and universities and healthcare organizations.

ACC 411 Business Valuation 3.
Prerequisite: ACC 210, BUS 320, and (BUS/ST 350 or ST 302 or ST 361 or ST 370 or ST 372).
Conceptual framework of how businesses work, value generation and reporting. Interpretation of financial statements and their use in valuation of the firm.

ACC 420 Strategic Management Accounting 3.
Prerequisite: ACC 200 with C- or better and (BUS/ST 350, or ST 302 or ST 361 or ST 370 or ST 372).
Strategic management accounting 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 340 or BUS 340.
An Enterprise Resource Planning (ERP) system is business software that is cross-functional, process-centered and uses a relational database. As NCSU is a member of the SAP University Alliance, you will obtain hands-on training with SAP, the ERP market leader. This knowledge will give business and IT students a competitive and advantage in the workplace. This course covers the managerial, accounting, and technical issues of ERP systems. Course content includes evolution of ERP systems, reengineering, process mapping, the ERP life cycle, functionality, bolt-ons, and auditing ERP systems. Credit will not be allowed for both ACC 440 and MBA 515.

ACC 450 Auditing and Assurance Services 3.
Prerequisite: ACC 311 with a C- or better and ACC 340 and (BUS/ST 350, or ST 302, or ST 361, or ST 370, or ST 372).
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.

ACC 451 Internal Auditing 3.
Prerequisite: ACC 210 with grade of C- or better.
The theory, practice and design of internal audit activities. Examination of industry standards as a guide to the internal audit field. Evaluation of internal controls, information technology and fraud risks and controls, audit evidence and assurance, communicating audit results and consulting engagements. Emphasis on the professional practice of the discipline of internal auditing.

ACC 495 Special Topics in Accounting 1-6.
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.
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 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.

ACC 499 Internship in ACC 1-6.
Prerequisite: Senior standing, GPA greater than or equal to 3.25.
A full-time professional internship in accounting. Eligibility for participation to be by invitation and by the demand for interns among accounting firms participating in the internship program. 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 vary in duration from 8 to 15 weeks. Restricted to ACF, ACS, & ACM majors.

ACC 508 Advanced Commercial Law 3.
Prerequisite: MAC Program.
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 and regulation including case-law that must be followed as a part of the strategic planning process and in the process of implementing business methods and procedures.

Prerequisite: MAC Program.
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.
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.

ACC 520 Advanced Management Accounting 3.
Prerequisite: MAC Program.
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 are appropriate for consideration by executive management and the board of directors.

ACC 530 Advanced Income Tax 3.
Prerequisite: MAC Program.
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.

ACC 533 Accounting and Tax Research 3.
Prerequisite: MAC Program.
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.

ACC 540 IT Risks and Controls 3.
Prerequisite: MAC Program.
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. Students will examine IT control solutions used to address IT risks and will address issues affecting assurance engagements related to IT systems.

ACC 550 Advanced Auditing 3.
Prerequisite: MAC Program.
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.

ACC 588 Special Topics in Accounting 1-6.
Course objectives dependent upon unique circumstances motivating offering of course. Timely curriculum innovation the primary motivation. Departmental consent required.

ACC 600 Managerial and Career Effectiveness 1.
Prerequisite: MAC Program.
Knowledge and skills needed to advance professional accounting career. Strategic communication of self and ideas in professional and classroom settings. Diagnosis of organizational culture. Implementation of management and appropriate business behavior. Leadership of individuals, group dynamics, and team building.

ACC 630 Independent Study 1-6.
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.

ACC 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

ACC 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

ADN - Art and Design Courses

ADN 111 Two Dimensional Design 3.
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 and a language of design.

ADN 112 Three Dimensional Design 3.
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 design issues. Provides non-design students a working knowledge of design principles and a language of design.

P: D 100, D 101, and ENG 101;
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.

Prerequisite: D 104, D 105, or permission of department. ADN majors only.
Emphasis on fundamental Art & Design visual language through investigative problem solving.

ADN 212 Basic Photography 3.
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.
ADN 219 Digital Imaging 3.
Prerequisite: D104 or ADN 111.
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.

ADN 220 Digital Illustration 3.
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.

ADN 221 Digital Illustration II 3.
Prerequisite: ADN 220.
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.

ADN 224 Digital Motion 3.
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.

ADN 226 Sequential Imaging 3.
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.

ADN 272 Introduction to Printing and Surface Design 3.
Prerequisite: C- or better in D104, ADN 111, or ADN 112.
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.

ADN 273 Fibers Materials and Processes 3.
Prerequisite: ADN 111 or ADN 112 or D 105.
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.

ADN 274 Basic Woven and Constructed Textiles 3.
Hands-on introduction to structures and techniques of hand weaving and related off-loom textile structures. Focus on basic hand weaving structures, 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.

ADN 275 Survey of Fibers in Art and Design 3.
Design Students Only.
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.

ADN 281 Basic Drawing 3.
Prerequisite: Design Majors and Design Minors.
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.

ADN 292 Special Topics in Design 1-3.
Topics of current interest in the School of Design. Used to develop new courses.

ADN 311 Basic Visual Laboratories 3.
Prerequisite: ADN 111, ADN 112.
Study of basic visual communication skills that relate to Art & Design areas of focus.

ADN 312 Intermediate Photography 3.
Prerequisite: ADN 212.
Continuation of an advanced level of the skills and techniques developed in Basic Photography. Purpose is to develop use of camera as a perceptual tool to increase awareness and sensitivity of visual imagery.

ADN 319 Introduction to Animation 3.
Prerequisite: ADN 219.
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.

ADN 372 Surface Embellishment 3.
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.

ADN 384 Basic Painting 3.
Prerequisite: D 104 or both ADN 111 and ADN 112.
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.
ADN 386 Basic Sculpture 3.
Prerequisite: D 104 or ADN 112.
Studio course introducing basic concepts, materials, and processes of sculpture. Instruction incorporates both traditional and contemporary form generation with emphasis on developing formal perception and projection.

ADN 400 Design Studio 6.
Prerequisite: ADN 202.
Studio offering Art & Design undergraduates the opportunity to intensively study general design issues (form, color, structure, proportions, scale, etc.) as applies to the study of Art & Design.

ADN 402 Senior Studio 6.
Prerequisite: Seven studios and ADN 219.
Advanced Design studio emphasizing the exploration of past, current and potential future technologies within Design Department content areas (e.g., painting, sculpture, fibers, jewelry, color and light, etc.). Students are expected to work independently, develop their own problem statements.

ADN 411 Visual Laboratory II 3.
Prerequisite: D 105 or ADN 111 or ADN 112 or ADN 281.
Study of intermediate visual communication skills that relate to Art & Design areas of focus.

ADN 414 Color and Light 3.
Physical and perceptual nature of color, color awareness, sensitivity and skills in visual communication with color as a designer’s tool.

ADN 418 Contemporary Issues in Art and Design 3.
Prerequisite: D 101 and D 103; Requisite: Junior Standing in ADN or Design Studies.
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.

ADN 419 Multimedia and Digital Imaging 3.
Prerequisite: D 105, ADN 219.
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.

ADN 423 Digital Modeling 3.
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.

ADN 428 Art and Design: Theory and Practice 3.
Prerequisite: Senior Level (6 studios), Art and Design Major.
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: ADN 219 and ADN 400.
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.

ADN 470 Fibers and Surface Design Studio 6.
Prerequisite: Grade of C- or better in (ADN 400 or ARC 202 or ID 202 or GD 202).
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.

ADN 472 Advanced Surface Design 3.
Prerequisite: D 104, ADN 272.
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 textilemedia. Specific focus changes each semester.

ADN 473 Advanced Three-Dimensional Fibers Forms and Structures 3.
Prerequisite: ADN 273 or equivalent.
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.

ADN 474 Advanced Digital Hand Weaving 3.
Prerequisite: ADN 219.
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.

ADN 475 Pre-Industrial World Textiles 3.
Prerequisite: Sophomore standing.
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.

ADN 480 Intermediate Studio 6.
Prerequisite: Grade of C- or better in (ADN 400 or ARC 202 or ID 202 or GD 202).
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.

ADN 481 Intermediate Drawing 3.
Prerequisite: ADN 281.
An intermediate-level drawing course that further develops the designer’s graphic, analytic, observational, and conceptual skills.
ADN 484 Intermediate Painting 3.
Prerequisite: D 105 or both ADN 111 and ADN 112.
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.

ADN 486 Intermediate Sculpture 3.
Prerequisite: ADN 386.
An intermediate-level sculpture course that further develops the designer's analytic, observational, and conceptual skills.

Prerequisite: Junior standing, Design Majors, Approval Study Abroad Office.
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.

ADN 491 Special Seminar in Design 1-3.
Seminars on subjects of current interest in design.

ADN 492 Special Topics in Design 1-3.
Topics of current interest in Design & Technology. Used to develop new courses.

ADN 493 Art and Design Senior Lecture 3.
Prerequisite: ADN 219, ADN 281, ADN 418, completion of a 400 level studio; Corequisite: ADN 400, ADN 460, ADN 470, or ADN 480.
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 work from previous Art and Design courses into a comprehensive portfolio and personal website. Students are required to participate in the Art and Design Senior Exhibition and provide their own transportation to the exhibition.

ADN 494 Internship in Design 1-6.
Prerequisite: Junior standing; 3.0 GPA or better.
Supervised field experience in design offices, galleries, museums and other organizations. Maximum of 6 credit hours.

ADN 495 Independent Study in Design 1-6.
Prerequisite: Junior standing in Design with 3.0 in Design or better.
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.

ADN 502 Advanced Visual Laboratory 3.
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.

ADN 503 Graduate Seminar in Art & Design 3.
Seminar introduction to research in art and design, addressing theoretical, historical, and methodological contexts for individual exploration. Reading, discussion, and presentations will emphasize current work and concept development in all art media. Methods of examining idea sources, process, documentation, critiquing, speaking, and writing about visual concepts.

ADN 560 Advanced Animation Studio 6.
Prerequisite: ADN 460, ADN 419; College of Design Graduate Student.
The studio serves as an intensive investigation of the tools, techniques, and processes for experimental multimedia animation. The studio will address the entire creative animation process, from initial storyboard concept to final production. The studio will serve as an advanced studio of animation and imaging by investigating multimedia animation from numerous perspectives, including filmmaking, cognitive psychology, the fine arts and interaction design. Creativity in concept and execution (the creative process) will be a major focus of the studio experience.

ADN 561 Digital Animation and Imaging Seminar 3.
Prerequisite: ADN 460, ADN 419; College of Design Graduate Student.
Intensive research, presentation, and discussion of animation. Addressing historical animation issues related to media, culture and technology. Advanced study of animation and imaging through study of the history of multimedia animation from numerous perspectives, including filmmaking, painting and drawing, theater and animation history.

ADN 575 Pre-Industrial World Textiles 3.
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, development of production, and design characteristics, including 20th-century fiber art movements. Seminar format.

ADN 581 Final Project Research 3.
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.

ADN 588 Final Project Studio 6.
Prerequisite: ADN 570(18cr) and ADN 581. Student in last semester of graduate enrollment.
Final studio project for graduate students in Art & Design, under the supervision of graduate advisory committee members.

ADN 592 Special Topics in Art and Design 1-6.
Topics of current interest to the program or concentration offered by faculty in the department of Art and Design. Subjects offered under this number are normally used to test and develop new courses.

ADN 630 Independent Study in Art & Design 1-3.
Prerequisite: ADN 503; and ADN 570.
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.
ADN 685 Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

ADN 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

ADN 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

AEC - Applied Ecology Courses

AEC 295 Special Topics in Applied Ecology 1-3.
Prerequisite: BIO 181.
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.
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.

AEC 400 Applied Ecology 3.
Prerequisite: PB/BIO 360.
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.

AEC 419 Freshwater Ecology 4.
Prerequisite: C- or better in BIO/PB 360.
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.

AEC 420 Introduction to Fisheries Science 3.
Prerequisite: C- or better in BIO/PB 360.
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.

AEC 423 Introduction to Fisheries Sciences Laboratory 1.
Corequisite: FW/BIO 420.
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.

AEC 441 Biology of Fishes 3.
Prerequisite: C- or better in BIO/PB 360.
Behavior, evolution, physiology and ecology of fishes, emphasizing their adaptations for life in streams, lakes, and oceans.

AEC 442 Biology of Fishes Laboratory 1.
Corequisite: AEC 441.
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.

AEC 460 Field Ecology and Methods 4.
Prerequisite: C- or better in ST 311 and BIO 360.
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 experiments to global studies of patterns and diversity. Course is restricted to seniors.

Prerequisite: BIO 181 (Variable, depending on instructor).
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 coordinator in department of applied ecology is required. Students are responsible for risk and safety assessment at off campus locations. Students are responsible for transportation.

Prerequisite: BIO 181 (Variable, depending on instructor).
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 coordinator in department of applied ecology is required. Students are responsible for risk and safety assessment at off campus locations.
AEC 495 Advanced Special Topics in Applied Ecology 1-3.
Prerequisite: BIO 181.
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.

AEC 501 Ornithology 4.
Prerequisite: BIO 181, BIO 183, and (BIO 250 or BIO/PB 360).
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.

AEC 515 Fish Physiology 3.
Prerequisite: GN 411, ZO 420, 421, 441.
The biology of fishes: physiology, anatomy, endocrinology, behavior and genetics. Designed especially for graduate students in fisheries. Several trips to research laboratories taken.

AEC 519 Freshwater Ecology 4.
Prerequisite: Graduate Standing.
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.

AEC 586 Aquaculture 3.
Prerequisite: BO 360, Senior standing or Graduate standing.
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.

AEC 587 Aquaculture Laboratory 1.
Prerequisite: BO 360 or ZO 260, Senior standing or Graduate standing. Corequisite: ZO 586.
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.)

AEC 592 Special Topics in Applied Ecology 1-3.
Special Topics in Applied Ecology. Topics will vary.

AEC 630 Special Topics in AEC 1-3.
Special Topics in AEC.

AEC 726 Quantitative Fisheries Management 3.
Current methods for assessment and management of exploited fish populations, including sampling methods, data analysis and modeling. A required research paper or project.

AEE - Agricultural and Extension Education Courses

AEE 101 Introduction to Career and Technical Education 1.
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.

AEE 103 Fundamentals of Agricultural and Extension Education 1.
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.

AEE 141 Computer Applications in the Agricultural Institute 2.
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.

AEE 206 Introduction to Teaching Agriculture 3.
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.

AEE 208 Agricultural Biotechnology: Issues and Implications 3.
Prerequisite: (BIO 105 or BIO 115 or BIO 181 or BIO 183).
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.

AEE 226 Computer Applications and Information Technology in Agricultural & Extension Ed 3.
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 for processing information and imaging; network access; and electronic communications.

AEE 230 Introduction to Cooperative Extension 3.
This course is designed for all students who are interested 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.
AEE 291 Service Learning Program Leader Development I 1.
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.

AEE 292 Service Learning Program Leader Development II 2.
Prerequisite: AEE 291.
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 practice what has been learned with their own teams. Students will travel with their respective teams during spring break to complete the week long service-learning project. Students will be responsible for fundraising for approximately half the cost of their trip. Trip costs vary and depends on location selected.

AEE 303 Administration and Supervision of Student Organizations 3.
Prerequisite: AEE 206.
Principles and techniques for organizing, administering and supervising student organization activities.

AEE 311 Communication Methods and Media 3.
Prerequisite: ENG 101.
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.

AEE 322 Experiential Learning in Agriculture 3.
Prerequisite: AEE 206.
Planning, organizing, implementing, supervising and evaluating Supervised Agricultural Experience (SAE) programs in agriculture.

AEE 323 Leadership Development in Agriculture and Life Sciences 3.
Leadership development in agricultural and related settings; foundations of leadership theory and practice; techniques for developing leadership skills; development of understanding of group interactions and group leader roles, technical communication skills, interpersonal influence, commitment, and goals achievement strategies necessary for effective leaders.

AEE 325 Planning and Delivering Non-Formal Education 3.
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.

AEE 326 Teaching Diverse Learners in AED 3.
Prerequisite: AEE 206; Junior standing; and AED Majors only.
Legislation and issues regarding diverse learners in middle and high school agricultural education are examined. Discussion and practice in planning and facilitating teaching strategies to help those with special needs in an agricultural setting are emphasized. Techniques to integrate reading and writing into the curriculum are identified and practiced. Field trips are required.

AEE 327 Conducting Summer Programs in Agricultural Education 1.
Prerequisite: AEE 206, AEE 303, AEE 322, and Corequisite of AEE 426.
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.

AEE 332 Youth Leadership Dev 3.
Prerequisite: AEE 323-Leadership Development in Agriculture.
This course is intended to prepare students to be effective facilitators of youth leadership development programs. Theory will be emphasized in the course because it is essential to be grounded in theory in order to apply it. Major course topics include but are not limited to: understanding the unique leadership development needs of young people, learning how to develop programs that meet those needs, and the evaluation of youth leadership programs. Students will be required to be active in and outside of class sessions. In this course you will learn by doing! Students must provide their own transportation for field trips and outside of class activities.

AEE 333 Youth Program Development and Management 3.
This course is intended to prepare students to be effective youth program facilitators. Application of theory related to youth program management will be emphasized. Major course topics include but are not limited to: understanding various educational delivery modes used in youth programming, selecting and using developmentally appropriate curriculum, using the experiential learning model to teach young people. Students will be required to be active in and outside of class sessions, including outside preparation for the lab component of the course. Students must provide their own transportation for field trips and outside of class activities. Students are encouraged to have successfully completed AEE 323 prior to enrolling in this course.

AEE 350 Personal Leadership Development in Agriculture and Life Sciences 3.
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.

AEE 350 Personal Leadership Development in Agriculture and Life Sciences 3.
Prerequisite: AEE 323-Leadership Development in Agriculture.
This course is intended to prepare students to be effective facilitators of youth leadership development programs. Theory will be emphasized in the course because it is essential to be grounded in theory in order to apply it. Major course topics include but are not limited to: understanding the unique leadership development needs of young people, learning how to develop programs that meet those needs, and the evaluation of youth leadership programs. Students will be required to be active in and outside of class sessions. In this course you will learn by doing! Students must provide their own transportation for field trips and outside of class activities. Students are encouraged to have successfully completed AEE 323 prior to enrolling in this course.

AEE 360 Developing Team Leadership in Agriculture and Life Sciences 3.
Prerequisite: AEE 323-Leadership Development in Agriculture.
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.

AEE 423 Practicum in Agricultural Extension/Industry 8.
Prerequisite: AEE 230, AEE 325, and Corequisite of AEE 490.
Participation in professional work experiences in preparation for effective leadership positions in the Cooperative Extension Service or the agribusiness industry.
AEE 424 Planning Agricultural Educational Programs 3.
Prerequisite: AEE(ED) 426, Corequisite: AEE(ED) 427.
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.

AEE 426 Methods of Teaching Agriculture 3.
Prerequisite: Junior standing.
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.

AEE 427 Student Teaching in Agriculture 8.
Prerequisite: AEE (ED) 426; Admission to Professional Semester,
Corequisite: AEE (ED) 490, AEE (ED) 424;
Skills and techniques involved in teaching vocational agriculture through practice in a public school setting with concurrent on-campus seminars.

AEE 433 Leadership and Management of Volunteers in Agricultural and Extension Education 3.
Prerequisite: Junior standing.
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.

AEE 434 Collaborative Leadership: Building Partnerships Across Community Programs 3.
This course is intended to prepare students to become collaborative leaders at home, at school and within their communities. Theory will be emphasized in the course because it is essential to be grounded in theory in order to apply it. Topics covered in the course include but are not limited to: what is community, how do partnerships form, challenges and opportunities for successful collaborations. This is an active course where students will be required to be engaged in and outside of class sessions. Students are encouraged to have successfully completed AEE 323 prior to enrolling in this course. Students must provide their own transportation for field trips and outside of class activities. AEE 323 encouraged but not required.

AEE 435 Professional Presentations in Agricultural Organizations 3.
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.

AEE 460 Organizational Leadership Development in Agriculture and Life Sciences 3.
Prerequisite: AEE 323-Leadership Development in Agriculture.
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.

AEE 470 Agricultural Communications 3.
Prerequisite: AEE 311, Senior standing.
Use of agricultural communication materials. Emphasis on application of principles, materials and processes of B&W and color photography to problems of communication and the development of visual presentation materials for instruction and training.

AEE 478 Advanced Issues in Extension Education 3.
Prerequisite: AEE 230.
Advanced issues and trends contributing to the administration, organization, and structure of extension education in a changing world. Senior standing required.

AEE 490 Seminar in Agricultural and Extension Education 1.
Prerequisite: Admission to Professional Semester.
Analysis of opportunities and challenges facing educational leaders in agriculture.

AEE 492 External Learning Experience in Agricultural and Extension Education 1-6.
Prerequisite: Sophomore standing.
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.

AEE 493 Special Problems in Agriculture and Extension Education 1-6.
Prerequisite: Sophomore standing.
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 teaching coordinator. Not intended for teacher licensure for students in AEE.

AEE 495 Special Topics in Agricultural and Extension Education 1-3.
Offered as needed to present material not normally available in regular course offerings or for offerings of new courses on a trial basis. Not intended for teacher licensure for students in AEE.

AEE 500 Agricultural Education, Schools and Society 3.
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. Web-based course.

AEE 501 Foundations Of Agricultural and Extension Education 3.
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.
AEE 503 Youth Program Management 3.
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.

AEE 505 Trends and Issues in Agricultural and Extension Education 3.
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.

AEE 507 Comparative Agricultural and Extension Education 3.
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.

AEE 521 Program Planning in Agricultural and Extension Education 3.
Prerequisite: Graduate standing or PBS status. Consideration of the need for planning programs in education; objectives and evaluation of community programs; use of advisory group; organization and use of facilities.

AEE 522 Occupational Experience in Agriculture 3.
Prerequisite: Graduate standing or PBS status. 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.

AEE 523 Adult Education in Agriculture 3.
Prerequisite: Graduate standing or PBS status. Designed to meet needs of leaders in adult education. Opportunity to study some of basic problems and values in working with adult groups. Attention given to problem of fitting educational program for adults into public school program and other educational programs as well as to methods of teaching adults.

AEE 524 Coordinating the High School Agricultural Education Program 3.
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.

AEE 526 Information Technologies in Agricultural and Extension Education 3.
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.

AEE 528 Instructional Design in Agricultural and Extension Education 3.
Planning, developing, implementing, evaluating and managing the instructional process; theories, models, development and research in instructional design; conducting tasks analysis and needs assessments; distance learning considerations. Web-based course.

AEE 529 Curriculum Development in Agricultural and Extension Education 3.
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.

AEE 530 Priority Management in Agricultural and Extension Education 3.
Examination of theoretical, psychological and empirical bases for strategies and techniques contributing to enhancement of managerial and personal effectiveness of agricultural educators and individuals in related agricultural organizations.

AEE 533 Leadership and Management of Volunteers in Agricultural and Extension Education 3.
Graduate and Post-baccalaureate Studies students only (GR, PBS). 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.

AEE 535 Teaching Agriculture in Secondary Schools 3.
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.

AEE 560 Organizational and Administrative Leadership in Agricultural and Extension Education 3.
Prerequisite: Master student or PBS status. 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.

AEE 577 Evaluation in Agricultural and Extension Education 3.
Prerequisite: Graduate standing. Evaluation principles, models, and procedures used in developing and analyzing, agricultural, vocational, technical, and extension education programs; role of comprehensive evaluation in needs assessments, program planning, program implementation, and the marketing of outcomes to major stake-holders; designs for evaluating agricultural and extension programs. Evaluation logic model is presented to identify and describe program inputs, activities, outputs, and outcomes.

AEE 578 Scientific Inquiry in Agricultural and Extension Education 3.
Prerequisite: Graduate standing. 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.

AEE 579 Research Design in Agricultural and Extension Education 3.
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.
AEE 595 Special Topics in Agricultural and Extension Education 1-4. 
Prerequisite: Graduate standing or PBS status. 
Presentation of material not normally available in regular graduate course offerings or for offerings of new 500 level courses on a trial basis.

AEE 601 Seminar 1. 
Prerequisite: Graduate standing or PBS status. 
Current topics and issues in agricultural and extension education. 
Selection and research of topics, presentation of seminars, and leading group discussions.

AEE 610 Special Topics 1-3. 
Prerequisite: Graduate standing or PBS status. 
Presentation of material not normally available in regular graduate course offerings or for offerings of new 500 level courses on a trial basis.

AEE 620 Special Problems in Agricultural and Extension Education 1-6. 
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.

AEE 641 Practicum In Agricultural and Extension Education 1-6. 
Faculty-supervised practicum in an educational, extension or agricultural industry setting.

AEE 685 Master's Supervised Teaching 1-3. 
Prerequisite: Master's student. 
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.

AEE 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1. 
Prerequisite: Master's student. 
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.

AEE 689 Non-Thesis Master Continuous Registration - Full Time Registration 3. 
Prerequisite: Master's student. 
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.

AEE 690 Master's Examination 1-3. 
Prerequisite: Master's student. 
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.

AEE 693 Master's Supervised Research 1-9. 
Prerequisite: Master's student. 
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student. 
Thesis research.

AEE 696 Summer Thesis Research 1. 
Prerequisite: Master's student. 
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. 
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.

AEE 705 International Agricultural Development 3. 
Prerequisite: Graduate standing. 
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.

AEE 735 Effective Teaching in Agriculture and Life Sciences 3. 
Prerequisite: Graduate standing. 
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.

AEE 740 Extension In Developing Countries 3. 
Prerequisite: Graduate standing or PBS status. 
Rural extension (agriculture, forestry, development, etc.). Strategies for enabling of farm/rural people to better usage of science, technology and other types of knowledge in fulfilling their own aspirations within their cultural context. Examination of practice of rural extension/development in many parts of the world and basic conceptual ideas and processes.

AEE 777 Qualitative Research Methods in the Agricultural & Life Sciences 3. 
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.

AEE 820 Special Problems in Agricultural and Extension Education 1-6. 
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.

AEE 841 Practicum in Agricultural and Extension Education 1-6. 
Faculty-supervised practicum in an educational, extension or agricultural industry setting.

AEE 885 Doctoral Supervised Teaching 1-3. 
Prerequisite: Doctoral student. 
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.
Instruction in research and research under the mentorship of a member of the Graduate faculty.

Prerequisite: Doctoral student.
Dissertation research.

AEE 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

AES - Agricultural and Environmental Systems Courses

AES 201 Shop Processes and Management 3.
Safety practices, materials, equipment, processes, procedures, and management techniques related to operation and maintenance of a mechanized agricultural enterprise or agriculture-related industry. Theory and practice through basic shop operations and procedures.

AES 250 Survey of Agricultural and Environmental Issues 3.
This course presents an overview of the history of technology in agriculture. Topics include how the adoption of agriculture affected society, how ancient Greek farmers gave the world the idea of the family farm, and how this notion saved the earliest attempts to colonize North America from disaster. Additionally, a broad overview of current agricultural and environmental problems and attempts to find solutions suitable not only to farmers and the agri-business community but to all urban and environmentally aware society will be covered.

AES 323 Water Management 3.
Prerequisite: Junior standing.
Water management principles applied to agriculture; hydrologic cycle, runoff, surface and sub-surface drainage, soil conservation measures to reduce erosion and sedimentation, irrigation, pond construction, open channel flow, water rights and environmental laws pertaining to water management. Emphasis on problem solving.

Prerequisite: PY 211 or PY 205.
Environmental relationships, design methods, materials and construction procedures as they relate to agricultural animal production facilities. Problem situations integrating structural design, environmental control, and waste handling.

AES 333 Processing Agricultural Products 4.
Prerequisite: PY 211 or PY 205.
Application of the principles of fluid flow, heat transfer, refrigeration, psychrometrics, and materials handling to the processing of agricultural products. Pump sizing, heat exchanger selection, refrigeration analyses, fan sizing, crop drying, and selection of materials handling equipment.

AES 343 Agricultural Electrification 4.
Junior standing or above.
Practical and efficient use of electrical energy for agricultural and home application. Energy conservation, electric rates, farm and house wiring, circuit design, single-phase and three-phase distribution systems, electric motors, lighting, space and water heating, electric controls, safety and protective devices. This course has a required field trip.

AES 411 Agricultural Machinery and Power Units 4.
Prerequisite: CH 101, CH 102, and PY 211 or PY 205.
Agricultural machinery principles, energy requirements, operation, calibration and environmental considerations. Diesel engine principles and their application to engine power, efficiencies and systems. Power trains and hydraulic systems. Application of basic machinery and power principles to mechanical needs in environmental systems.

AES 432 Agricultural and Environmental Safety and Health 3.
Prerequisite: Junior standing and 6 hrs CALS Group A, B or C Electives.
Safety and health issues for agricultural and environmental occupations. Hazard recognition, injury and illness prevention, regulations, and safety and health management strategies for agricultural production, chemical handling, and waste management. Environmental factors which affect human health and safety.

AES 443 Environmental Restoration Implementation 3.
Prerequisite: AES 323 or BAE 471.
Students will learn how to implement environmental restoration designs for streams, wetlands, and stormwater best management practices to improve ecosystem health. Topics include interpretation of construction drawings and specifications, calculating construction quantities and developing contractor bid tabs, environmental permitting and regulations, erosion and sediment control, project management and scheduling, construction oversight, specialized construction materials and equipment for environmental projects, survey stakeout, vegetation installation and management, site inspection and maintenance, and monitoring of structural and ecological conditions of restoration projects. In-class field trips are required.

AFS - Africana Studies Courses

AFS 230 Introduction to African-American Music 3.
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.

AFS 240 African Civilization 3.
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, Zinibar and Monomotapa.

AFS 241 Introduction to African-American Studies II 3.
Second in a two semesters sequence in the interdisciplinary study of sub-Saharan Africa, its arts, culture, and people, and the African-American experience.

AFS 248 Survey of African-American Literature 3.
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.

AFS 260 History of Jazz 3.
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.
AFS 275 Introduction to History of South and East Africa 3.
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.

AFS 276 Introduction to History of West Africa 3.
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.

AFS 305 Racial and Ethnic Relations 3.
Prerequisite: 3 cr. in SOC, 200 level.
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.

AFS 342 Introduction to the African Diaspora 3.
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.

AFS 343 African Religions 3.
Examination of African Religions on the African continent and throughout
the African Diaspora. Focus on traditional religious practices, African
reformulation of Islam and Christianity, New Orleans and Haitian vodun,
Cuban Santeria, and Brazilian Candomble. Designed to de-mystify
African religion without divesting it of its cultural uniqueness and richness.

AFS 344 Leadership in African American Communities 3.
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.

AFS 345 Psychology and the African American Experience 3.
Prerequisite: PSY 200 or PSY 201.
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.

AFS 346 Black Popular Culture 3.
A multidisciplinary examination of contemporary black cultural expression
in film, music, art, and the media. Emphasis on race, class, gender, and
political discourse.

AFS 349 African Literature in English 3.
Prerequisite: Sophomore standing.
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.

AFS 372 African-American History Through the Civil War, 1619-1865
3.  
Prerequisite: 3 hours of history or Sophomore standing.
African background and continuity of the particular role, experience and
influence of African Americans in the United States through the Civil War.

AFS 373 African-American History Since 1865 3.
Prerequisite: 3 hours of history or Sophomore standing.
The history of African-Americans from the Reconstruction era through the
Civil Rights movement of the 1950s and 1960s to the present.

AFS 375 African American Cinema 3.
Prerequisite: ENG 101.
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.

AFS 409 Black Political Participation in America 3.
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.

AFS 440 Senior Seminar in Africana Studies 3.
Prerequisite: AFS 342; Africana Studies Majors or Africana Studies
Minors.
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 approaches and critical
analyses.

AFS 442 Issues in the African Diaspora 3.
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.

AFS 448 African-American Literature 3.
Prerequisite: Junior standing.
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.

AFS 455 History of the Civil Rights Movement 3.
Prerequisite: 3 hrs. of History.
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 HI (AFS) 455 and HI 555.

AFS 475 History of the Republic of South Africa 3.
Prerequisite: 3 hours of history.
Evolution of the Republic of South Africa, 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.
AGI 114 Mathematical Skills II 3.  
Prerequisite: A grade of C or better in AGI 114.  
Applications of mathematical principles to solve problems encountered in Agricultural Institute courses. Percentages, ratios, proportions, averages, exponents, basic algebra, graphs, basic geometry and basic trigonometry with applications.

AGI 120 Spanish For AG Stu 3.  
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 employees in different work environments and under different situations within their specific agricultural fields. This course does not satisfy the Foreign Language Proficiency Requirement of the GEP.

AGI 151 Community Leadership and Development 3.  
Concentration upon preparation of students for leadership in their communities. Attention to leadership styles, social and personal factors contributing to an individual's rise to a leadership position, changing structures within communities, and social issues facing community leaders. Focus upon both urban and rural communities with primary emphasis on rural settings. DUBOSE-BLUM.

AGI 192 AGI External Learning Experience 1-6.  
Learning experience in one of the eight majors in the Agricultural Institute that utilizes facilities and resources external to the campus. (Contact with professionals in the area of student's major must be initiated by student and approved by a faculty adviser and the Director of the Agricultural Institute prior to the experience).

AGI 193 AGI Special Problems and On-campus Learning 1-6.  
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 Agricultural Institute prior to the experience).

AGI 194 International Learning Experience in AGI 1-6.  
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 them. Travel expenses may be incurred by the student. Departmental approval required.

AGI 195 Special Topics in the Agricultural Institute 1-4.  
Offered as needed to present material not normally available in regular departmental course offerings or for offering of new courses on a trial basis.

ALS - Agriculture and Life Sciences Courses

ALS 103 Freshman Transitions and Diversity in Agriculture & Life Sciences 1.  
Prerequisite: CALS Majors with less than 30 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.
ALS 110 Academic and Career Skills Seminar 1.
Prerequisite: Ag and Life Science Majors.
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.

ALS 295 Special Topics in Agriculture and Life Sciences 1-3.
Offered as needed to present material not normally available in regular departmental course offerings; or for offerings of new courses on a trial basis.

ALS 303 Transfer Transitions and Diversity in Agriculture & Life Sciences 1.
R: CALS Majors >30 credits.
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.

ALS 398 Agriculture and Life Sciences Honors Seminar 2.
Prerequisite: Enrollment by invitation for sophomores or juniors in CALS with GPA 3.35 or higher.
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 in the agricultural and life sciences; required participation in on- and off-campus scholarly retreats.

ALS 494 International Learning Experience in Agriculture and Life Sciences 1-6.
Course offered as needed for international learning experiences in agriculture and life sciences involving international travel and immersion in an international culture. A written report is required and student must identify a faculty member to work with them. Travel expenses may be incurred by the student. Departmental Approval Required.

ALS 495 Special Topics in Agriculture and Life Sciences 1-3.
Offered as needed to present material not normally available in regular departmental course offerings or for offering of new courses on a trial basis.

ALS 498 Honors Research or Teaching I 1-3.
Prerequisite: ALS 398, GPA 3.35 or higher.
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.

ALS 499 Honors Research or Teaching II 1-4.
Prerequisite: ALS 498, GPA 3.35 or higher.
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.

ANS - Animal Science Courses

ANS 101 Introduction to Livestock and Poultry Industries 3.
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.

ANS 102 Animal Feeds and Nutrition 3.
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).

ANS 103 Beef Production 3.
Genetics, reproduction, nutrition, animal health, forage management and marketing channels as related to beef cattle enterprises.

ANS 104 Swine Production 4.
Management principles associated with swine production. Primary emphasis on interactions of health, equipment, nutrition, reproduction and genetics during nursery, finishing, farrowing and breeding phases of production. Management of farrowing, finishing and farrow to finish operations. Emphasis on management kills, computer applications and economics.

ANS 105 Introduction to Companion Animal Science 3.
Prerequisite: Freshman standing or Sophomore standing.
Introduction to animals that people keep as companions. Variation, behavior, anatomy, physiology, disease, and training of animals as diverse as fish, snakes, mice, rats, birds, cats, and dogs. Special relationships between humans and companion animals in a societal context.

ANS 110 Introduction to Equine Science 3.
Prerequisite: Freshman standing or Sophomore standing.
History, management, and use of horses and their profound impact on society. Selection, care, and enjoyment of horses with emphasis on genetics, nutrition, reproduction, behavior, and health.

ANS 150 Introduction to Animal Science 3.
Fundamental principles of animal management; contributions of animals and animal products to humanity; application of science to animal production; issues regarding animal production.

ANS 151 Introduction to Animal Science Lab 1.
Corequisite: ANS 150.
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: SAS, IAS, AEX, AGS, and AED. Transportation is provided to the off-campus labs, and students will be returned to campus prior to the end of the scheduled lab period.

ANS 201 Techniques of Animal Care 2.
Prerequisite: ANS 150 (all ANS Majors) or PO 101 (Ag Institute Livestock, Poultry Mgmt Program).
A laboratory course in the applied management of beef cattle, dairy cattle, swine and small ruminants with participatory assignments of common techniques utilized in livestock production.
ANS 205 Physiology of Domestic Animals 3.
Prerequisite: (BIO 181 or BIO 183) and Sophomore standing.
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.

ANS 206 Anatomy of Domestic Animals Lab 1.
Corequisite: ANS 205.
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 examination of gross and microscopic anatomy. SAS and IAS majors only.

ANS 208 Agricultural Biotechnology: Issues and Implications 3.
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.

ANS 215 Agricultural Genetics 3.
Prerequisite: ZO 160 or BIO 183.
Basic principles of inheritance in plants and animals of agricultural significance. Transmission genetics and its effects on the usefulness of plants and animals. Basic principles of plant and animal improvement.

ANS 220 Reproductive Physiology 3.
Prerequisite: ANS 205 or BIO 250.
Biological processes in reproduction and lactation with emphasis on domestic mammals such as cattle, sheep, goats, horses, swine, dogs, and cats. Environmental and genetic factors that affect these processes. Identification, evaluation and solutions of problems in these physiological areas.

ANS 221 Reproductive Physiology Lab 1.
Corequisite of ANS 220.
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).

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.

ANS 230 Animal Nutrition 3.
Prerequisite: ANS 150 or BIO 183; ANS 205 is also recommended.
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.

ANS 231 Animal Nutrition Lab 1.
Corequisite: ANS 230.
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).

ANS 240 Livestock Merchandising 3.
Prerequisite: ANS 150; Restrictive Statement: Students must be Juniors or Seniors.
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 Animal Educational Units outside of normal class time and student must provide own transportation. Two required mandatory Saturday events. The animal auction held on the 2nd Saturday of April and the Open House held either one or two Saturdays (varies depending on the Spring Holiday) prior to the animal auction.

ANS 240A Livestock Merchandising 3.
Prerequisite: ANS 101; Restrictive Statement: AGI Students Only.
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 Animal Educational Units outside of normal class time and student must provide own transportation. Two required mandatory Saturday events. The animal auction held on the 2nd Saturday of April and the Open House held either one or two Saturdays (varies depending on the Spring Holiday) prior to the animal auction.

ANS 251 Animal Nutrition Lab 1.
Corequisite: ANS 250.
ANS 251 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 250. This course is restricted to Animal Science Majors (SAS, IAS).
ANS 266 Swine Environment Management 1.  
Prerequisite: ANS 150 or equivalent.  
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.

ANS 267 Swine Manure and Nutrient Management 1.  
Prerequisite: ANS 150 or equivalent.  
Course includes manure production rates, manure handling systems, storage and manure management planning for land applications. Some odor mitigation technologies will be covered.

ANS 268 Employee Management for the Swine Industry 1.  
Prerequisite: ANS 150 or equivalent.  
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.

ANS 269 Internship in the Swine Industry 1.  
Prerequisite: ANS 150 or equivalent.  
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.

ANS 270 Pork Export Markets from a Swine Production Perspective 1.  
Prerequisite: ANS 150 or equivalent.  
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.

ANS 281 Professional Development of PreVeterinary Track Students 1.  
Prerequisite: BIO 183 and Sophomore Standing.  
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 school applications. Students will be expected to discuss current animal and public health issues as well as areas of national shortage in the veterinary profession. One Saturday at the NCSU vet school Open House is required (first Saturday in April). Sophomore standing is required.

ANS 291 Animal Science Study Abroad 1-6.  
Course sections offered as needed for international learning experiences in Animal Science involving international travel and N.C. State University Faculty-supervised learning in the non-U.S. location. A maximum of one credit hour per week of supervised study will be assigned, and the faculty member will provide students with a syllabus outlining the requirements for successful completion (grade of “S”). This course counts as a free elective. All expenses including travel, are the responsibility of the student. The student is also responsible for obtaining a valid passport.

ANS 292 Australian Animal Agriculture 3.  
Prerequisite: Cumulative GPA greater than 2.0..  
This course involves travel to Australia through N.C. State University's Study Abroad Program. Participants will have the opportunity to increase their knowledge and understanding in the principle areas of animal and veterinary sciences and Australian studies. Species studied include cattle (beef and dairy), sheep, goats, pigs, native Australian animals, and non-native feral animals (such as rabbits). All expenses, including the Study Abroad fee and airline travel, are the responsibility of the student. The student is also responsible for obtaining a valid passport.

Prerequisite: ANS 110.  
Conformation and function, performance, and soundness of the horse. Breed standards, rules, and regulations for evaluation, selection, and performance. Field trips.

ANS 304 Dairy Cattle Evaluation 2.  
Prerequisite: ANS 150.  
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.

ANS 309 Livestock Evaluation 3.  
Prerequisite: ANS 150.  
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.

ANS 322 Muscle Foods and Eggs 3.  
Prerequisite: ZO 160, BIO 181 or BIO 183.  
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 processedmeat items.

ANS 324 Milk and Dairy Products 3.  
Prerequisite: BIO 181 or 183, CH 101.  
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.

ANS 330 Laboratory Animal Science 3.  
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, animalhealth 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.
ANS 350 Introduction to HACCP 3.
Introductory course on the Hazard Analysis and Critical Control Points System (HACCP) which is designed to decrease hazards in foods. An International HACCP Alliance approved curriculum which covers prerequisite programs. A step by step approach for developing and implementing a HACCP plan for USDA regulated food processing plants. Offered only as a world wide web course through the Office of Instructional Telecommunications.

ANS 400 Companion Animal Management 3.
Prerequisite: ANS 105 and Junior standing.
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.

ANS 402 Beef Cattle Management Lecture 2.
Prerequisite: ANS 150; Restrictive Statement: Students must be Juniors or Seniors.
ANS 402 integrates technical information in animal nutrition, breeding, genetics, and reproductive physiology and incorporates this into information on management skills, business practices, and decision-making processes. This integration requires competency in oral and written communication skills; therefore, a major strategy is to practice and improve students’ communication skills during the semester.

ANS 403 Swine Management 3.
Prerequisite: ANS 150; Restrictive Statement: Students must be Juniors or Seniors.
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.

ANS 404 Dairy Cattle Management Lecture 2.
Prerequisite: (ANS 225 or ANS 230) and Junior standing.
ANS 404 covers nutritional requirements of the dairy cow, digestive physiology, practical applications of balancing rations, feeding systems, and management tools for effective feeding strategies. Students will also receive information on labor management and efficient record keeping tools.

ANS 408 Small Ruminant Management 3.
Prerequisite: ANS 150, Junior standing.
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.

ANS 410 Equine Breeding Farm Management 3.
Prerequisite: ANS 110 and Junior standing.
Equine anatomy, physiology, nutrition, genetics and health. Laboratory emphasis on reproductive management, breeding, problem solving, and management skills. Field trips required.

ANS 411 Management of Growing and Performance Horses 3.
Prerequisite: ANS 110.
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.

ANS 415 Comparative Nutrition 3.
Prerequisite: ANS 225 or ANS 230 or CH 220 or CH 223 or CH 227.
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.

ANS 425 Feed Manufacturing Technology 3.
Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225.
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.

ANS 440 Animal Genetic Improvement 3.
Prerequisite: (ANS/HS 215 or GN 311) and (ST 311 or ST/BUS 350) and Junior standing.
Modern evaluation and selection procedures for domestic animals; selection goals, estimation of breeding values and performance testing; their impact on genetic changes.

ANS 452 Comparative Reproductive Physiology and Biotechnology 3.
Prerequisite: ANS 220.
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 will not be given for both ANS 452 and ANS (PHY) 552.

ANS 453 Physiology and Genetics of Growth and Development 3.
Prerequisite: ANS 230. Junior standing.
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 given for both ANS 453 and 553.

ANS 454 Lactation, Milk and Nutrition 3.
Prerequisite: ANS 230 or FS/NTR 400; BCH 451 or ZO 421.
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.

ANS 462 Beef Cattle Management Lab 1.
Corequisite: ANS 402.
ANS 462 is a hands-on lab held at the Beef Educational Unit of N.C. State University. This lab is required for Animal Science majors who have taken or are taking ANS 402, Beef Cattle Management Lecture. AND 462 is restricted to Animal Science majors and minors. In ANS 462, students learn proper cattle handling techniques and management practices that are important for beef cattle management.

ANS 464 Dairy Cattle Management Lab 1.
Corequisite: ANS 404.
ANS 464 lab is hands-on guide to principles of modern dairy cattle management. It will provide students an overview of a complete dairy enterprise. All students will receive instruction on the nutritional requirements of the dairy cow, digestive physiology and practical applications to balancing rations, feeding systems and management tools for effective feeding strategies, records keeping and role of diary record management system, post harvest technology including milk supply, milk processing and marketing and milk products. Restricted to Animal Science majors and minors.
ANS 480 Judging Team 1.  
Prerequisite: ANS 303 or ANS 304 or ANS 309.  
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).

ANS 492 External Learning Experience 1-6.  
Prerequisite: Sophomore standing.  
A learning experience in Animal Science 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 the student and be approved by a faculty adviser, the prospective employer, and the departmental Internship Coordinator prior to the experience.

ANS 493 Research, Teaching, or Extension Experience 1-6.  
Prerequisite: Sophomore standing.  
A learning experience in Animal Science within an academic framework that utilizes campus facilities and resources for supervised undergraduate research, teaching assistant, or extension experiences. Arrangements must be initiated by the student and be approved by a faculty adviser, the prospective supervisor, and the departmental Internship Coordinator.

ANS 495 Special Topics in Animal Science 1-3.  
Offered as needed to present material not normally available in regular course offerings or for offering of new courses on a trial basis.

Prerequisite: ANS 220.  
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, Corequisite: ANS 530.  
Practical experience in routine reproductive management techniques discussed in ANS 530. Must hold graduate status.

ANS 540 Selection of Domestic Animals 3.  
Prerequisite: (ANS 215 or GN 411) and (ST 311 or ST/BUS 350), or permission of instructor.  
Modern evaluation and selection procedures for domestic animals; selection goals, estimation of breeding values and performance testing related to their impact on genetic changes. Multiple species including horses, dogs, cats, beef cattle, dairy cattle, pigs, sheep, and poultry will be discussed. Students cannot get credit for both ANS 440 and ANS 540.

ANS 550 Applied Ruminant Nutrition 3.  
Prerequisite: ANS 230 or ANS(NTR,PO) 415. Permission given to undergraduates.  
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.

ANS 552 Advanced Reproductive Physiology and Biotechnology 3.  
Prerequisite: ANS 220.  
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 will not be given for both ANS 452 and ANS(PHY) 552.

ANS 553 Growth and Development of Domestic Animals 3.  
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 given for both ANS 453 and 553.

ANS 554 Lactation, Milk, and Nutrition 3.  
Prerequisite: ANS 230 or FS/NTR 400; BCH 451 or ZO 421.  
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.

ANS 561 Equine Nutrition 3.  
Prerequisite: ANS 230 or ANS 225 or ANS (NTR,PO) 415 or PO/NTR 515.  
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.

ANS 571 Regulation of Metabolism 3.  
Prerequisite: BCH 451, GN 311, a course in physiology, cell biology. Study of hormonal, enzymatic and molecular-genetic regulation of carbohydrate and lipid metabolism; emphasis on mammalian species.

ANS 575 Current Topics in Genomics and Proteomics in Animal Science 3.  
Prerequisite: ANS 215 or GN 411.  
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 dealing with animal genome research.

ANS 590 Topical Problems in Animal Science 1-3.  
Selection or assignment of special problems in various phases of animal science.

ANS 601 Animal Science Seminar 1.  

ANS 602 Seminar In Biology Of Reproduction 2.  
Prerequisite: ANS(PHY) 702.  
Current topics in animal reproduction presented by reproductive physiologists from various Research Triangle institutions. Student presentations of research projects or library projects in area of animal reproduction.

ANS 603 Reproductive Physiology Seminar 1.  

ANS 604 Animal Breeding and Genetics Seminar 1.  

ANS 610 Topical Problems in Animal Science 1-6.  
Selection or assignment of special problems in various phases of animal science.
ANS 641 Practicum in Animal Science 1-3.

ANS 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

ANS 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

ANS 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

ANS 690 Master's Exam 1-6.
Prerequisite: Master's student.
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.

ANS 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

ANS 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

ANS 701 Protein and Amino Acid Metabolism 3.
Prerequisite: ANS/BCH 571 and ZO 421 and a 400-level nutrition course, such as NTR 400, 415, or 419, or equivalent type course numbers here.. Study of protein and amino acid metabolism, regulation, dietary requirements and techniques for their investigation in human and other animals.

ANS 702 Reproductive Physiology of Mammals 3.
Prerequisite: ZO 421.
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.

ANS 706 Mammalian Embryo Manipulation 3.
Prerequisite: ANS 702 or consent of instructor.
Mammalian embryo development and micromanipulation. Topics in mammalian embryo manipulation to be considered include: blastocysts, embryo development in vitro, in vitro fertilization, in vitro oocyte maturation, molecular analysis of development, transgenesis by DNA microinjection or somatic cell nuclear transfer, and applications of gene transfer.

ANS 708 Genetics of Animal Improvement 3.
Prerequisite: GN 311 and ST 512.
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.

ANS 709 Energy Metabolism 3.
Prerequisite: BCH 553.
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.

ANS 713 Quantitative Genetics and Breeding 3.
Prerequisite: GN 509, ST 512.
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.

ANS 726 Advanced Topics In Quantitative Genetics and Breeding 3.
Prerequisite: ST 511, Corequisite: ST 512.
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.

ANS 764 Advances in Gastrointestinal Pathophysiology 3.
Prerequisite: PHY 503, PHY 504.
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.

ANS 775 Mineral Metabolism 3.
Prerequisite: ANS(NTR,PO) 415, BCH 451 and ZO 421.
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.
ANS 780 Mammalian Endocrinology 3.
Prerequisite: BCH 451, ZO 421.
Mammalian endocrine system with emphasis on ontology 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.

ANS 785 Digestion and Metabolism in Ruminants 3.
Prerequisite: Graduate standing.
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.

ANS 790 Advanced Special Topics in Animal Science 1-3.

ANS 801 Animal Science Seminar 1.

ANS 802 Seminar In Biology Of Reproduction 2.
Prerequisite: ANS(PHY) 702.
Current topics in animal reproduction presented by reproductive physiologists from various Research Triangle institutions. Student presentations of research projects or library projects in area of animal reproduction.

ANS 803 Reproductive Physiology Seminar 1.

ANS 804 Animal Breeding and Genetics Seminar 1.

ANS 810 Topical Problems in Animal Science 1-6.
Selection or assignment of special problems in various phases of animal science.

ANS 841 Practicum in Animal Science 1-3.

ANS 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

ANS 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

ANS 896 Summer Thesis Research 1.
Prerequisite: Doctoral student.
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.
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.

ANT - Anthropology Courses

ANT 251 Physical Anthropology 3.

ANT 252 Cultural Anthropology 3.
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.

ANT 253 Unearthing the Past: Introduction to World Archaeology 3.
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.

ANT 254 Language and Culture 3.
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.

ANT 256 Technology in Society and Culture 3.
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.

ANT 295 Special Topics in Anthropology 1-3.
Offered as needed to present 200-level subject materials not normally available in regular course offerings or for new courses on a trial basis.

ANT 310 Native Peoples and Cultures of North America 3.
Prerequisite: ANT 252 or HI 365.
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 and prospects.

ANT 315 The Aztecs, Maya, and Their Predecessors: Archaeology of Mesoamerica 3.
Prerequisite: 3 credits of 200-level Anthropology, or HI 215, or HI 216.
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 inequality, 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.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisite(s)</th>
<th>Description</th>
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<tbody>
<tr>
<td>ANT 325</td>
<td>Andean South America 3.</td>
<td>Prerequisite: ANT 252 or HI 215 or HI 216.</td>
<td>The societies, cultures, politics, economics and ecology of the Andean countries of South America (Peru, Bolivia, Ecuador, Chile, Colombia). Special attention to the development of pre-Columbian Andean Societies.</td>
</tr>
<tr>
<td>ANT 330</td>
<td>Peoples and Cultures of Africa 3.</td>
<td>Prerequisite: ANT 252 or HI 275 or HI 276.</td>
<td>African peoples and cultures, especially in sub-Saharan Africa; past and present social patterns of indigenous African populations from a cross-cultural perspective.</td>
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<tr>
<td>ANT 346</td>
<td>Peoples and Cultures of Southeast Asia 3.</td>
<td>Prerequisite: ANT 252.</td>
<td>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.</td>
</tr>
<tr>
<td>ANT 351</td>
<td>Contemporary Culture in Japan 3.</td>
<td>Prerequisite: FLJ 101.</td>
<td>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.</td>
</tr>
<tr>
<td>ANT 354</td>
<td>Peoples and Cultures of the Pacific 3.</td>
<td>Prerequisite: ANT 252.</td>
<td>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.</td>
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<tr>
<td>ANT 370</td>
<td>Introduction to Forensic Anthropology 3.</td>
<td>Prerequisite: ANT 251.</td>
<td>Broad overview of forensic anthropology-an applied field of biological anthropology. Application of the science of biological anthropology to the legal process and humanitarian arena. Identification of skeletal remains to determine age, sex, ancestry, stature, and unique features of a decedent. General identification techniques addressed but proficiency not expected.</td>
</tr>
<tr>
<td>ANT 371</td>
<td>Human Variation 3.</td>
<td>Prerequisite: ANT 251.</td>
<td>Survey of basic principles of population genetics with emphasis on mechanisms that shape human biological variation. Geographic variation. Analysis of laws of heredity exhibited in modern human populations via microevolution and adaptation. Historical development of concepts with specific application to physical and forensic anthropology. Discussion of most current research.</td>
</tr>
<tr>
<td>ANT 374</td>
<td>Disease and Society 3.</td>
<td>Prerequisite: ANT 251 or ANT 252.</td>
<td>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.</td>
</tr>
<tr>
<td>ANT 385</td>
<td>Island Archaeology 3.</td>
<td>Prerequisite: ANT 253.</td>
<td>Exploration of the archaeology of islands. Analysis of the conditions and phenomena surrounding human adaptation to and impact on island environments. Geographic areas include Oceania, Caribbean, Mediterranean, Japan, and the Americas.</td>
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<tr>
<td>ANT 395</td>
<td>Special Topics in Anthropology 1-3.</td>
<td>Prerequisite: 3 credits of 200-level Anthropology.</td>
<td>Offered as needed to present 300-level subject materials not normally available in regular course offerings or for new courses on a trial basis.</td>
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<tr>
<td>ANT 411</td>
<td>Overview of Anthropological Theory 3.</td>
<td>Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346.</td>
<td>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.</td>
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<tr>
<td>ANT 412</td>
<td>Applied Anthropology 3.</td>
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<td>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 ANT 412 and 512.</td>
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<tr>
<td>ANT 416</td>
<td>Research Methods in Cultural Anthropology 3.</td>
<td>Prerequisite: ANT 252 and one of the following: ANT 310,325,330, 346, 351, or 354.</td>
<td>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.</td>
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<tr>
<td>ANT 419</td>
<td>Ethnographic Field Methods 3.</td>
<td>Prerequisite: Six hours of cultural anthropology.</td>
<td>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.</td>
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<tr>
<td>ANT 421</td>
<td>Human Osteology 3.</td>
<td>Prerequisite: ANT 251 and any ANT 300 Level.</td>
<td>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.</td>
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ANT 424 Bioarchaeology 3.
Prerequisite: ANT 421.
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.

ANT 427 Bioarchaeological Fieldwork 3.
Prerequisite: ANT 421.
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.

ANT 429 Advanced Methods in Forensic Anthropology 4.
Prerequisite: ANT 370, ANT 421.
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.

ANT 431 Tourism, Culture and Anthropology 3.
Prerequisite: Three hours of cultural anthropology.
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 tourists and tourism on local communities. Principal theories of leisure in relation to tourism. Theories of culture change in relation to travel and tourism. Credit not given for both ANT 431 and ANT 531.

ANT 433 Anthropology of Ecotourism and Heritage Conservation 3.
Prerequisite: ANT 425.
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.

ANT 444 Cross-Cultural Perspectives on Women 3.
Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346.
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.

ANT 450 Culture, Ecology, and Sustainable Living 3.
Prerequisite: One of the following: ANT 310,325,330 or 346.
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, ethnoscience and cognitive ecology, subsistence and social organization, historical and political ecology, environmentalism, and environmental policy issues.

ANT 460 Urban Anthropology 3.
Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346.
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 contemporary urbanization.

ANT 464 Anthropology of Religion 3.
Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346.
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.

ANT 475 Human Impacts on Ancient Environments 3.
Prerequisite: ANT 253.
Archaeological investigation of human-environmental interactions. Focuses on various techniques archaeologists and paleoecologists use to reconstruct prehistoric environments. Topics include the analysis of animal remains (e.g., shellfish, fish, marine mammals, birds), soils, and plants, dating techniques, and stable isotopes.

ANT 483 Archaeological Method and Theory 3.
Prerequisite: ANT 251 or 253 and 3 cred 300-level ANT.
Methods and Theory used by archaeologists to locate and interpret material evidence about past human activities. Topics include techniques for discovering and analyzing cultural remains, the history of archaeology as a discipline, and the major theoretical underpinnings that have guided archaeological practice and interpretation. Course is required for graduate students in Bioarchaeology concentration. Students may not receive credit for ANT 483 and ANT 583.

ANT 495 Special Topics in Anthropology 3.
Detailed investigation of a topic in anthropology. Topic and mode of study determined by faculty member(s).

ANT 496 Anthropology Internship 6.
Prerequisite: ANT 412, ANT 416; Senior standing in Anthropology (B.A.).
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.

ANT 498 Independent Study in Anthropology 1-6.
Prerequisite: Six hours of ANT.
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.
ANT 511 Overview of Anthropological Theory 3.
Prerequisite: Graduate standing or ANT 252 and any 300-level ANT course.
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.

ANT 512 Applied Anthropology 3.
Prerequisite: ANT 252.
A review of historical development of applied anthropology and study of anthropology as applied in government, industry, community development, education and medicine. Analysis of processes of cultural change in terms of application of anthropological techniques to programs of developmental change.

ANT 516 Qualitative Research Methods 3.
Prerequisite: Graduate standing.
Systematic overview of qualitative research methods including theoretical perspectives, research techniques, research design and data management. Reviews relevant ethical questions and social science presentation of research findings. Credit will not be given for both ANT 416 and 516.

ANT 521 Human Osteology 3.
Prerequisite: Graduate standing or permission of instructor, Corequisite: ANT 524, ANT 529.
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. Graduate students will be required to attend an additional one-hour weekly problem session. Credit cannot be received for both ANT 421 and ANT 521.

ANT 524 Bioarchaeology 3.
Prerequisite: ANT 421.
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.

ANT 529 Advanced Methods in Forensic Anthropology 4.
Prerequisite: Graduate Standing.
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.

ANT 531 Tourism, Culture and Anthropology 3.
Prerequisite: Graduate Standing.
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 tourists and tourism on local communities. Principal theories of leisure in relation to tourism. Theories of culture change in relation to travel and tourism. Credit not granted for both ANT 431 and ANT 531.

ANT 533 Anthropology of Ecotourism and Heritage Conservation 3.
Prerequisite: ANT 252.
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. Must hold Graduate standing, students cannot receive credit for both ANT 433 and ANT 533.

ANT 544 Cross-Cultural Perspective on Women 3.
Prerequisite: 3 hours Cultural Anthropology or Graduate standing.
Comparison of women in a variety of societies: western and non-western; hunting and gathering to industrialized. Cross-cultural perspectives on the similarity and diversity of women's statuses and roles. Effect of gender on social position. Credit will not be offered for both ANT 444 and ANT 544.

ANT 550 Culture, Ecology, and Sustainable Living 3.
Prerequisite: Graduate standing.
Theoretical and methodological introduction to the anthropological study of humans and their environments. Students enrolled for graduate credit must complete a weekly one-hour problem session. Credit not allowed for both ANT 450 and ANT 550.

ANT 560 Urban Anthropology 3.
Prerequisite: ANT 252 or Graduate standing.
Anthropological study of cities. Examination of cross-cultural patterns of behavior in urban areas and adaptive strategies that urban dwellers employ. Major theoretical and methodological approaches relevant to an understanding of contemporary urbanization. Credit will not be given for both ANT 460 and ANT 560.

ANT 564 Anthropology of Religion 3.
Prerequisite: Graduate standing.
Examines anthropology perspectives on the role of religion in social life; discussion of theoretical and methodological issues pertaining to the study of ritual and belief. Students enrolled for graduate credit must complete a weekly one hour problem session. Credit not allowed for both ANT 464 and ANT 564.

ANT 575 Environmental Archaeology 3.
Anthropological investigation of human-environmental interactions. Focuses on various techniques archaeologists and paleoecologists use to reconstruct prehistoric environments. Topics include the analysis of animal remains (e.g., shellfish, fish, marine mammals, birds), soils, and plants, dating techniques, and stable isotopes. Must hold graduate standing, credit not allowed for both ANT 475 and ANT 575.
ANT 583 Archaeological Method and Theory 3.
Methods and Theory used by archaeologists to locate and interpret material evidence about past human activities. Topics include techniques for discovering and analyzing cultural remains, the history of archaeology as a discipline, and the major theoretical underpinnings that have guided archaeological practice and interpretation. Course is required for graduate students in Bioarchaeology concentration. Students may not receive credit for ANT 483 and ANT 583.

ANT 585 Skeletal Biology in Anthropology 3.
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 Cultural Resource Management 3.
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.

ANT 595 Special Topics in Anthropology 1-6.
Prerequisite: Graduate Standing.
In depth exploration of specialized topics in Anthropology. Also used to test and develop new courses.

ANT 598 Independent Study in ANT 1-6.
Independent study of a topic in anthropology. Topic and mode of study determined by faculty member(s) and student(s).

ANT 610 Special Topics in Anthropology 1-6.
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 1-6.
Prerequisite: Graduate Standing.
Instruction in research, and research under the mentorship of a member of the Graduate Faculty. Restricted to Masters Students in Anthropology.

ANT 695 Masters Research 1-6.
Prerequisite: Graduate Standing.
Theis 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.
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.

ANT 810 Special Topics in Anthropology 1-6.
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.

ARC 289 Architectural Travel Study I 3.
Prerequisite: ARC 141 and ARC 142.
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.

ARC 292 Special Topics in Architecture 1-3.
Topics of current interest in Architecture. Normally used to develop new courses.

ARC 301 Architectural Design: Tectonics 6.
Prerequisite: ARC 202 and ARC 211 and ARC 232; Corequisite: ARC 331 and ARC 432.
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 301 and ARC 331 and ARC 432.
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.

ARC 331 Architectural Structures I 3.
Prerequisite: ARC 232.
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.

ARC 332 Architectural Structures II 3.
Prerequisite: ARC 331.

Prerequisite: ARC 302 and BED-A student.
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 401 and BED-A students.
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: Masters of Architecture students; Co-requisite: ARC 211.
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 Track 3 students; ARC 403; Co-requisite: ARC 251.
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: Master of Architecture students; ARC 404; Co-requisite: ARC 331 and ARC 432.
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.

ARC 414 Environmental Control Systems 3.
Prerequisite: ARC 211.
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.

ARC 432 Architectural Construction Systems 3.
Prerequisite: ARC 232.
Building construction systems related to architectural design. Historical and current building practices. Implications for design and systems selection. Case studies. Field trips are required.

ARC 441 History of Contemporary Architecture 3.
Prerequisite: ARC 241, ARC 242; BED-A students, Bachelor of Architecture students, or Masters of Architecture students.
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.

ARC 442 History of NC Architecture 3.
Prerequisite: ARC 241, ARC 242.
Survey of NC Architecture from 17th-century settlement to World War II. Coverage of a wide range of building types and development patterns.

ARC 450 Architectural Drawing 3.
Corequisite: ARC 451.
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.
ARC 451 Digital Drawing and Modeling 3.
Co-requisite: ARC 450.
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.

Prerequisite: ARC 302. Participation in off-campus program. 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.

ARC 492 Special Topics in Architecture 1-3.
Topics of current interest in Architecture. Normally used to develop new courses.

ARC 495 Independent Study in Architecture 1-3.
Prerequisite: BED-A students with Junior standing and a GPA greater than or equal to 3.0.
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 the student and faculty member prior to registration by the department.

Prerequisite: M.Arch Track 1 and Track 3 student, ARC 405 or BEDA Degree (or equivalent).
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: BEDA degree.
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.

ARC 502 Professional Architecture Studio II 6.
Prerequisite: ARC 501.
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.

ARC 503 Advanced Architectural Design (Series) 6.
Prerequisite: Graduate standing.
Advanced studies in architectural design. Projects concerning various aspects of building design, urban design and community design in comprehensive and integrative manner.

ARC 520 Sustainable Architecture 3.
Prerequisite: Architecture or Environmental Design in Architecture Majors Only.
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.

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.

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.

ARC 523 Building Energy Modeling and Simulation 3.
Prerequisite: ARC 414.
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.

ARC 524 Building Energy Optimization 3.
Prerequisite: ARC 523.
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.

ARC 530 Tectonics and Craft 3.
Prerequisite: Architecture Majors, ARC 432.
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.

ARC 534 Design of Architectural Details 3.
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.
ARC 535 Experiments in Architecture Prototypes 3.
Prerequisite: ARC 232 or equivalent.
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.

ARC 536 Materials for Design 3.
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 M. Arch or B. Arch Students.

ARC 540 Architectural Theory 3.
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 M. Arch, B. Arch, and BEDA Seniors. Non-architecture majors by instructor's permission.

ARC 541 Architecture, Culture, and Meaning 3.
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.

ARC 542 Sacred Architecture 3.
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.

ARC 543 Analysis of Precedent 3.
Prerequisite: Grad. standing.
Investigation of architectural elements, relationships and ordering ideas through comparative graphic analysis of buildings designed by architects. Emphasis on buildings as physical artifacts.

ARC 544 American City Planning History 3.
Prerequisite: ARC 241 and ARC 242 and ARC 441 or permission of instructor.
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.

ARC 546 Theory of Building Types 3.
Prerequisite: Two ARC studios.
Theoretical implications and practical applications of typology in architecture. Analysis and documentation of selected building types in their historical evolution. Graphic identification of type characteristics.

ARC 548 Vernacular Architecture 3.
Prerequisite: M.Arch student without an undergraduate degree in architecture must have completed ARC 211, ARC 241, ARC 232.
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.

ARC 561 The Practice of Architecture 3.
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.

ARC 562 Legal Issues in Architecture 3.
Prerequisite: Architecture Majors, ARC 561.
The main principles of law affecting the profession of architecture as it is influenced by contracts, torts, agency, property, and environmental restrictions.

ARC 570 Anatomy of the City 3.
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.

ARC 571 Urban House 3.
Prerequisite: Graduate standing.
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.
ARC 572 Regional Infrastructures 3.
Restricted to: M. Arch, B. Arch, BEDA seniors, and M. LArch.
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.

ARC 574 Place and Place Making 3.
Prerequisite: Graduate standing.
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.

ARC 576 Community Design 3.
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.

ARC 577 Sustainable Communities 3.

ARC 581 Project Preparation Seminar 3.
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.

ARC 589 Architectural Travel Study II 3.
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. Required of all participants in Dept. of Architecture Foreign Exchange and Summer Abroad Programs. Restricted to departmental approval.

ARC 590 Special Topics in Architecture 1-3.
Prerequisite: Graduate standing.
Topics of current interest by faculty in the Department of Architecture. Subjects under this number normally to test and develop new courses.

ARC 598 Final Project Studio In Architecture 6.
Prerequisite: 18 hrs. of ARC 503 and ARC 697.
Final project for graduate students supervised by members of their graduate advisory committee. Requires department approval.

ARC 630 Independent Study 1-6.
Prerequisite: Graduate standing.
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.

ARC 685 Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

ARC 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

ARC 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

ARC 696 Summer Thesis Res 1.

ARC 697 Final Project Research in Architecture 1-6.
Prerequisite: Graduate standing.
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.

ARC 896 Summer Dissert Res 1.

ARE - Agricultural Economics Courses

ARE 104 Agricultural Business Management 3.
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.

ARE 106 Agri Business Law 3.
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. CAMPBELL.

ARE 112 Agricultural & Agribusiness Marketing 3.
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.

ARE 113 Principles of Salesmanship 3.
“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.
ARE 114 Value Added Agriculture and Niche Marketing 3.
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.

ARE 115 Agribusiness Accounting 3.
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.

ARE 132 Management of Personnel 3.
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.

ARE 133 Agricultural & Environmental Policy 3.
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. PHILLIPS.

ARE 141 Personal Financial Management 3.
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. RUSS.

ARE 194 International Agribusiness Management Study Abroad 1-6.
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 or 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.

ARE 201 Introduction to Agricultural & Resource Economics 3.
Credit is not allowed for both ARE 201 and EC 201 or EC 205.
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.

ARE 201A Introduction to Agricultural & Resource Economics 3.
AGI Students Only.
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.

ARE 215 Small Business Accounting 3.
Prerequisite: ARE 201 or EC 201 or EC 205.

ARE 260 Marketing and Risk Management in the Pork Industry 1.
Prerequisite: ANS 150.
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.

ARE 301 Intermediate Microeconomics 3.
Prerequisite: MA 121 or 131; ARE 201 or EC 205 or EC 201.
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. Credit not allowed in more than one of EC 301, 310, 401.

ARE 303 Farm Management 3.
Prerequisite: ARE 201 or EC 201 or EC 205.
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.

ARE 304 Agribusiness Management 3.
Prerequisite: ARE 201 or EC 201 or EC 205.
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.

ARE 306 Agricultural Law 3.
Prerequisite: ARE 201 or EC 201 or EC 205.
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.
ARE 309 Environmental Law & Economic Policy 3.
Prerequisite: ARE 201 or EC 201 or EC 205.
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.

ARE 311 Agricultural Markets 3.
Prerequisite: ARE 201 or EC 201 or EC 205.
Agricultural marketing system and economic forces affecting its structure and efficiency. Public policy issues affecting agricultural markets. Emphasis on the analysis of current sources of agricultural market information. Marketing and storage problems over time; futures markets and the management of risk; transportation and international trade; government agricultural programs.

ARE 312 Agribusiness Marketing 3.
Prerequisite: ARE 201 or EC 201 or EC 205.
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.

ARE 321 Agricultural Financial Management 3.
Prerequisite: ARE 201 or EC 201 or EC 205.

ARE 323 Agribusiness Finance 3.
Prerequisites: ARE 201 or EC 201 and (ARE 200 or ARE 210 or equivalent Introductory Accounting Course).
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.

ARE 332 Human Resource Management for Agribusiness 3.
Prerequisite: ARE 201 or EC 201 or EC 205.
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.

ARE 336 Introduction to Resource and Environmental Economics 3.
Prerequisite: ARE 201 or EC 201 or EC 205.
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.

ARE 345 Global Agribusiness Management 3.
Prerequisite: EC 201 or 205 or ARE 201.
Global trade is the largest growth area in American agribusiness, and knowledge of international agribusiness markets is one of the primary qualifications desired from college graduates entering the workforce. This course provides detailed knowledge of the six major regions for agribusiness trade worldwide, to prepare students to understand, speak intelligently about, and capitalize on opportunities for NC and US agribusiness products in the global marketplace. Students will be required to provide their own transportation to local markets and incidental expenses for meals representative of the six major regions connected with class assignments. Please see the Instructor for details.

ARE 404 Advanced Agribusiness Management 3.
Prerequisite: (ARE 303 or ARE 304), ARE 321, and (ARE 311 or ARE 312).
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 strategy 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.

ARE 412 Advanced Agribusiness Marketing 3.
Prerequisite: ARE/EC 201 or EC 205; Pre- or Co-requisite: ARE 312 or BUS 360.
ARE provides opportunities for undergraduates to gain experience with the practical application of Marketing principles with real and fictitious Agribusiness products through two courses taken on campus: ARE 412 and ARE 413. These opportunities are provided to students that are specifically interested in pursuing a Marketing or Sales position after graduation, especially when an internship is not an option. The practical applications often require two semesters (one full academic year) to complete, so student involved in projects are encouraged to take ARE 412 in the Fall and ARE 413 in the Spring. Projects very each year.

ARE 413 Applied Agribusiness Marketing 3.
Prerequisites: ARE 201/EC 201 or EC 205, ARE 312, and ARE 412.
ARE provides opportunities for undergraduates to gain experience with the practical application of marketing principles with real and fictitious agribusiness products through two courses taken on campus, ARE 412 and ARE 413. These opportunities are provided to students that are specifically interested in pursuing a Marketing or Sales position after graduation, especially when an internship is not an option. The practical applications often require two semesters (one full academic year) to complete, so students involved in projects are encouraged to take ARE 412 in the Fall, and ARE 413 in the Spring. Projects vary each year.

This course is an elective for ABM, BBM, and related CALS majors.
Departmental approval required to enroll in course.
Prerequisite: ARE(EC) 301 or ARE(EC) 401.
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.

ARE 436 Environmental Economics 3.
Prerequisite: ARE(EC) 301.
Usefulness of economics in understanding pollution, congestion, conservation and other environmental problems. Relevant economic tools such as pricing schemes, abatement cost curves, damage functions and benefit-cost analysis. Pollution taxes, regulations, marketable permits and subsidies considered in designing alterations, in the incentive system. Current public policy alternatives in the context of non-market decision-making.

ARE 444 Ethics in Agribusiness 3.
Ethical behavior is a crucial issue in American business, especially after numerous 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.

ARE 490 Career Seminar in Agriculture & Resource Economics 1.
Prerequisite: Sophomore standing.
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.

ARE 492 External Learning Experience 1-6.
Prerequisite: Sophomore standing.
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.

ARE 493 Special Problems/Research Exploration 1-6.
Prerequisite: ARE Sophomore standing.
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.

ARE 494 Agribusiness Study Abroad 1-6.
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.

ARE 495 Special Topics in Agricultural and Resource Economics 1-6.
Presentation of material not normally available in regular course offerings or offering of new courses on a trial basis.

ARS - Arts Studies Courses

ARS 251 The Arts of a World Capital: London 3.
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.

ARS 252 The Arts of Vienna 1900 3.
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.

ARS 257 Technology in the Arts 3.
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.

ARS 258 Mathematics and Models in Music 3.
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.

ARS 259 The Arts and Politics 3.
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.

ARS 306 Music Composition with Computers 3.
Prerequisite: Some knowledge of music or computer science (e.g. CSC 200).
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).

ARS 346 Black Popular Culture 3.
A multidisciplinary examination of contemporary black cultural expression in film, music, art, and the media. Emphasis on race, class, gender, and political discourse.
ARS 351 Arts, Ideas and Values 3.
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.

ARS 353 Arts and Cross-Cultural Contacts 3.
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.

ARS 354 The Arts and the Sacred 3.
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.

ARS 414 Interdisciplinary Arts Seminar 3.
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.

ARS 494 Topics in Arts Studies 3.
Prerequisite: Junior standing and 15 hours in either dance, design, film studies, music, theater, or visual arts.
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.

ARS 498 Independent Study in Arts Studies 1-3.
Prerequisite: Nine hours of course work in Arts Studies.
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 and faculty member prior to registration by the department.

AS - Aerospace Studies Courses

AS 121 The Foundation of the United States Air Force I 1.
Part I 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.

Part II 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.

AS 221 The Evolution of USAF Air and Space Power I 1.
Part I of a course featuring topics on Air Force heritage and leaders; introduction to air and space power through examination of competencies and functions; and continued application of communication skills. Its purpose is to instill an appreciation of the development and employment of air power and to motivate students to transition from AFROTC cadet to Air Force ROTC officer candidate.

AS 222 The Evolution of USAF Air and Space Power II 1.
Part II of a course featuring topics on Air Force heritage and leaders; introduction to air and space power through examination of competencies and functions; and continued application of communication skills. Its purpose is to instill an appreciation of the development and employment of air power and to motivate students to transition from AFROTC cadet to Air Force ROTC officer candidate.

Prerequisite: Successful completion of Field Training.
Part I of a course that teaches cadets advanced skills and knowledge in management and leadership. Special emphasis is placed on enhancing leadership skills. Cadets have an opportunity to try out these leadership and management techniques in a supervised environment as juniors and seniors.

AS 322 Air Force Leadership Studies II 3.
Prerequisite: Successful completion of Field Training.
Part II of a course that teaches cadets advanced skills and knowledge in management and leadership. Special emphasis is placed on enhancing leadership skills. Cadets have an opportunity to try out these leadership and management techniques in a supervised environment as juniors and seniors.

AS 421 National Security Affairs/Preparation for Active Duty I 3.
Prerequisite: Successful completion of Field Training.
Part I of a course designed for college seniors and that gives them the foundation to understand their role as military officers in American society. It is an overview of the complex social and political issues facing the military profession and requires a measure of sophistication commensurate with the senior college level.

AS 422 National Security Affairs/Preparation for Active Duty II 3.
Prerequisite: Successful completion of Field Training.
Part II of a course designed for college seniors and that gives them the foundation to understand their role as military officers in American society. It is an overview of the complex social and political issues facing the military profession and requires a measure of sophistication commensurate with the senior college level.

AS 495 Special Topics in Aerospace Studies 2.
Offered as needed to treat new or special subject matter relating to the Department of the Air Force.

AVS - Arts Village Courses

AVS 100 Arts Village Forum 1.
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 deepened 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.

BAE - Biological and Agricultural Engineering Courses

BAE 100 Introduction to Biological Engineering 1.
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.
BAE 123 Light Equipment Technology 3.
Principles of operation and maintenance of powered turf, garden, and landscape equipment. Small engines, power transmission systems, equipment maintenance, and operator safety.

BAE 133 Agricultural Tractors and Machinery 4.
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.

BAE 200 Computer Methods in Biological Engineering 2.
Prerequisite: Grade of C or better in MA 141 and E 115.
Students develop computer-based problem solving techniques to solve introductory problems in Biological and Biomedical Engineering. Emphasis is on developing solution algorithms and implementing these with spreadsheets, equation solvers, and computer programming.

BAE 202 Introduction to Biological and Agricultural Engineering Methods 4.
Prerequisite: E 115.
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.

BAE 203 Introduction to AutoCAD Civil 3D for Environmental & Ecological Engineers 2.
Prerequisite: BAE 200.
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.

BAE 204 Introduction to Environmental and Ecological Engineering 2.
Prerequisite: BAE 200 and (BIO 181 or BIO 183); Corequisite: BAE 203 and SSC 200.
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.

BAE 302 Transport Phenomena 3.
Prerequisite: (BAE 200, CSC 112, CSC 114 or CSC 116), (CE 215 or MAE 208), MA 341 and MAE 301; Corequisite: CE 382 or MAE 308.
Theory and application of heat and mass transfer in biological, food, and agricultural systems. Topics include fluid flow, conduction, convection, radiation, psychrometrics, and refrigeration.

BAE 305 Properties of Biological Engineering Materials 3.
Prerequisite: (BIO 181 or BIO 183), and either (BAE 200, CSC 112, CSC 114 or CSC 116) and (CE 215 or MAE 208) and Corequisites: (MAE 308 or CE 382), and (MAE 314 or CE 313).
Physical properties of biological and non-biological engineering materials, their uniqueness and variability within systems. Relationships between plant, animal, and human tissues, property measurement, and evaluation of dimensional, mechanical, rheological, thermal, electrical, and optical properties.

BAE 322 Introduction to Food Process Engineering 3.
Prerequisite: BAE 302; MAE 308 or CE 382; MAE 301 or CHE 315.
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.

BAE 325 Introductory Geomatics 3.
Prerequisite: Junior standing.
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.

BAE 361 Analytical Methods in Engineering Design 3.
Prerequisite: BAE 202, CE 215 or MAE 208, MA 341; Corequisite: MAE 314.
Engineering problem solving through studies of topics in engineering design. Kinematic analysis of linkages, analysis and design/selection of machine structures and power transmission components, including vibration modeling and control in lumped mass mechanical and biomechanical systems.

BAE 371 Land Resources Environmental Engineering 3.
Prerequisite: BAE 200, CSC 112, CSC 114, CSC 116; Corequisite: SSC 200 and either (CE 382 or MAE 308).
Hydrology and erosion principles. Designing structures and selecting practices to control land runoff, erosion, sediment pollution and flooding.

BAE 401 Instrumentation for Biological Systems 3.
Prerequisite: ECE 331.
Basic concepts of instrumentation for monitoring of 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.

BAE 425 Industrial Microbiology and Bioprocessing 3.
Prerequisite: Junior or higher standing in CALS or COE; MB 351.
Introduction to the structure and functions of microbial cells and their cultivation and utilization in bioprocess engineering. Fermentation systems and downstream processing methods. Enzyme kinetics, production and application. Biomanufacturing of fuels, industrial chemicals, pharmaceuticals, food additives and food products such as beer, wine, cheese and yogurt. Microbial biomass production. Introduction to environmental biotechnology including waste water treatment, bioremediation and biomining. Biodeterioration and its control. Product development, regulations and safety. Field trip(s) are an essential educational component of the course and are required. Credit will not be given for both BAE(BBS) 425 and BAE 525.
BAE 435 Precision Agriculture Technology 3.
Prerequisite: Junior standing or Senior standing.
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/SSC 435 and BAE/SSC 535.

BAE 442 Systems Approach to Agricultural and Environmental Issues 3.
Prerequisite: ENG 331 or ENG 332 or ENG 333; Senior standing.
Systems approach to complex agricultural and environmental issues and problematic situations including people’s views. Multiple stages of soft systems approach: open inquiry into and description of issues, conceptual modeling, feasibility and implementation of changes. Individual project using systems approach to a complex issue in agriculture or the environment.

BAE 451 Engineering Design I 2.
Prerequisite: (CE 313 or MAE 314), BAE 202, 302, 315, and either (BAE 322, 361, or 371).
Design Concepts of engineering problems; objectives, specifications, manufacturing, prior art and analysis. Oral and written exercises in reverse engineering, national and international standards, quality control, intellectual law and engineering ethics. Team projects from agricultural, bio-processing and environmental engineering. Must be within 36 credit hours of completing the BE degree. Field trips are required. Must be within 36 credit hours of completing the BE degree.

BAE 452 Engineering Design II 2.
Prerequisite: BAE 451.
Continuation of BAE 451; Project analysis, design, scheduling, construction, tests and reports. Teamwork and the function of engineering design in society. Field trips are required. Must be within 36 hours of completing the BE degree.

BAE 462 Machinery Design and Applications 3.
Prerequisite: BAE 361.
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.

BAE 472 Irrigation and Drainage 3.
Prerequisite: BAE 471.
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.

BAE 473 Introduction to Surface/Water Quality Modeling 3.
Prerequisite: BAE 471.
Concepts in basic hydrologic, erosion and chemical transport used in modeling. Evaluation of typical hydrologic/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.

BAE 474 Principles and Applications of Ecological Engineering 3.
Prerequisite: MB 351 or SSC 332, BAE 471.
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.

BAE 481 Structures & Environment 3.
Prerequisite: BAE 302; CE 313 or MAE 314.
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.

BAE 488 Postharvest Engineering 3.
Prerequisite: BAE 302 or MAE 310.
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.

BAE 492 External Learning Experience 1-6.
Prerequisite: Sophomore standing.
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.

BAE 493 Special Problems in Biological and Agricultural Engineering 1-6.
Prerequisite: Sophomore standing.
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.

BAE 495 Special Topics in Biological and Agricultural Engineering 1-3.
Offered as needed for presenting material not normally available in regular BAE departmental courses or for new BAE courses on a trial basis.

BAE 501 Instrumentation for Biological Systems 3.
Prerequisite: ECE 331.
Basic concepts of instrumentation for monitoring 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.
BAE 502 Instrumentation for Hydrologic Applications 3.
Prerequisite: MA 341, BAE 401 or ECE 331, ST 370 or ST 511.
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.

BAE 525 Industrial Microbiology and Bioprocessing 3.
Prerequisite: MB 351.
Introduction to the structure and functions of microbial cells and their cultivation and utilization in bioprocess engineering. Fermentation systems and downstream processing methods. Enzyme kinetics, production and application. Biomanufacturing of fuels, industrial chemicals, pharmaceuticals, food additives and food products such as beer, wine, cheese, and yogurt. Microbial biomass production. Introduction to environmental biotechnology including waste water treatment, bioremediation and biomaining. Biodeterioration and its control. Product development, regulations and safety. Graduate standing required. Students cannot obtain credit for both BAE(BBS) 425 and BAE 525.

Prerequisite: Introductory Organic Chemistry or Biochemistry.
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 standing in COE, CALS, PAMS or CNR.

BAE 535 Precision Agriculture Technology 3.
Prerequisite: Junior standing or Senior standing.
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/SSC 435 and BAE/SSC 535.

BAE 536 GIS Applications in Precision Agriculture 1.
Prerequisite: GIS 410 or GIS 510 or BAE 435 or BAE 535.
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.

BAE 560 Aerosol Science and Engineering 3.
Prerequisite: MA 341.
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.

BAE 561 Agricultural Air Quality 3.
Prerequisite: MA 341.
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.

BAE 572 Irrigation and Drainage 3.
Prerequisite: BAE 471, SSC 200.
Design, management and evaluation of irrigation and drainage systems; concepts and processes of system design.

BAE 573 Introduction to Surface Hydrologic/Water Quality Modeling 3.
Prerequisite: Graduate standing, BAE 471, SSC 200.
Concepts in basic hydrologic, erosion and chemical transport used in modeling. Evaluation of typical hydrologic/water quality models on watershed systems. Usage of state-of-the-art models in project examples.

BAE 574 DRAINMOD: Theory and Application 3.
Prerequisite: One of the following: BAE 471, BAE 472, BAE 573, BAE 771, or SSC 511.
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: BAE 471 or CE 383.
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.

BAE 576 Watershed Monitoring and Assessment 3.
Prerequisite: [AES323 (SSC323/BAE323) or BAE471 or FOR429 (NR420) or CE586, and ST311 or ST361 or ST511.
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.

BAE 578 Agricultural Waste Management 3.
Prerequisite: Biology or Engineering background.
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 discussions that emphasize problem solving and analysis.
BAE 579 Stream Channel Assessment and Restoration 3. 
Prerequisite: BAE 471 or CE 383.
Applications of fluvial geomorphology principles for assessment and restoration of natural stream channels. Topics include stream processes related to channel formation, bankfull channel dimensions, stream classification, morphological assessments, stream stability, restoration options for unstable channels, natural channel design approaches, and stream morphology monitoring. Field exercises include channel surveying using total stations, stream classification, and stability assessment. Field trips to stream restoration projects are included.

BAE 580 Introduction to Land and Water Engineering 3. 
Prerequisite: MA 241.
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.

BAE 581 Open Channel Hydraulics for Natural Systems 3. 
Prerequisite: CE 382 or equivalent. CE 381 recommended.
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.

BAE 582 Risk and Failure Assessment of Stream Restoration Structures 1. 
Prerequisite: CE 382 or MAE 308 or equivalent.
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.

BAE 583 Ecohydraulics and River Corridor Function 1. 
Prerequisite: CE 382 or MAE 308 or equivalent.
This course provides an ecological perspective of lotic systems and introduces students to ecological processes that structure river corridors. This course defines hydraulic, hydrologic, chemical, sedimentary, and biotic influences on an aquatic ecosystem. The five modules define components of aquatic ecosystems and their interactions, and explore ecological implications of engineered designs and cause-effect relationships from the watershed scale down to individual organisms. This course assumes students have a working knowledge of general biological and physical principles related to fluvial ecosystems.

BAE 584 Introduction to Fluvial Geomorphology 3. 
Prerequisite: BAE 471 or BAE 580.
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.

BAE 585 Integrating AutoCAD Civil 3D and GIS 1. 
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.

BAE 590 Special Problems 1-3. 
Prerequisite: Senior standing or Graduate standing in Biological and Agricultural Engineering.
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.

BAE 591 Master's Research Methods I 1. 
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.

BAE 592 Master's Research Methods II 1. 
Prerequisite: BAE 591.
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 both a practice and a final seminar. This course is restricted to MS students majoring in BAE.

BAE 593 Integrating AutoCAD Civil 3D and GIS 1-4. 
Prerequisite: Graduate standing.
A study of topics in the special fields of interest of graduate students under the direction of the graduate faculty.

BAE 610 Special Topics 1-4. 
Prerequisite: Graduate standing.
A study of topics in the special fields of interest of graduate students under the direction of the graduate faculty.

BAE 620 Special Problems 1-3. 
Prerequisite: Senior standing or Graduate standing in Biological and Agricultural Engineering.
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.

BAE 685 Master’s Supervised Teaching 1-3. 
Prerequisite: Master's student.
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.
BAE 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master’s student.
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.

BAE 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master’s student.
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.

BAE 690 Master’s Examination 1-6.
Prerequisite: Master’s student.
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.

BAE 693 Master’s Supervised Research 1-9.
Prerequisite: Master’s student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

BAE 695 Master’s Thesis Research 1-9.
Prerequisite: Master’s student.
Thesis research.

BAE 696 Summer Thesis Research 1.
Prerequisite: Master’s student.
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.

BAE 699 Master’s Thesis Preparation 1-9.
Prerequisite: Master’s student.
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.

BAE 771 Theory Of Drainage--Saturated Flow 3.
Prerequisite: MA 301.
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 steady-state and transient flow equations to determine their applicability to drainage problems. Consideration of analogs and models of particular drainage problems.

BAE 785 Food Rheology 3.
Prerequisite: FS 231 or MAE 314.
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.

BAE 790 Special Topics 1-3.
Special topics in BAE.

BAE 791 Doctoral Research Methods I 1.
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.

BAE 792 Doctoral Research Methods II 1.
Prerequisite: BAE 791.
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 practice and final seminar. The course is restricted to PhD students majoring in BAE.

BAE 801 Seminar 1.
Prerequisite: Graduate standing in BAE.
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.

BAE 810 Special Topics 1-4.
A study of topics in the special fields of interest of graduate students under the direction of the graduate faculty.

BAE 820 Special Problems 1-3.
Prerequisite: Senior standing or Graduate standing in Biological and Agricultural Engineering.
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.

BAE 825 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

BAE 829 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

BAE 836 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

BBS - Bioprocessing Courses

BBS 201 Introduction to Biopharmaceutical Science 3.
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.

BBS 301 Process Validation Science 3.
Prerequisite: (FS 231 and BBS 201) or BBS 426.
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.

BBS 426 Upstream Biomanufacturing Laboratory 2.
Prerequisite: (MB 351 and FS 231) CHE/BEC 463.
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.

BBS 526 Upstream Biomanufacturing Laboratory 2.
Prerequisite: (MB 351 and FS 231) CHE/BEC 463.
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.

BCH - Biochemistry Courses

BCH 101 Introduction to Microbiology and Biochemistry Laboratory Practices 3.
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.

BCH 103 Introduction to Biochemistry 1.
Introduction to curriculm 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.

BCH 220 Role of Biotechnology in Society 3.
Prerequisite: BIO 181, CH 101.
Biotechnology and Societing 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, the ability to understand how biotechnology works. Offered only in Poland through Study Abroad (4-week course). Departmental approval required.

BCH 330 Physical Biochemistry 3.
P: (CH 201 or CH 203) and (BCH 351 or BCH 451) and (MA 231 or MA 242) and (PY 208 or PY 212).
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 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).

BCH 351 General Biochemistry 4.
Prerequisite: (CH 201 or CH 203) and (FS 231 or BCH 451) and (MA 231 or MA 242) and (PY 208 or PY 212).
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 discusses amino acids and proteins, carbohydrates, lipids, and nucleic acids. The pathways discussed will include glycolysis, gluconeogenesis, and the Krebs cycle. 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.

Prerequisite: CH 223 or CH 227.
Introduction to the fundamental principles of biochemistry. Emphasis on biochemical structures, properties, functions and interactions, including enzyme kinetics and central pathways of metabolism.

BCH 452 Introductory Biochemistry Laboratory 2.
Corequisite: BCH 451.
Laboratory experience to complement BCH 451. Basic skills in the use of volumetric equipment, spectrophotometers, chromatography, and electrophoresis. Manipulation and assay of small quantities of biological materials, and analysis of laboratory data.
BCH 453 Biochemistry of Gene Expression 3.
Prerequisite: BCH 451, Corequisite: GN 311, MB 351.

BCH 454 Advanced Biochemistry Laboratory 4.
Prerequisite: BCH 452, Corequisite: BCH 453.

BCH 455 Proteins and Molecular Mechanisms 3.
Prerequisite: BCH 451, BCH 453/553.
Principles of protein structure and function, protein folding, enzymology, ligand binding, protein transport, and metabolic pathways.

BCH 492 External Learning Experience 1-6.
Prerequisite: Sophomore standing.
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.

BCH 493 Special Problems in Biochemistry 1-6.
Prerequisite: Sophomore standing.
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.

BCH 495 Special Topics in Biochemistry 1-5.
Prerequisite: Junior standing.
Offered as needed to present materials not normally available in regular BCH departmental courses or for new BCH courses on a trial basis.

BCH 552 Experimental Biochemistry 3.
Prerequisite: BCH 452:BCH 453.
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.

BCH 553 Biochemistry of Gene Expression 3.
Prerequisite: BCH 451, Corequisite: GN 311, MB 351.

BCH 555 Proteins and Molecular Mechanisms 3.
Prerequisite: BCH 451, BCH 453/553.
Principles of protein structure and function, protein folding, enzymology, ligand binding, protein transport, and metabolic pathways.

BCH 560 Molecular Biology for Teachers 3.
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.

BCH 571 Regulation of Metabolism 3.
Prerequisite: BCH 451, GN 411, a course in physiology, cell biology. Study of hormonal, enzymatic and molecular-genetic regulation of carbohydrate and lipid metabolism; emphasis on mammalian species.

BCH 590 Special Topics in Biochemistry 1-3.
Prerequisite: BCH 451.
The study of topics of special interest by small groups of students instructed by members of the faculty.

BCH 601 Macromolecular Structure 1.
Prerequisite: BCH 453 or BCH 553; a course in physical chemistry highly recommended.
Introduction to the current understanding and methods used for the study of structures, thermodynamics and conformational dynamics of proteins, nucleic acids and membranes.

BCH 610 Special Topics 1-3.
Prerequisite: BCH 451.
The study of topics of special interest by small groups of students instructed by members of the faculty.

BCH 615 Special Topics in Biochemistry 1-3.
Prerequisite: Graduate standing in BCH.
Critical study of special problems and selected topics of current interest in biochemistry and related fields.

BCH 670 Laboratory Rotations 1.
Prerequisite: BCH 451.
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 692.

BCH 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

BCH 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

BCH 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

BCH 690 Master's Examination 1-3.
Prerequisite: Master's student.
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.

BCH 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Master's student.
Thesis research.

BCH 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

BCH 701 Macromolecular Structure 3.
Prerequisite: BCH 453 or BCH 553; a course in physical chemistry highly recommended.
Introduction to the current understanding and methods used for the study of structures, thermodynamics and conformational dynamics of proteins, nucleic acids and membranes.

BCH 703 Macromolecular Synthesis and Regulation 3.
Prerequisite: BCH 453 or BCH 553.
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.

BCH 705 Molecular Biology Of the Cell 3.
Prerequisite: BCH 701 or BCH 703.
Regulation of cellular processes, membrane structure and function, signal transduction, protein trafficking/sorting, secretion, photosynthesis and nitrogen fixation.

BCH 710 Biological Scanning Electron Microscopy 2.
Prerequisite: Graduate standing with some biological background.
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.).

BCH 751 Biophysical Chemistry 3.
Prerequisite: BCH 451; one sem. of physical chemistry.
Fundamental and practical aspects of biological macromolecular structure, thermodynamics, hydrodynamics, kinetics and spectroscopy with emphasis on mechanisms in functionally important structural transformations.

BCH 760 Protein Crystallography and Macromolecular Modeling 3.
Prerequisite: BCH 455 or BCH 555 or equivalent.
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.

BCH 761 Advanced Molecular Biology Of the Cell 3.
Prerequisite: BCH 703 and 705.
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.

BCH 763 Biochemistry Of Hormone Action 3.
Prerequisite: BCH 705 or GN 757.
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 701 and 703.
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.

BCH 770 Enzyme Kinetics and Mechanisms 3.
Prerequisite: BCH 451 and BCH 455/555 or equivalent.
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 multienzyme 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.

BCH 801 Seminar In Biochemistry 1.

BCH 810 Special Topics 1-3.
Prerequisite: BCH 451.
The study of topics of special interest by small groups of students instructed by members of the faculty.

BCH 815 Advanced Special Topics 1-3.
Prerequisite: Graduate standing in BCH.
Critical study of special problems and selected topics of current interest in biochemistry and related fields.

BCH 870 Laboratory Rotations 1.
Prerequisite: BCH 451.
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 692.

BCH 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

BCH 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.
BCH 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

BEC - Biomanufacturing Training Education Center Courses

BEC 220 Introduction to Drug Development and Careers in Biomanufacturing 1.
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 microbiological technology.

BEC 330 Principles and Applications of Bioseparations 2.
Prerequisite: CH 223 or CH 227.
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.

BEC 363 Foundations of Recombinant Microorganisms for Biomanufacturing 2.
Prerequisite: BIO 183.
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.

BEC 426 Upstream Biomanufacturing Laboratory 2.
Prerequisite: (MB 351 and FS 231) CHE/BEC 463.
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.

BEC 436 Introduction to Downstream Process Development 2.
Prerequisite: BEC 330 or graduate standing.
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.

BEC 440 Expression Systems in Biomanufacturing 1. 3.
Prerequisite: BEC 363 or (MB 351 and MB 352).
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: MA 241 and PY 208 and (CH 223 or CH 227).
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.

BEC 463 Fermentation of Recombinant Microorganisms 2.
Prerequisite: CH 223 or CH 227; Corequisite: (BIT 410 or BCH 452 or MB 352 or BEC 363).
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.

BEC 475 Global Regulatory Affairs for Medical Products 3.
Prerequisite: Senior standing.
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.

BEC 480 cGMP Fermentation Operations 2.
Corequisite: BBS/BEC/FS 426.
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.
BEC 483 Tissue Engineering Technologies 2.
Prerequisite: BIT 466/566 or permission of instructor.
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.

BEC 485 cGMP Downstream Operations 2.
Corequisite: BEC 436/536.
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.

BEC 488 Animal Cell Culture Engineering 2.
Prerequisite: (CHE 447 or BEC 463 or BIT 466).
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, and single-use (disposal) bioreactors. This is a half-semester course.

BEC 495 Special Topics in Biomanufacturing 1-4.
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.

BEC 497 Biomanufacturing Research Projects 1-3.
Introduction to biomanufacturing research through experimental, theoretical, and literature studies. Oral and written presentation of reports. Departmental approval required.

BEC 515 Biopharmaceutical Product Characterization Techniques 2.
Prerequisite: CH 222 or equivalent.
This 8 week graduate course introduces engineering students to bioanalytical testing to processes that produce structurally complex biopharmaceuticals. Students will gain hands-on experience including assay validation, drug/biologic substance characterization (structural and activity) and biopharmaceutical purity. The technologies and related theory will include rapid micro SDS-PAGE, lab-on-a-chip, HPLC, mass spectrometry, UV/Vis absorbance and fluorescence spectroscopy. Students will also learn assay development and validation concepts as per ICH Q2(R1) and other U.S. and international government regulatory guidelines.

BEC 532 Biological Processing Science 2.
Prerequisite: BCH 451 or graduate standing.
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.

BEC 536 Introduction to Downstream Process Development 2.
P: BEC 532 or BEC 330 or permission of instructor.
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.

BEC 540 Expression Systems in Biomanufacturing 1-3.
Prerequisite: MB 351/352.
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.

BEC 541 Expression Systems in Biomanufacturing II 3.
Prerequisite: BEC 440/540 or BIT 410/510.
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: MA 241 and PY 208 and (CH 223 or CH 227).
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.

BEC 575 Global Regulatory Affairs for Medical Products 3.
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.

BEC 577 Advanced Biomanufacturing and Biocatalysis 3.
Graduate standing in engineering or life-science graduate program.
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.
BEC 580 cGMP Fermentation Operations 2.
Corequisite: BBS/BEC/FS 426.
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.

BEC 583 Tissue Engineering Technologies 2.
Prerequisite: BIT 466/566 or permission of instructor.
In this half-semester laboratory module, students will gain practical experience with two key elements of tissue engineering: the construction of a complex living tissue that closely resembles its natural counterpart, and the assessment of the angiogenic potential of the engineered tissue. The effects of different biomaterials and angiogenic factors will be evaluated.

BEC 585 cGMP Downstream Operations 2.
Corequisite: BEC 436/536.
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.

BEC 590 Industry Practicum in Biomanufacturing 3.
Technical, operations, project management and regulatory compliance problems related to the design of a biomanufacturing process for cGMP manufacture of therapeutic antibodies, Fc-fusion proteins or antibody fragments to be used as human biotherapeutics. The BTEC simulated cGMP manufacturing facility will be the basis for solving problems.

BEC 595 Special Topics in Biomanufacturing 1-4.
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.
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.

BEC 620 Leadership and Preparation for Industry Internship in Biomanufacturing 2.
Advanced communication skills specific to the regulatory requirements of the biomanufacturing and biopharmaceutical industries regulated by the U.S. FDA. Instructors teach 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.

BEC 621 Communicating and Industry Internship in Biomanufacturing 1.
Prerequisite: BEC 620.
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. Biomanufacturing Graduate Faculty evaluates each industry internship experience by student presentation and written paper. An industry internship is required of all Professional Science Masters (PSM) degree programs in the U.S. Restricted to BIOM graduate students and students applying to the BIOM program.

BEC 669 Biomanufacturing Research Projects 1-4.
Prerequisite: Graduate standing in engineering, biological science or physical science.
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.

BIO - Biological Sciences Courses

BIO 105 Biology in the Modern World 3.
Credit is not allowed for BIO 105 and BIO 181 or BIO 125. Principles and concepts of biology including cellular structure and function, metabolism and energy transformation, homeostasis, reproduction, heredity, diversity of life, ecology, evolution and animal behavior. Emphasis on human affairs and human examples. For non-science students. Students may not receive credit for both BIO 105 and (BIO 115 or BIO 181 or BIO 183).

BIO 106 Biology in the Modern World Laboratory 1.
Corequisite: BIO 105. Laboratory experience in biological principles to complement BIO 105. For non-science students. Students may not receive credit for both BIO 106 and (BIO 116, BIO 181 or BIO 183).

BIO 140 Survey of Animal Diversity 3.
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 or BIO 403 or ZO 150.

BIO 141 Animal Diversity Laboratory 1.
Prerequisite: BIO 140. Laboratory experience in biological principles to complement BIO 141.

BIO 145 Animal Diversity Laboratory 1.
Prerequisite: BIO 145. Laboratory experience in biological principles to complement BIO 145.

BIO 165 Introduction to Environmental Research 5.
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.
Credit is not allowed for BIO 181 and BIO 105 or BIO 125.
Emphasis on interactions of organisms with their environments, evolutionary change and role of natural selection in the evolution of life forms, biological diversity in the context of form and function of organisms, and on critical thinking, problem solving, and effective communication. Cannot receive credit for both BIO 181 and (BIO 105 or BIO 106 or BIO 115 or BIO 116).

BIO 183 Introductory Biology: Cellular and Molecular Biology 4.
Prerequisite: BIO 181 or CH 101.
Basic concepts and principles of molecular, cellular, and developmental biology. Emphasis will be on the physical basis of life, the cell as the fundamental unit of life, the mechanisms involved in the development of multicellular organisms and on critical thinking, problem solving, experimental design, and effective communication. Cannot receive credit for both BIO 183 and (BIO 105 or BIO 106 or BIO 115 or BIO 116).

BIO 212 Basic Human Anatomy and Physiology 4.
Prerequisite: C- or better in BIO 183.
Major emphasis on structure and function of the muscular, skeletal, circulatory and nervous systems of humans. Credit in both BIO 212 and BIO 301 or BIO 302 is not allowed.

BIO 220 Marine Biology 3.
Prerequisite: MEA 200 or BIO 181.
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.

BIO 227 Understanding Structural Diversity through Biological Illustration 3.
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.

BIO 233 Human-Animal Interactions 3.
This course is designed to explore the relationships 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.

BIO 250 Animal Anatomy and Physiology 4.
Prerequisite: C- or better in BIO 183.
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.

BIO 330 Evolutionary Biology 3.
Prerequisite: C- or better in BIO 181 and BIO 183.
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.

BIO 333 Captive Animal Biology 3.
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).
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.
BIO 350 Animal Phylogeny and Diversity 4.
Prerequisite: A grade of C- or better in BIO 181 and sophomore standing. Credit is not allowed for both BIO 350 and BIO 402/403.
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 both BIO 350 and BIO 140 or ZO 150 or BIO 402 or BIO 403.

BIO 353 Wildlife Management 3.
Prerequisite: BIO 181.
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.

BIO 360 Ecology 4.
Prerequisite: C- or better in BIO 181.
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.

BIO 361 Developmental Biology 3.
Prerequisite: C- or better in BIO 183.
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.

Prerequisite: C- or better in BIO 181 or BIO 140.
An integrated study of the functional anatomy, phylogeny, and embryonic development of organ systems in vertebrate animals.

BIO 375 Developmental Anatomy Laboratory 2.
Prerequisite: C- or better in BIO 181 or BIO 140.
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.

BIO 402 Invertebrate Biology 4.
Prerequisite: A grade of C- or better in BIO 181 and BIO 183. Credit is not allowed for both BIO 350 and BIO 402/403.
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 BIO 402 and BIO 350 or BIO 140.

BIO 405 Functional Histology 3.
Prerequisite: C- or better in BIO 183.
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.

BIO 410 Introduction to Animal Behavior 3.
Prerequisite: C- or better in BIO 181 and BIO 183.
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.

BIO 414 Cell Biology 3.
Prerequisite: C- or better in BIO 183 and (CH 221 or CH 225).
The chemical and physical bases of cellular structure and function with emphasis on methods and interpretations.

BIO 421 Advanced Human Anatomy and Physiology 3.
Prerequisite: C- or better in BIO 250 or BIO 212.
A comprehensive survey of the processes involved in the function of specialized cells, tissues and organ systems. Emphasis on basic concepts with orientation toward mammalian and human systems.

BIO 422 Biological Clocks 3.
Prerequisite: C- or better in BIO 250 or BIO 212.
The anatomy, physiology, and development of biological clocks in a variety of organisms, including humans. Credit in both BIO 422 and ZO 522 is not allowed.

BIO 424 Endocrinology 3.
Prerequisite: C- or better in BIO 250 or BIO 212.
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.

BIO 425 General Entomology 3.
Prerequisite: BIO 181 or BIO 140 or ZO 150 or BIO 350.
Explores the science of entomology by focusing on the basic principles of systematics, morphology, physiology, development, behavior, ecology, and control of insects. Field trips provide opportunities to collect insects and study their adaptations to a wide variety of natural environments.

BIO 426 Advanced Human Anatomy & Physiology Lab 1.
Prerequisite: C- or better in BIO 212 or BIO 250; Corequisite: BIO 421.
A comprehensive laboratory course surveying the process involved in the function and structure of specialized cells, tissues, and organ systems. Emphasis will be on problem solving and critical thinking skills.
BIO 434 Hormones and Behavior 3.
Prerequisite: C- or better in BIO 212 or BIO 250 or (ANS 205 & ANS 206).
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.

BIO 440 The Human Animal: An Evolutionary Perspective 3.
Prerequisite: C- or better in one of the following: BIO 317, BIO/PB 330, BIO 410, PSY 406, or PSY 416.
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.

BIO 444 The Biology of Love and Sex 3.
P: C- or better in two of the following: BIO 330, BIO 410, BIO 424, BIO 488, GN 311; R: Junior or Senior Standing.
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.

BIO 449 Principles of Biological Oceanography 3.
Biological productivity and trophic relationships in plankton, nekton and benthos; community ecology of selected habitats (estuaries, intertidal zones, coral reefs, deep sea); and adaptation of organisms to the marine environment. Credit is not allowed for both MEA/BIO 449 and MEA/BIO 549.

BIO 456 Epigenetics, Development, and Disease 3.
Prerequisite: B or better in GN 311.
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 or SR standing.

BIO 481 Senior Capstone Project 1.
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.

BIO 482 Capstone Course in Molecular, Cellular, and Developmental Biology 3.
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.
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.

BIO 483 Capstone Course in Integrative Physiology and Neurobiology 3.
Prerequisite: C- or better in BIO 424, BIO 488, and one of the following: BIO/PB 414 or BCH 451 or BCH 451 or GN 311 or ST 311.
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 IPN curriculum; other students with the necessary prerequisites will be admitted on a space available basis.

BIO 484 Capstone Course in Human Biology 3.
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.
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/PB 330, BIO/PB 360, and one of the following: BIO 460 or GN 311 or NR 406 or ST 311.
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.
BIO 486 Capstone Course in Zoology 3.
Prerequisite: C- or better in BIO 250, BIO/PB 360, and one of the following: BIO 350 or BIO 402/403 or GN 311 or ST 311.

Topical problems in zoology. BIO 486 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 effective, professional communication. Topics and instructors will vary from semester to semester. Priority will initially be given to seniors in the SZO curriculum; other students with the necessary prerequisites will be admitted on a space available basis.

BIO 488 Neurobiology 3.
Prerequisite: C- or better in BIO 250 or BIO 212.

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.

BIO 492 External Learning Experience 1-6.
Prerequisite: Sophomore standing.

Learning experience in agriculture and life sciences within an academic framework with facilities and resources external to the campus. Contact and arrangements with prospective supervisors by the student. Prior approval by faculty advisor, prospective supervisor, and departmental teaching coordinator.

BIO 493 Special Problems in Biological Sciences 1-6.
Prerequisite: Sophomore standing.

Learning experience in agriculture and life sciences within an academic framework with campus facilities and resources. Contact and arrangements with prospective supervisors by the student. Prior approval by faculty advisor, prospective supervisor, and departmental teaching coordinator.

BIO 495 Special Topics in Biology 1-6.

Individualized study, under faculty supervision, of biological topics, and developmental course on a trial basis.

BIO 498 Honors Project Part I 3.

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 member, (2) work with that mentor to complete a contract describing the expectations for their work and the expectations of the student, (3) have the contract approved by the honors program coordinator. The approved contract will specify the specific requirements and expectations of the BIO 498 experience. Enrollment only by permission of the honors program director.

BIO 499 Honors Project Part 2 3.
Prerequisite: BIO 498.

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 specify the specific requirements and expectations of the BIO 499 experience. Enrollment only by permission of honors program director.

BIO 518 Experience and the Brain 3.
Prerequisite: BIO 488 or ZO 588.

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.

Co-requisite: ST 511.

Dynamics of natural populations. Current work, theories and problems dealing with population growth, fluctuation, and patterns of dispersion, species interactions, community structure and ecological genetics. One semester of calculus and a junior/senior level ecology course are required.

BIO 561 Conservation Biology 3.

Conservation Biology applies principles from ecology, genetics, and other biological disciplines 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 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.

BIT - Biotechnology Courses

BIT 100 Current Topics in Biotechnology 4.
Prerequisite: High School Biology.

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.

BIT 200 Early Research in Biotechnology 4.
Prerequisite: High School Biology.

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. Students may need to come to the lab outside class meeting times to complete work on occasion (flexible hours). Examples of research questions to be investigated in different sections: - Investigating bacteriophage for the management of American Floubrood Disease (AFS) of honey bees - Using planarian as a model for studying genes important in stem cell differentiation and regeneration - Investigating the genetic potential of complex microbial populations - Gene expression profiling in zebrafish embryos exposed to antibiotics and anti-acne compounds Freshmen and Sophomores only.
BIT 210 Phage Hunters 3.
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.

BIT 211 Phage Genomics 2.
Prerequisite: BIT(MB) 210.
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 phages isolated in the previous semester will undergo genome sequencing over winter break, and in this course students will learn to sequence 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.

BIT 295 Special Topics in Biotechnology 1-3.
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

BIT 410 Manipulation of Recombinant DNA 4.
Prerequisite: BIO 183 or ZO/BIO 160 and CH 223 or CH 227 with a C- or better.
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.

BIT 462 Gene Expression Analysis: Microarrays 2.
Prerequisite: BIT 410 or BIT 510.
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.

BIT 464 Protein Purification 2.
Prerequisite: BIT 410 or BIT 510 or BCH 454.

BIT 465 Real-time PCR Techniques 2.
Prerequisite: BIT 410 or BIT 510.
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.

BIT 466 Animal Cell Culture Techniques 2.
Prerequisite: BIT 410 or BIT 510 or BCH 454.
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.

BIT 467 PCR and DNA Fingerprinting 2.
Prerequisite: BIT 410/510.
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 of sample and forensic identification of individuals using isolated human hairs. Credit is not allowed for both BIT 467 and BIT 567.

BIT 468 Genome Mapping 2.
Prerequisite: BIT 410 or BIT 510 or BCH 454.
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.

BIT 471 RNA Interference and Model Organisms 2.
Prerequisite: BIT 410 or BIT 510 or BCH 454.
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.

BIT 473 Experimental Analysis of Protein-Protein Interactions 2.
Prerequisite: BIT 410 or BCH 454.
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.
BIT 474 Plant Genetic Engineering 2.
Prerequisite: BIT 410 or BIT 510 or BCH 454 or PB 421.
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.

BIT 476 Applied Bioinformatics 2.
Prerequisite: BIT 410 or BCH 454 or GN 311.
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.

BIT 481 Plant Tissue Culture and Transformation 2.
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.

BIT 492 External Learning Experience 1-6.
A learning experience in the area of biotechnology 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, and the departmental teaching coordinator prior to the experience. Project must be approved by the Academic Coordinator or Program Director of the Biotechnology Program.

BIT 493 Special Problems in Biotechnology 1-6.
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 of Program Director of the Biotechnology Program.

BIT 495 Special Topics in Biotechnology 1-3.
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

BIT 501 Ethical Issues in Biotechnology 1.
Students investigate and discuss current controversial issues in biotechnology. This course emphasizes thinking about new technologies in a rational and thoughtful way.

BIT 510 Core Technologies in Molecular and Cellular Biology 4.
Prerequisite: Equivalent of CH 223 and (MB 351 or GN 311).
Basic technologies of recombinant DNA procedures, gene expression, isolation and identification of nucleic acids and proteins.

BIT 526 Gene Expression: Microarrays 2.
Prerequisite: BIT 410 or BIT 510.
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.

BIT 546 Protein Purification 2.

BIT 562 Gene Expression: Microarrays 2.
Prerequisite: BIT 410 or BIT 510.
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.

BIT 565 Real-time PCR Techniques 2.
Prerequisite: BIT 410 or BIT 510.
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.

BIT 566 Animal Cell Culture Techniques 2.
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, second part.

BIT 567 Pcr DNA Fingerprin 2.
Introduction to polymerase chain reaction. Optimization of PCR reactions and primer design for DNA sequences using DAN databases available on the web. Laboratory sections include using rapid techniques for isolating and sequencing DNA from small amounts of sample and forensic identification of individuals using isolated human hairs.

BIT 568 Genome Mapping 2.
Prerequisite: BIT 410 or BIT 510 or BCH 454.
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 the lecture and the lab.
BIT 569 RNA Purification and Analysis 2.  
Prerequisite: BIT 410 or BIT 510.  
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 non-radioactive labeling and detection by chemi-luminescence. Half semester course.

BIT 571 RNA Interference and Model Organisms 2.  
Prerequisite: BIT 410 or BIT 510 or BCH 454.  
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 lants, 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.

BIT 572 Proteomics 3.  
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.

BIT 573 Protein-Protein Interactions 2.  
Prerequisite: BIT 410 or BIT 510 or BCH 454.  
The interactions of proteins mediate numerous biological processes of cells. This course focuses on ways to identify and study protein-protein interactions. Students will apply a variety of methods for studying 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.

BIT 574 Plant Genetic Engineering 2.  
Prerequisite: BIT 410 or BIT 510 or BCH 454 or PB 421.  
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.

BIT 581 Plant Transformation 2.  
BIT 595 Special Topics 1-3.  
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

BIT 815 Advanced Special Topics 1-6.  
Prerequisite: BIT 510.  
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.

BIT 896 Summer Dissertation Res 1.
BMA 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

BMA 690 Master's Examination 1-5.
Prerequisite: Master's student.
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.

BMA 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

BMA 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

BMA 771 Biomathematics I 3.
Prerequisite: Advanced calculus, reasonable background in biology.
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 offspring), 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.

BMA 772 Biomathematics II 3.
Prerequisite: BMA 771, elementary probability theory.
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.

BMA 773 Stochastic Modeling 3.
Prerequisite: BMA 772 or ST (MA) 746.

BMA 774 Partial Differential Equation Modeling in Biology 3.
Prerequisite: BMA 771 or MA/OR 731; BMA 772 or MA 401 or MA 501.

BMA 790 Special Topics 1-99.

BMA 801 Seminar 1.
Prerequisite: Graduate standing.
Graduate students in biomathematics are expected to attend through most of their residence period.

BMA 815 Advanced Special Topics 1-3.
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).

BMA 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

BMA 890 Doctoral Preliminary Exam 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

BMA 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.
BME - Biomedical Engineering Courses

BME 201 Computer Methods in Biomedical Engineering 3.
Prerequisite: BME matriculated students.
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.

BME 203 Introduction to the Materials Science of Biomaterials 3.
Prerequisite: C- or better in CH 101, CH 102 and PY 205.
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.

BME 204 Biomedical Measurements 3.
Prerequisite: BME Majors.
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.

BME 210 Biomedical Electronics 4.
Prerequisite: MA 242, PY 208. For BME Majors only.
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.

BME 252 Biomedical Engineering Design and Manufacturing I 1.
Prerequisite: BME Majors.
Students will learn the basic tools of design such as solid modeling by means of web-based tutorials and a series of small CAD project assignments. Students will learn to use current software for design, analysis, and computer-aided manufacturing (CAM). Students will also be introduced to modern manufacturing through the transition from CAD (Computer-Aided Design) to CAM using modern rapid manufacturing equipment to carry out one small, well-defined design and manufacturing project.

BME 301 Human Physiology for Engineers I 3.
Prerequisite: BME 201 and either ZO 160 or BIO 183, BME Majors, Corequisite: BME 311.
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 neural 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.

BME 302 Human Physiology for Engineers II 3.
Prerequisite: BME 301. For BME Majors only.
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.

BME 311 Linear Systems in Biomedical Engineering 3.
Prerequisite: BME 201 and (ECE 331 or BME 210). Corequisite: BME 301 and MA 341. For BME Majors only.

BME 312 Analog and Digital Circuits Laboratory I.
Prerequisite: ECE 331, BME Majors.
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.

BME 342 Analytical and Experimental Methods for Biomedical Engineers 3.
Prerequisite: BME 201; MAE 208 or CE 215; MAE 314 or CE 313; MA 341.
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. Transducersnecessary 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.

BME 352 Biomedical Engineering Design and Manufacturing II 2.
Prerequisite: BME 252; BME majors.
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.

BME 362 Biomaterials Characterization 3.
Prerequisite: (CH 220 or 221 or 225) and (BME 203 or MSE 200 or MSE 201).
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.
BME 412 Biomedical Signal Processing 3.
Prerequisite: BME 311, ST 370.
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 random biomedical signals and systems. Wiener filtering. Sampling theory. Discrete-time signal analysis. Applications of Z-transform and discrete Fourier transform. Digital filter design methods for biomedical instruments. BME or MS or PHD; credit not allowed for both BME 412 and BME 512.

BME 422 Fundamentals of Biomedical Instrumentation 3.
Prerequisite: BME 210 or BME 312.
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.

BME 425 Bioelectricity 3.
Prerequisite: BME 302 or (ZO 421 and a course in electrical circuits).
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.

BME 441 Biomechanics 3.
Prerequisite: ZO 160 or BIO 183; BME 342; ST 370.
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.

BME 451 Biomedical Engineering Senior Design I 3.
Prerequisite: BME 302, BME 352, and either ENG 331 or ENG 333, and completion of two of the suggested BME electives for their area of emphasis; BME majors.
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.

BME 452 Biomedical Engineering Senior Design II 3.
Prerequisite: BME 451, BME Majors.
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.

BME 466 Polymeric Biomaterials Engineering 3.
Prerequisite: PY 208 and (TE 200 or CH 220 or CH 221 or CH 225) and (MAE 206 or CE 214).
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.

BME 467 Mechanics of Tissues & Implants Requirements 3.
Prerequisite: (ZO 160 or BIO 183) and (MAE 314 or CE 313).
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.

BME 480 Biomedical Microcontroller Applications 3.
Prerequisite: BME 422. BME Majors only.
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. Student 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.

BME 481 Human Factors Engineering and Quality Management Systems for Engineers 3.
Co-requisite: BME 451.
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 experiment, human factors, 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.

BME 483 Tissue Engineering Technologies 2.
Prerequisite: BIT 466/566 or permission of instructor.
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.

BME 484 Tissue Engineering Fundamentals 3.
Prerequisite: (ZO 160 or BIO 183), CH 221, and (MAE 301 or MSE 301 or CHE 315 or TE 303).
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.
BME 495 Special Topics in Biomedical Engineering 1-4.
Offered as needed for presenting material not normally available in
regular BME Department courses or for new BME courses on a trial
basis.

BME 498 Undergraduate Research in Biomedical Engineering 3.
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 independent research culminating in
a final paper and presentation at the NC State Undergraduate Research
Symposium or other appropriate venue. Students must identify an advisor
from within the BME faculty with whom to work on a regular basis. The
advisor must approve the student prior to the student registering for the
course. The BME Undergraduate Coordinator must approve the use of
the course as a restricted elective for the BME degree. Departmental
Approval Required.

BME 512 Biomedical Signal Processing 3.
Prerequisite: BME 311, and ST 370 or ST 371.
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 randombiomedical signals and
Applications of Z-transform and discrete Fourier transform. Digital filter
design methods for biomedical instruments. BME or graduate standing
only; credit is not allowed for both BME 412 and BME 512.

BME 522 Medical Instrumentation 3.
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.

BME 525 Bioelectricity 3.
Prerequisite: BME 302 or ZO 421 and a course in electrical circuits,
Senior standing or Graduate standing.
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. Credit not given
for both BME 485 and BME 585.

BME 536 Digital Control Systems 3.
Prerequisite: ECE 435 and Graduate Standing in Engineering.
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.

BME 540 Nanobiotechnology Processing, Characterization, and
Applications 3.
Prerequisite: BIO 183 and PY 212.
Topics at the interface of nanoscale science and biotechnology
will be discussed. Chemical, physical, and biological properties of
nanostructured biomaterials, devices, and systems. Lectures and
problem-based learning will be used to present development of
nanobiotechnology-enhanced materials and devices.

BME 541 Biomechanics 3.
Prerequisite: ZO 160 or BIO 183, BME 342, ST 370.
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. Credit is not allowed for
both BME 441 and BME 541.

BME 543 Cardiovascular Biomechanics 3.
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 550 Medical Imaging: Ultrasonic, Optical, and Magnetic
Resonance Systems 3.
Prerequisite: BME 412, ST 370 or ST 371, and PY 208.
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.

BME 551 Medical Device Design 3.
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 assessment market analysis
and intellectual property review; new medical devices with broad markets;
design output and device specification; product feasibility and risk
assessment; design for medical device manufacturing.

BME 552 Medical Device Design II 3.
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 intellectual property protection.
Students will work with local patent attorneys and/or agents to draft a
patent application. The final prototypes will be evaluated by clinicians for
potential use with patients.

BME 560 Medical Imaging: X-ray, CT, and Nuclear Medicine Systems
3.
Prerequisite: BME 311, ST 370 or ST 371, and PY 208.
Overview of medical imaging systems using ionizing radiation. Interaction
of radiation with matter. Radiation production and detection. Radiography
systems and applications. Tomography. PET and SPECT systems and
applications.

BME 566 Polymeric Biomaterials Engineering 3.
Prerequisite: PY 208 and (TE 200 or CH 220 or CH 221 or CH 225) and
(MAE 206 or CE 214).
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. Credit for TE 466 and TE 566 is not allowed.
BME 583 Tissue Engineering Technologies 2.
Prerequisite: BIT 468/568 or permission of instructor.
In this half-semester laboratory module, students will gain practical experience with two key elements of tissue engineering: the construction of a complex living tissue that closely resembles its natural counterpart, and the assessment of the angiogenic potential of the engineered tissue. The effects of different biomaterials and angiogenic factors will be evaluated.

BME 584 Tissue Engineering Fundamentals 3.
Prerequisite: BIO 183 and (CH 221 or CH 225) and (MAE 301 or MSE 301 or CHE 315 or TE 303).
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. 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 and tissue systems; clinical translation; and ethics.

BME 590 Special Topics in Biomedical Engineering 1-4.
Prerequisite: Senior or Graduate standing in Engineering or physical or biological sciences or textiles.
A study of topics in the special fields under the direction of the graduate faculty.

BME 620 Special Problems in Biomedical Engineering 1-4.
Prerequisite: Graduate standing in BME.
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.

BME 650 Internship in Biomedical Engineering 1.
Prerequisite: Graduate standing in BME.
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.

BME 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

BME 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

BME 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

BME 790 Advanced Special Topics in Biomedical Engineering 1-3.
Prerequisite: Graduate standing in engineering, physical, or biological sciences or textiles.
A study of topics in advanced or emerging special areas under the direction of the graduate faculty. Experimental doctoral level courses.

BME 802 Advanced Seminar in Biomedical Engineering 1.
Prerequisite: Doctoral student in BME or other engineering, physical science, or biological science majors, or textiles.
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.

BME 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

BME 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

BME 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

BUS - Business Management Courses

BUS 225 Personal Finance 3.
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, deferred savings, insurance, retirement planning, estate planning, and real estate finance.

BUS 295 Special Topics in Business Management 1-6.
Experimental course development. Special topics in Business Management at the introductory level.
**BUS 305 Legal and Regulatory Environment** 3.
Introduction to contract, tort and agency law, the judicial system, common law, statutory law, and constitutional law. Review and discussion of the major legal and regulatory issues affecting business including ethics, fiduciary duty, white collar crime, dispute resolution, intellectual property, international, and product safety laws. Credit is not allowed for both BUS 305 and MIE 305.

**BUS 320 Financial Management** 3.
Prerequisite: ACC 210 and EC 201 or ARE 201 or EC 205.
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.

**BUS 340 Information Systems Management** 3.
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.

**BUS 350 Economics and Business Statistics** 3.
Prerequisite: MA 114.
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.

**BUS 360 Marketing Methods** 3.
Prerequisite: MIE 201, Sophomore standing.
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.

**BUS 370 Operations Management** 3.
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.

**BUS 420 Financial Management of Corporations** 3.
Prerequisite: BUS 320 and (BUS/ST 350, or ST 302, or ST 361, or ST 370, or ST 372).

**BUS 422 Investments and Portfolio Management** 3.
Prerequisite: BUS 320 and (BUS/ST 350, or ST 302, or ST 311, or ST 361, or ST 370, or ST 372).
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.

**BUS 425 Advanced Personal Financial Management** 3.
Prerequisite: BUS 320.
Detailed economic, financial and legal analysis of risk management, retirement planning, nontraditional investments, estate planning. Strong emphasis on professional financial planning for those interested in personal finance as a career. Directly applicable for needs of small business.

**BUS 426 International Financial Management** 3.
Prerequisite: BUS 320 and (BUS/ST 350, or ST 302, or ST 361, or ST 370, or ST 372).
Foreign exchange markets and their implications for direct and portfolio investment abroad. International capital markets. Multinational company exchange rate exposure measurement and management. Techniques and instruments of financing international trade and investment. Multinational capital budgeting and capital cost measurement. Techniques of international cash management. Credit for both BUS 426 and EC 449 not allowed.

**BUS 440 Database Management** 3.
Prerequisite: ACC 340 or BUS 340.
The fundamentals of database management within business applications. Data structures, user requirements, structured query language, query by example, application development, user interface design.

**BUS 441 Business Data Communications and Networking** 3.
Prerequisite: ACC 340 or BUS 340.
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.

**BUS 442 Information Systems Development** 3.
Prerequisite: ACC 340 or BUS 340.
Concepts and skills necessary for developing information systems to aid in managerial decisions. Hands-on experience with development theory and concepts; object-oriented design concepts, graphical user interface design concepts, algorithm design concepts, and data structures.

**BUS 443 Business Analytics** 3.
Prerequisite: ACC 340 or BUS 340.
This is an introductory course in Business Analytics. It focuses on the theoretical and practical aspects of how businesses model existing data to predict the probability of future events and the values of key performance indicators. It uses the methods and tools of science to drive business decision making. Students will learn prescriptive, predictive, and descriptive techniques and tools. Topics will include statistical and mathematical modeling, data visualization, optimization, risk simulation, data mining, and decision analysis.

**BUS 444 Systems Analysis and Design** 3.
Prerequisite: ACC 340 or BUS 340.
Overview of methodical approaches to developing information systems throughout the systems analysis, design and implementation processes. Topics include SDLC, project management, feasibility studies, requirements analysis, etc.
BUS 449 Information Technology Capstone 3.
Prerequisite: BUS 440 or 441 or 442 or 443 or 444.
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 industry-based management team. Field trips and/or outside class activities (including client/consultant work) are a major part of this course. Students who are unable to participate in these types of events should not enroll in this course.

BUS 460 Consumer Behavior 3.
Prerequisite: BUS 360.
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.

BUS 461 Services Marketing 3.
Prerequisite: BUS 360.
This course focuses on the unique challenges of managing services and delivering quality service to customers. The attraction, retention, and building of strong customer relationships through service quality and customer satisfaction is at the heart of the course content.

BUS 462 Marketing Research 3.
Prerequisite: BUS 360 and (BUS/ST 350, or ST 302, or ST 361, or ST 370, or ST 372).
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.

BUS 464 International Marketing 3.
Prerequisite: BUS 360.
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.

BUS 465 Integrated Marketing Communications Management 3.
Prerequisite: BUS 360.
Development of marketing communication theory and exploration of integrated marketing communication (IMC) practice. Topics include: IMC planning, management and budgeting; IMC strategy development and execution; media strategy and research; advertising research; ethical and legal issues; creativity; IMC ideation, campaign development; and campaign presentation. This is partially web-based course.

BUS 466 Personal Selling 3.
Prerequisite: BUS 360.
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.

BUS 467 Product and Brand Management 3.
Prerequisite: BUS 360.
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 successfully manage existing products and brands.

BUS 468 Marketing Strategy 3.
Prerequisite: BUS 360.
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 370 and (BUS/ST350 or ST 302 or ST 361 or ST 370 or ST 372).
Major tools, techniques, and strategies used for designing and improving business processes, including process mapping, process analysis, continuous process improvement tools and techniques, strategies for process design, and process reengineering. Major group project in process analysis and improvement.

Prerequisite: BUS 370.
Design and management of operations planning and control systems for manufacturing and service firms. Forecasting, capacity management, production and work force scheduling, project management, just-in-time and time-based competition, the impact of information technologies on planning and control systems.

BUS 473 Supply Chain Strategy 3.
Prerequisite: BUS 370.

BUS 474 Logistics Management 3.
Prerequisite: BUS 370.
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.

BUS 475 Purchasing and Supply Management 3.
Prerequisite: BUS 370.
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.

BUS 478 Business Process Management 3.
Prerequisite: BUS 370 and (BUS/ST350 or ST 302 or ST 361 or ST 370 or ST 372).
Major tools, techniques, and strategies used for designing and improving business processes, including process mapping, process analysis, continuous process improvement tools and techniques, strategies for process design, and process reengineering. Major group project in process analysis and improvement.
BUS 479 Supply Chain Management Undergraduate Practicum 3.
Prerequisite: BUS 370 and one 400-level Operations/Supply Chain Management course.
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. Student groups need to provide their own transportation to off-campus sites.

BUS 495 Special Topics in Business Management 1-6.
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.
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 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.

BUS 585 Market Research In Textiles 3.
Prerequisite: TAM (EC) 482.
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.

BUS 590 Special Topics In Business Management 1-6.
Presentation of material not normally available in regular courses or offering of new courses on a trial basis.

BUS 610 SP Topics Bus Mgmt 1-99.

BUS 630 Independent Study In Business Management 1-6.
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.

BUS 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master’s student.
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.

BUS 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master’s student.
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.

CBS - Comparative Biological Science Courses

CBS 565 Fundamentals of Biomedical Sciences 3.
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.

CBS 570 Methods in Biomedical Sciences 1.
Introductory course for students interested in gaining a broad understanding of various laboratory methods used in molecular, cellular and "omics" based biomedical research.

CBS 580 Clinical Veterinary Epidemiology 3.
Prerequisite: ST 511.
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.

CBS 595 Special Topics 1-3.

CBS 602 Seminar In Biology Of Reproduction 2.
Prerequisite: ANS(PHY) 702.
Current topics in animal reproduction presented by reproductive physiologists from various Research Triangle institutions. Student presentations of research projects or library projects in area of animal reproduction.

CBS 610 Special Topics In Veterinary Medical Sciences 1-3.
Prerequisite: Senior standing or Graduate standing.
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.

CBS 625 Professional Conduct In Biomedical Research 1.
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.

CBS 665 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

CBS 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.
CBS 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

CBS 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

CBS 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

CBS 711 Applications in Reproductive Physiology 2.
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.

CBS 712 Reproductive Management and Disease in Domestic Animals 1.
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.

CBS 730 Veterinary Histology 3.
Prerequisite: BCH 451.
The structure of cells, tissues and organs of domestic animals using light microscopy.

CBS 731 Applied Veterinary Anatomy I 4.
Prerequisite: DVM.
Graduate veterinarian provided with detailed anatomic information relevant to surgical and medical problems in domestic carnivores. Designed for graduate veterinarians in pursuit of advanced training in areas of anatomy, physiology, surgery, radiology and pathology.

Prerequisite: Graduate standing.
Principles and applications of various tools for the optical visualization of cells and tissues, with information about how to best ascertain structure-function relationships. Introduction to sample preparation for light and electron microscopy, cryotomy, and the theory and utilization of transmission- and scanning electron microscopes, light microscopes and confocal laser scanning microscopes. In addition, cytochemistry, immunocytochemistry, digital imaging techniques, telemognition, and silver-based photography techniques will be covered.

CBS 743 Toxicologic Pathology I 3.
Prerequisite: DVM Majors.
A review of principles and practices of toxicologic pathology and a survey of common spontaneous and chemically induced lesions by organ systems with emphasis on recognition and interpretation.

CBS 754 Principles Of Analytical Epidemiology 3.
Prerequisite: Graduate standing.
Principles of epidemiology related to investigation of disease involving agent-host-environment concepts. Stress on epidemiological techniques and experimental design. Main focus on descriptive, analytical and experimental epidemiology pertinent to disease etiology and prevention.

CBS 755 Immunoparasitology 2.
Prerequisite: MB 751.
Helminth and protozoal parasite immune evasion and immunomodulation; consequences of parasite-induced immunopathogenesis; learning from failed attempts to develop protective vaccines against protozoa and helminths.

CBS 760 Molecular Technologies for Epidemiologic Investigation 3.
Prerequisite: Introductory Epidemiology.
The course is designed to help students refine their ability to select and interpret molecular diagnostic technologies for epidemiologic disease surveillance and investigation.

CBS 762 Principles of Pharmacology 3.
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.

CBS 764 Advances in Gastrointestinal Pathophysiology 3.
Prerequisite: PHY 503, PHY 504.
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.

CBS 770 Cell Biology 3.
Prerequisite: BCH 451 and BIO 183 and (CH 223 or CH 227).
Advanced cell and organelle structure and function and recent advances in molecular biology. Emphasis on current literature and application of research procedures.
CBS 771 Cancer Biology 4.  
Prerequisite: CBS 770.  
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.

CBS 773 Advanced Developmental Biology 2.  

CBS 774 Epidemiology Of Infectious Diseases Of International Importance 3.  
Discussion of infectious diseases and epidemiological principles. Stress on selected enteric, zoonotic, nosocomial diseases of worldwide importance. Consideration of population dynamics techniques related to host-vector-agent.

CBS 780 Veterinary Production Epidemiology 2.  
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.

CBS 782 Marine Mammal Medicine 2.  
Prerequisite: Graduate standing or enrollment in DVM curriculum. Discussion of disease issues in free ranging and captive cetaceans, pinnipeds and marine mustelids with emphasis on species found in North American waters. Examination of anatomic, physiologic and behavioral basis of health and population management and assessment of diagnostic and therapeutic approaches to disease in these species.

CBS 783 Advanced Immunology 3.  
Prerequisite: MB (IMM) 741.  
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.

CBS 784 Advanced and Molecular Pharmacology 2.  
Prerequisite: CBS 762.  
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.

CBS 787 Pharmacokinetics 3.  
Prerequisite: CBS 560, working knowledge of calculus.  
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 toxicologic studies.

CBS 790 Special Topics in Clinical Pathology 1-3.  
Prerequisite: Those holding the DVM degree.  
New, fundamental and in-depth understanding of selected topics in clinical pathology (blood coagulation, acid-base balance, hematology, cytology, and clinical chemistry). A new topic selected each semester. Students read pertinent current journal articles and references and lead weekly discussion sessions. Stress upon clinical application of this information.

CBS 795 Special Topics in Comparative Biomedical Sciences 1-3.  
Prerequisite: Graduate Students, DVM or equivalent degree.  
Special Topics in Comparative Biomedical Sciences.

CBS 800 CBS Seminar 1.  
Presentation and discussions on ongoing research and current topics in biomedical sciences.

CBS 802 Seminar In Biology Of Reproduction 2.  
Prerequisite: ANS(PHY) 702.  
Current topics in animal reproduction presented by reproductive physiologists from various Research Triangle institutions. Student presentations of research projects or library projects in area of animal reproduction.

CBS 803 Seminar in Surgical Pathology 1.  
Prerequisite: Those holding the DVM or equivalent degree.  
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.

CBS 804 Seminar in Necropsy Pathology 1.  
Prerequisite: Those holding the DVM or equivalent degree.  
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.

CBS 807 Seminar in Veterinary Microbiology/Immunology 1.  
Presentation of ongoing research and current topics in microbiology.

CBS 810 Special Topics 1-3.  
Prerequisite: Senior standing or Graduate standing.  
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.

CBS 812 Special Topics Pathology 1-4.  
Prerequisite: Those holding the DVM degree.  
Specific topics of study assigned in various laboratories involved in veterinary microbiology investigation. Students conduct in dept studies of assigned problem areas.

CBS 813 Special Topics Laboratory Pharmology 1-3.  
Prerequisite: Graduate standing.  
Involvement in practical participation in the normal research activities of different laboratories working in pharmacological research. Students pursue a semi-independent project.

CBS 815 Advanced Topics in Virology 1.  
Prerequisite: VMM 924 or MB 718.  
Selected topics of current interest in virology. A new topic selected each time course is offered to keep the advanced graduate students up to date on the most recent developments in these fields.
CBS 816 Advanced Topics In Immunology 1.
Prerequisite: MB 751.
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.

CBS 817 Advanced Topics In Zoological Medicine I 2.
Prerequisite: Graduate standing or enrollment in DVM curriculum.
Selected topics of current interest in clinical zoological medicine focused on marine mammals, fish, reptiles, amphibians, waterfowl, ratites, 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.

CBS 818 Advanced Topics In Zoological Medicine 2.
Prerequisite: Graduate standing or enrollment in DVM curriculum.
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.

CBS 820 Special Problems 1-3.

CBS 860 Techniques in Pharmacological Research 2.
Prerequisite: BCH 452B or CH 315 and Graduate standing.
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.

CBS 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

CBS 886 One Health: From Philosophy to Practice 2.
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.

CBS 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

CBS 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

CE - Civil Engineering Courses

Prerequisite: GPA greater than or equal to 2.5; Grade of C or better in PY 205; Grade of C or better in MA 241; Co-requisite: MA 242.
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.

Prerequisite: Minimum GPA => 2.5; Grade of C- or better in CE 214, and MA 242.
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.

CE 263 Introduction to Construction Engineering 3.
Co-requisite: CE 214.
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.

CE 297 Current Topics in Civil Engineering 1-4.
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.

CE 301 Civil Engineering Surveying and Geomatics 3.
Prerequisite: CEM, CE, or ENE Majors only.
Plane surveying, topographic 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 CEM, CE, ENE majors. Credit will not be given for both BAE 325 and CE 301.

CE 305 Traffic Engineering 3.
Prerequisite: CE or CEM Majors and Corequisite: ST 370.
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.
CE 313 Mechanics of Solids 3.
Prerequisite: Minimum GPA >= 2.5; Grade of C- or better in CE 214, and MA 242.
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 determinate and indeterminate axial force, torsion and bending members. Stress transformations, pressure vessels, combined loadings. Introduction to column buckling.

CE 324 Structural Behavior Measurement 1.
Prerequisite: Grade of C- or better in CE 313.

CE 325 Structural Analysis I 3.
Prerequisite: CSC 112; Grade of C- or better in CE 313.
Analysis of determinate and indeterminate bars, trusses, beams and frames using the matrix displacement method. Qualitative deflected shapes and shear and bending moment diagrams. Computer implementation of analysis procedures using MATLAB and commercial structural analysis software.

CE 327 Reinforced Concrete Design 3.
Prerequisite: Grade of C- or better in CE 313; CE 332.
Behavior, strength, and design of reinforced concrete members subjected to moment, shear, and axial forces. Introduction to the design of reinforced concrete structures.

CE 332 Materials of Construction 3.
Prerequisite: MSE 200 and Junior standing in CE or CEM.
Manufacture and properties of mineral and bituminous cements and mineral aggregates. Mechanical properties and durability of portland cement concrete, bituminous mixtures, masonry units, timber products, and miscellaneous construction materials. Materials testing.

CE 339 Civil Engineering Systems 3.
Prerequisite: CSC 112 and (MA 341 or MA 305).
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.

Prerequisite: C- or better in CE 313, Corequisite: CE 382.
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.

CE 365 Construction Equipment and Methods 3.
Prerequisite: CE 263 Co-requisite: ST 370.
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.

CE 367 Mechanical and Electrical Systems in Buildings 3.
Prerequisite: CE 382.
Introduction to mechanical and electrical systems in building construction. Includes HVAC, lighting and electrical systems, focusing on design concepts, equipment application and design of the construction process for modern building systems.

CE 373 Fundamentals of Environmental Engineering 3.
Prerequisite: CHE 205 or CE 382.
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.

CE 376 Environmental Chemistry and Microbiology 4.
Prerequisite: Junior standing in Environmental Engineering, MEA 323, and C- or better in CE 373 and Corequisite: ST 370.
Principles of Environmental Chemistry and Microbiology, experimental techniques for assessing water and air quality; sampling; statistical interpretation of data.

CE 381 Hydraulics Systems Measurements Lab 1.
Corequisite: CE 382.
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.

CE 382 Hydraulics 3.
Prerequisite: CE 214; Corequisite: MA 341 or MAE 305 or ST 370.
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 382 and MAE 308.

Prerequisite: Grade of C- or better in CE 382; For CE, ENE, and CEM Majors.
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.

CE 390 Engineering Economics 1.
Prerequisite: CSC 112 and (MA 341 or MA 305).
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.

CE 400 Transportation Engineering Project 3.
Prerequisite: CE 390, C- or better in CE 305, and one of the following courses: CE 401, 402, 403, or 413.
Integrated team approach to design of major transportation engineering projects. Professional topics in transportation engineering practice.

CE 401 Transportation Systems Engineering 3.
Prerequisite: C- or better in CE 305.
Multi-modal transportation systems; railroads, airports, highways, and other modes. Planning, analysis, and design. Fundamental concepts; supply, demand, flows, impacts, and network optimization.

CE 402 Traffic Operations 3.
Prerequisite: C- or better in CE 305.
Highway capacity; traffic control systems; intelligent vehicle/highway systems; and other advanced topics. Credit for both CE 402 and CE 502 is not allowed.
CE 403 Highway Design 3.
Prerequisite: C- or better in CE 305.
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.

CE 413 Principles of Pavement Design 3.
Prerequisite: CE 332, and Corequisite: CE 342.
Basic principles of analysis, design and performance of highway and airport pavements with critical evaluation of current design and maintenance strategies.

CE 420 Structural Engineering Project 3.
Prerequisite: CE 327, and CE 426, Corequisite: CE 425 and CE 390.
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.
Prerequisite: CE 327, and CE 426, Corequisite: CE 425 and CE 390. 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.

CE 425 Structural Analysis II 3.
Prerequisite: C- or better in CE 325.
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.

CE 426 Structural Steel Design 3.
Prerequisite: C- or better in CE 313.
Design and behavior of structural steel members and their connections subjected to moment, shear, and axial forces. Introduction to the design of steel structures.

CE 435 Engineering Geology 3.
Prerequisite: MEA 101 and Junior standing in colleges of Agriculture and Life Sciences, Engineering, Natural Resources, College of Sciences or Textiles.
Application of both geology and geotechnical engineering to engineering projects. Illustrations of relevant materials properties and techniques utilized in describing subsurface conditions.

CE 437 Civil Engineering Computing 3.
Prerequisite: CSC 112 and (MA 341 or MA 305).
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.

CE 440 Geotechnical Engineering Project 3.
Prerequisite: C- or better in CE 342; Corequisite: CE 390.
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.

CE 443 Seepage, Earth Embankments and Retaining Structures 3.
Prerequisite: C- or better in CE 342; Corequisite: CE 390.
Review of shear strength concepts; ground water hydraulics; slope stability; lateral earth pressure problems; placement of fills.

Prerequisites: CE 263 and CE 365.
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.

CE 464 Legal Aspects of Contracting 3.
Prerequisite: CE 463; Corequisite: CE 365.
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.

CE 466 Building Construction Engineering 3.
Corequisite: CE 327.
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.

CE 468 Construction Engineering Laboratory 1.
Prerequisite: CE 332, Corequisite: CE 327 or CE 426.
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.

CE 469 Construction Engineering Project 3.
Prerequisite: CE 463 Co-requisite: CE 464.
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.

CE 476 Air Pollution Control 3.
Prerequisite: CE 373, CE 390, MAE 301 and Corequisite: ST 370 or CHE 450 (CHE majors).
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 feedback 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 477 Principles of Solid Waste Engineering 3.
Prerequisite: CE 373, CE 390, CE 382, Corequisite: CE 342.
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 478 Energy and Climate 3.
Prerequisite: CE 390.
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.

CE 479 Air Quality 3.
Prerequisite: CE 373,CE 382; or CHE 311(CHE Majors); or MEA 421 (MEA Majors), Corequisite: ST 370; ST 380 (MEA Majors).
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 480 Water Resources Engineering Project 3.
Corequisite: CE 390; Prerequisite: Grade of C- or better in CE 382 and CE 383.
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.

CE 481 Environmental Engineering Project 3.
Prerequisite: CE 378, 383, 390, Corequisite: CE 484 and two of: CE 476, 477, 479, 488.
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 373, CE 382.
Elements of the design of water supply and wastewater disposal systems.

CE 487 Introduction to Coastal and Ocean Engineering 3.
Prerequisite: Senior standing and CE 382.
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.

CE 488 Water Resources Engineering 3.
Prerequisite: CE 339 or equivalent, Corequisite: CE 383.
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.

CE 493 Independent Study in Civil Engineering 1-4.
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" be completed by the student and faculty member prior to registration by the department.

CE 497 Current Topics in Civil Engineering 1-4.
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.

CE 498 Special Problems in Civil Engineering 1-4.
Prerequisite: Senior standing.
Directed reading in the literature of civil engineering, introduction to research methodology, seminar discussion dealing with special civil engineering topics of current interest.

CE 501 Transportation Systems Engineering 3.
Prerequisite: CE 305. Credit for both CE 401 and CE 501 is not allowed.
Planning and analysis of multi-modal transportation systems including railroads, airports, highways and other modes. Supply, demand, flows, impacts and network optimization. Completion of term papers and projects for students taking course for graduate credit.

CE 502 Traffic Operations 3.
Prerequisite: C- or better in CE 305.
Highway capacity; traffic control systems; intelligent vehicle/highway systems; and other advanced topics. Credit for both CE 402 and CE 5042 is not allowed.

CE 503 Highway Design 3.
Prerequisite: C- or better in CE 305.
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.

CE 504 Airport Planning and Design 3.
Prerequisite: C- or better in CE 305.
Analysis, planning and design of air transportation facilities.

CE 506 Transportation Engineering Data Collection and Analysis 3.
Prerequisite: CE 305, ST 370.
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.

CE 509 Highway Safety 3.
Prerequisite: CE 305, Corequisite: ST 370 or equivalent.
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.

CE 515 Advanced Strength of Materials 3.
Prerequisite: CE 313 or MAE 314.
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 mechanics.
CE 522 Theory and Design Of Prestressed Concrete 3.
Prerequisite: CE 327.
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.

CE 523 Theory and Behavior Of Steel Structures 3.
Prerequisite: CE 426.
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.

CE 524 Analysis and Design Of Masonry Structures 3.
Prerequisite: CE 327.
Theory and design of masonry arches, culverts, dams, foundations and masonry walls subjected to lateral loads.

CE 525 Structural Analysis II 3.
Prerequisite: C- or better in CE 325.
Analysis of beam, 2D and 3D truss, 2D and 3D frame and plane strain structures using matrix displacement methods. Introduction to the finite element method of analysis by deriving the element stiffness matrices using virtual work. Beam and frame elements with 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. Advanced topics such as curved beam elements, contact elements and nonlinearities. Credit for both CE 425 and CE 525 is not allowed.

CE 526 Finite Element Method in Structural Engineering 3.
Prerequisite: CE 515.
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 modeling considerations are reviewed and applied to the analysis of a realistic structure.

CE 527 Structural Dynamics 3.
Prerequisite: CE 425 or CE 525.
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.

CE 528 Structural Design in Wood 3.
Prerequisite: C- or better in CE 325.
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.

CE 529 FRP Strengthening and Repair of Concrete Structures 3.
Prerequisite: CE 327 and CE 325.
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. Applications to practical strengthening design of realistic reinforced concrete structures.

CE 536 Introduction to Numerical Methods for Civil Engineers 3.
Prerequisite: MA 302, MA 341, or MA 401.
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.

CE 537 Computer Methods and Applications 3.
Prerequisite: CSC 112 and (MA 341 or MA 305).
Computational approaches to support civil planning, analysis, evaluation and design. Applications to various areas of civil engineering, including construction, structures, transportation and water resources.

CE 538 Information Technology and Modeling 3.
Prerequisite: CE 390.
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.

CE 548 Engineering Properties Of Soils I 3.
Prerequisite: CE 342.
Significant soil properties in earthwork engineering, including soil elasticity and soil mineralogy, hydraulic conductivity, stress-strain relations and shear strength, compressibility and compaction. Laboratory work including plasticity, triaxial compression, permeability, consolidation and compaction tests.

CE 549 Soil and Site Improvement 3.
Prerequisite: CE 342.
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.

CE 561 Construction Project Management 3.
Prerequisite: CE 463.
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.

CE 562 Lean Construction Concepts and Methods 3.
Prerequisite: CE 463.
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.

CE 564 Legal Aspects Of Contracting 3.
Prerequisite: Graduate standing. Credit for both CE 464 and CE 564 is not allowed.
Legal aspects of contract documents, drawings and specifications; owner-engineer-constructor relationship and responsibilities; bids and contract performance; labor laws; governmental administrative and regulatory agencies; torts; business organizations; ethics and professionalism; analysis of current topics and issues. Investigation of recent statute and case implications.
CE 565 Construction Safety Management 3.  
Prerequisite: CE 465 or CE 466. 
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: ACC 220, CE 463. 
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.

CE 568 Construction Engineering Laboratory 1.  
Prerequisite: CE 332, Corequisite: CE 327 or CE 426. 
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.

CE 571 Physical Principles of Environmental Engineering 3.  
Prerequisite: CE 382, Graduate standing. 
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.

CE 573 Biological Principles of Environmental Engineering 3.  
Prerequisite: Graduate standing in CE, BAE, CHE, or SSC. 
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.

CE 574 Chemical Principles of Environmental Engineering 3.  
Prerequisite: Graduate standing in CE, BAE, CHE, E 377, MAE, SSC. 
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.

CE 576 Engineering Principles Of Air Pollution Control 3.  
Prerequisite: CE 375, CE 470, CHE 315 or MAE 301, Corequisite: ST 511 or 515. 
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.

CE 577 Engineering Principles Of Solid Waste Management 3.  
Prerequisite: CE 373. 
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.

CE 578 Energy and Climate 3.  
Prerequisite: CE 390 or permission of instructor. 
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. But is open to non-engineering students.

CE 579 Principles of Air Quality Engineering 3.  
Prerequisite: CE 373, CE 382 or CHE 311(CHE Majors), or MEA 421(MEA Majors), Corequisite: ST 370, ST 380(MEA Majors). 
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 581 Fluid Mechanics in Natural Environments 3.  
Prerequisite: CE 382 or MEA 463 or permission of instructor. 
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.

CE 583 Engineering Aspects Of Coastal Processes 3.  
Prerequisite: CE 382. 
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.

CE 584 Hydraulics Of Ground Water 3.  
Prerequisite: CE 382. 
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.

CE 586 Engineering Hydrology 3.  
Prerequisite: CE 383. 
Hydrologic principles underlying procedures for surface water modeling; applications of common hydrologic models to actual watersheds.

CE 588 Water Resources Engineering 3.  
Prerequisite: CE 382. 
Extension of 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, deterministic and indeterminate pipe networks, and analysis of open channels with appurtenances.
CE 590 Special Topics In Civil Engineering 1-3.
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.

CE 591 Special Topics in Civil Engineering Computing 1-3.
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.

CE 592 Special Topics in Construction Engineering 1-3.
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.

CE 593 Special Topics in Geotechnical Engineering 1-3.
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.

CE 594 Special Topics in Structures and Mechanics 1-3.
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.

CE 595 Special Topics in Transportation Engineering 1-3.
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.

CE 596 Special Topics in Water Resource and Environmental Engineering 1-3.
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.

CE 603 Construction Engineering Seminar 1.
Discussions and reports of subjects in civil engineering and allied fields.

CE 605 Structures and Mechanics Seminar 1.
Discussions and reports of subjects in civil engineering and allied fields.

Discussions and reports of subjects in civil engineering and allied fields.

CE 610 Special Topics CE 1-3.

CE 635 Advanced Reading In Civil Engineering 1-3.
Prerequisite: Graduate standing.
Directed reading of advanced topics in some phase of civil engineering.

CE 675 Civil Engineering Projects 1-6.
Research- or design-oriented independent study and investigation of a specific civil engineering topic, culminating in final written report.

CE 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

CE 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

CE 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

CE 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

CE 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

CE 701 Urban Transportation Planning 3.
Prerequisite: CE 501.
Planning and design of urban transportation systems as related to comprehensive urban planning; principles of land use planning, urban thoroughfare planning and regional planning.

CE 702 Traffic Flow Theory 3.
Prerequisite: CE 502, Corequisite: ST 370.
Stream flow, shock wave, queueing, and other macroscopic theories; car following, gap acceptance, and other microscopic theories; distributions of traffic stream parameters; building traffic simulation models.

CE 705 Intelligent Transportation Systems 3.
Prerequisite: CE 501 and CE 502.
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.

CE 706 Advanced Traffic Control 3.
Prerequisite: CE 502.
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.

CE 707 Transportation Policy and Funding 3.
Prerequisite: CE 501 or graduating in Economics or Public Administration.
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.
CE 714 Stress Waves 3.
Prerequisite: MA 341; CE 313 or PY 411 or MA 401.
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: CE 515 (old CE 715).
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.

CE 721 Matrix and Finite Element Structural Analysis 3.
Prerequisite: CE 526.

CE 723 Advanced Structural Dynamics 3.
Prerequisite: CE 527.
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.

CE 724 Probabilistic Methods Of Structural Engineering 3.
Prerequisite: MA 421.

CE 725 Earthquake Structural Engineering 3.
Prerequisite: CE 527.
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.

CE 726 Advanced Theory Of Concrete Structures 3.
Prerequisite: CE 522.

Prerequisite: CE 537 or 538.
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.

CE 741 Geomechanics of Stress Deformation 3.
Prerequisite: CE 440, or CE 443 or CE 548.
Concepts of volume change and effective stress, stress-strain behavior of clays and sands, stress path and failure conditions; mechanistic 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.

CE 742 Deformation and Instability of Soils 3.
Prerequisite: CE 440, or CE 443 or CE 548.

CE 744 Foundation Engineering 3.
Prerequisite: CE 342.
Subsoil investigations; excavations; design of sheeting and bracing systems; control of water; footing, grillage and pile foundations; caisson and cofferdam methods of construction.

CE 746 Soil Dynamics and Earthquake Engineering 3.
Prerequisite: CE 440, or CE 443 or CE 548.
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.

CE 747 Geosynthetics in Geotechnical Engineering 3.
Prerequisite: CE 548.
Introduction to use, manufacturing techniques, design and construction of geosynthetics in geotechnical engineering applications; design and analysis of geotextiles, geogrids and geomembranes in pavements, base and subbase reinforcement, reinforced walls, slopes, moisture barriers, dams and hazardous impoundment, landfill liners and covers.

CE 751 Theory Of Concrete Mixtures 3.
Prerequisite: CE 332.
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 and hardened concretes; strength-age-curing relationships; durability; admixtures; special concretes; production and quality control.

CE 754 Highway Pavement Design 3.
Prerequisite: CE 342.
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 design of pavements using different methodologies.

CE 757 Pavement Management Systems 3.
Prerequisite: CE 755.
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 prediction models; and principles of prioritization/optimization.
CE 759 Inelastic Behavior Of Construction Materials 3.
Prerequisite: CE 515.
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.

CE 761 Design Of Temporary Structures in Construction 3.
Prerequisite: CE 522 or CE 744 or CE 766.
Computer-based analysis of temporary structures in construction and their design, safety and control. Emphasis on concrete formwork, falsework, earth support, cofferdams, underpinning, lifting and rigging.

CE 762 Construction Productivity 3.
Prerequisite: CE 463.
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.

CE 763 Materials Management In Construction 3.
Prerequisite: CE 463, CE 465.
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; materials handling; study of current issues; development of practical solution to a real-world problem.

CE 765 Construction Equipment Systems 3.
Prerequisite: CE 761 OR 762.
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.

CE 766 Building Construction Systems 3.
Prerequisite: CE 466 or CE 327 or Graduate standing in ARC.

CE 771 Physical-Chemical Water Treatment Processes 3.
Prerequisite: CE 574, Corequisite: CE 571.
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.

CE 772 Environmental Exposure and Risk Analysis 3.
Prerequisite: ST 511 or 515.
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.

CE 774 Environmental Bioprocess Technology 3.
Prerequisite: CE 573, CE 574.
Principles of microbiological, biochemical, and biophysical processes used in environmental waste treatment and remediation processes, with particular emphasis on water quality control processes.

CE 775 Modeling and Analysis Of Environmental Systems 3.
Prerequisite: CE 339 and CE 382.

CE 776 Advanced Water Management Systems 3.
Prerequisite: CE 339, CE 775.
Application of systems analysis methods to design, analysis and management of water resources and environmental engineering.

Prerequisite: CE 586 or ST 515.
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.

CE 779 Advanced Air Quality 3.
Prerequisite: (CH 201 or CH 203) and MEA(CE) 479.
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.

CE 784 Ground Water Contaminant Transport 3.
Prerequisite: CE 584 and 574.
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 technology.

CE 786 Hydroclimatology 3.
Prerequisite: CE 586.
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.

CE 790 Advanced Topics In Civil Engineering 1-3.
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.
CE 791 Advanced Topics in Civil Engineering Computing 1-3.

CE 792 Advanced Topics in Construction Engineering 1-3.

CE 793 Advanced Topics in Geotechnical Engineering 1-3.

CE 794 Advanced Topics in Structures and Mechanics 1-3.

CE 795 Advanced Topics in Transportation Engineering 1-3.

CE 796 Advanced Topics in Water Resource and Environmental Engineering 1-3.

CE 803 Advanced Construction Engineering Seminar 1.

CE 805 Advanced Structures and Mechanics Seminar 1.


CE 839 Advanced Reading in Civil Engineering 1-3.
Prerequisite: Graduate standing.
Directed reading of advanced topics in some phase of civil engineering.

CE 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

CE 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

CE 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

CH - Chemistry Courses

CH 100 Chemistry and Society 4.
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. Credit is not allowed for CH 100 if student has prior credit for CH 101.

CH 101 Chemistry - A Molecular Science 3.
Prerequisite: One yr of high school chemistry and successful completion of the Chem Placement Exam or completion of CH 111 w/ C- or better; and eligible for MA 107. Coreq: CH 102. ADD BOTH CH 101 and CH 102 TO YOUR SHOPPING CART AND THEN ENROLL SIMULTANEOUSLY.
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.

CH 102 General Chemistry Laboratory 1.
Corequisite: CH 101.
Laboratory experience to accompany CH 101. Introduction to basic laboratory equipment and skills.

CH 103 General Chemistry I for Students in Chemical Sciences 3.
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.
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, 17CHEMB, 14FY-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.

CH 104 General Chemistry Laboratory I for Students in Chemical Sciences 1.
Co-requisite: CH 103.
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, 17CHEMB, 14FY-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.

CH 111 Preparatory Chemistry 3.
Preparation for CH101. 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.

CH 201 Chemistry - A Quantitative Science 3.
Prerequisite: CH 101 with grade C- or better, CH 102, and eligibility for MA 121 or higher, Corequisite: CH 202.
Detailed quantitative aspects of solutions, solution stoichiometry, thermodynamics, chemical equilibrium, acid-base equilibria, solubility equilibria, electrochemistry, chemical kinetics, and nuclear chemistry.

CH 202 Quantitative Chemistry Laboratory 1.
Prerequisite: CH 101, CH 102, Corequisite: CH 201.
Laboratory experience to complement CH 201. Experimental exploration of thermodynamic, kinetic, and electrochemical behavior.
CH 203 General Chemistry II for Students in Chemical Sciences.  
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.  
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 17MARS CBS-17MARSCHM majors and to students with departmental approval. Students cannot receive credit for both CH 201 and CH 203.

CH 204 General Chemistry Laboratory II for Students in Chemical Sciences 1.  
Co-requisite: CH 203.  
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 17MARS CBS-17MARSCHM majors and to students with departmental approval. Students cannot receive credit for both CH 202 and CH 204.

CH 211 Analytical Chemistry I 3.  
Prerequisite: CH 108, Corequisite: CH 212 and PY 208.  
Methods of quantitative analysis based on solution chemistry, potentiometry, coulometry, chromatography, and molecular absorption and fluorescence spectroscopy. Statistics of measurement precision. Credit not allowed for both CH 211 and CH 315.

Prerequisite: CH 101.  
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.

CH 221 Organic Chemistry I 3.  
Prerequisite: CH 101 with a grade of C- or better and CH 102; Corequisite: CH 222.  
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 alky halides. Introduction to spectral techniques of IR, UV-vis, and NMR. Students cannot receive credit for both CH 221 and CH 225.

CH 222 Organic Chemistry I Lab 1.  
Prerequisite: CH 101 and CH 102; Corequisite: CH 221.  
Laboratory experience to accompany CH 221. Introduction to basic organic laboratory equipment and techniques. Students cannot receive credit for both CH 222 and CH 226.

CH 223 Organic Chemistry II 3.  
Prerequisite: CH 221 with a grade of C- or better and CH 222; Corequisite: CH 224.  
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.

CH 224 Organic Chemistry II Lab 1.  
Prerequisite: CH 221 and CH 222; Corequisite: CH 223.  
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.

CH 225 Organic Chemistry I for Students in Chemical Sciences 3.  
Prerequisites: (CH 201 or CH 203) and (CH 202 or CH 204); Co-requisite: CH 226.  
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 17MARS CBS-17MARSCHM majors and to students with departmental approval. Students cannot receive credit for both CH 221 and CH 225.

CH 226 Organic Chemistry Laboratory I for Students in Chemical Sciences 1.  
Co-requisite: CH 225.  
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 17MARS CBS-17MARSCHM majors and to students with departmental approval. Students cannot receive credit for both CH 222 and CH 226.

CH 227 Organic Chemistry II for Students in Chemical Sciences 3.  
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.  
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 17MARS CBS-17MARSCHM majors and to students with departmental approval. Students cannot receive credit for both CH 223 and CH 227.
CH 228 Organic Chemistry Laboratory II for Students in Chemical Sciences 1.
Co-requisite: CH 227.
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 17MARSCHBS-17MARSCHM majors and to students with departmental approval. Students cannot receive credit for both CH 224 and CH 228.

CH 230 Computational Chemistry Lab I 1.
Prerequisite: CH 221 or CH 225; Co-requisite: MA 241.
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 sequence.

CH 232 Computational Chemistry Lab II 1.
Prerequisite: CH 221 or CH 225, Corequisite: MA 241. 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.

CH 295 Special Topics in Chemistry 1-3.
Special topics in chemistry at the early undergraduate level. Trial offerings of new or experimental courses in chemistry. Enrollment requires permission of the department.

CH 315 Quantitative Analysis 3.
Prerequisite: (CH 201 or CH 203) with a grade of C- or better, Co-requisite: CH 316.
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.

CH 316 Quantitative Analysis Laboratory 1.
Prerequisite: (CH 201 or CH 203) and (CH 202 or CH 204); Corequisite: CH 315.
Application of spectrochemical, electrochemical, volumetric, and chromatographic methods of analysis for the identification and quantification of components in a mixture.

CH 331 Introductory Physical Chemistry 4.
Prerequisite: (CH 201 or CH 203) and (CH 202 and 204) and (MA 231 or 241) and (PY 205 or PY 211).
Fundamental physiochemical principles including chemical thermodynamics, physical and chemical equilibrium, electrochemistry and reaction kinetics. For students requiring only a single semester of physical chemistry.

CH 335 Principles of Green Chemistry 4.
Prerequisite: Grade of C or better in CH 101/102, CH 201/202 (or equivalent general chemistry series), and CH 221/222 (or equivalent). 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; alternative feedstocks; enzymatic catalysis; ionic liquids; re-engineering of chemical processes; chemical synthesis.

CH 401 Systematic Inorganic Chemistry I 3.
Prerequisite: (CH 201 or CH 203) with grade of C- or better. 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 coordination chemistry. Major paper required.

CH 403 Systematic Inorganic Chemistry II 3.
Prerequisite: CH 401, CH 431.
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.

CH 415 Analytical Chemistry II 3.
Prerequisite: CH 315 or PCC 412.
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.

CH 431 Physical Chemistry I 3.
Prerequisite: (CH 201 or CH 203), MA 242, PY 203 or 208, Corequisite: MA 341.
An intensive study of physical chemical principles including states of matter, classical thermodynamics, physical and chemical equilibria, and electrochemistry.

CH 433 Physical Chemistry II 3.
Prerequisite: MA 341.
An intensive study of physical chemical principles including molecular spectroscopy, statistical thermodynamics, reaction kinetics, kinetic theory, and transport properties. Credit may not be claimed for both CH 433 and CH 437.

CH 435 Introduction to Quantum Chemistry 3.
Prerequisite: CH 431.
An introduction to the basic principles of quantum theory and its application to atomic and molecular structure and spectroscopy.

CH 437 Physical Chemistry for Engineers 4.
Prerequisite: PY 208, CHE 315, MA 341.
Selected physiochemical principles including quantum theory, spectroscopy, statistical thermodynamics, and rates of chemical reactions. Credit may not be claimed for both CH 433 and CH 437.

CH 441 Forensic Chemistry 3.
Prerequisite: (CH 201 or CH 203) and (CH 223 or CH 227). Chemical identification (recognition), and chemical separation techniques (identification) used to demarcate class and individual characteristics relevant in legal claims.

CH 442 Advanced Synthetic Techniques 4.
Prerequisite: CH 223 or CH 227, Corequisite: CH 401.
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.
CH 444 Advanced Synthetic Techniques II 4.
Prerequisite: CH 442.
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.

CH 452 Advanced Measurement Techniques I 4.
Prerequisite: CH 431.
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.

CH 454 Advanced Measurement Techniques II 4.
Prerequisite: CH 311 or CH 315.
Laboratory course designed on systematic method development in practical applications for the separation and analysis of environmental, pharmaceutical and biologically important samples. Isocratic and gradient elution HPLC separations and temperature programming in GC are covered. In addition to GC, the three major HPLC modes of Reversed Phase, Ion Exchange, and Hydrophilic Interaction will be studied for separations of mixtures of small organic molecules and biologically important molecules such as peptides and carbohydrates.

CH 463 Molecular Origins of Life 3.
Prerequisite: BCH 351 or BCH 451 or Permission of Instructor.
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 for both CH 463 and CH 563 will not be allowed.

CH 491 Honors Chemistry 1-4.
Prerequisite: (CH 223 or CH 227) and Admission to Honors Program.
Independent study and research projects in chemistry. 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.

CH 495 Special Topics in Chemistry 1-4.
Special topics in chemistry at the advanced undergraduate level. Trial offerings of new or experimental courses in chemistry. Enrollment requires permission of the department.

CH 499 Undergraduate Research in Chemistry 1-3.
Prerequisite: Two years of chemistry.
Independent investigation of a research problem under the supervision of a chemistry faculty member.

CH 563 Molecular Origins of Life 3.
Prerequisite: (CH 201 or CH 203) and (CH 221 or CH 225) and (CH 223 or CH 227), and BCH 451/equivalent.
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 for both CH 463 and CH 563 will not be allowed.

CH 572 Proteomics 3.
Prerequisite: BIT 410 or BIT 510 or BCH 454.
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.

CH 601 Seminar 1.
Prerequisite: Graduate standing in CH.
Review and discussion of scientific articles, progress reports on research and special problems of interest to chemists.

CH 610 Special Topics In Chemistry 1-3.
Detailed study of a particular problem or technique pertaining to chemistry.

CH 677 Advanced Chemistry Projects 1-3.
Prerequisite: Graduate standing in CH.
Independent literature study of a current subject in chemistry. Required written critical review paper of selected subject.

CH 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

CH 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

CH 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

CH 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.
CH 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

CH 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

CH 701 Advanced Inorganic Chemistry I: Structure and Bonding 3.
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.

CH 703 Advanced Inorganic Chemistry II: Applications of Group Theory to Bonding and Spectroscopy 3.
Prerequisite: CH 701 or equivalent.
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.

CH 705 Organometallic and Inorganic Reaction Mechanism 3.
Prerequisite: Graduate standing.
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.

CH 711 Advanced Analytical Chemistry I 3.
Prerequisite: CH 433; CH 415.
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.

CH 713 Advanced Analytical Chemistry II 2.
Prerequisite: CH 711.
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.

CH 714 Electronics and Instrumentation Laboratory 1.
Prerequisite: CH 711. Corequisite: CH 713.
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.

CH 721 Advanced Organic Chemistry I 3.
Prerequisite: CH 223 or CH 227 or CH 433 or CH 435.
Structure stereochemistry and reactions of various classes of hydrocarbons. Molecular orbital treatment of bonding and reactivity of alkenes, conformational interpretation of cycloalkene and cycloalkene reactivity and application of optical isomerism to study of reaction mechanisms.

CH 723 Advanced Organic Chemistry II 3.
Prerequisite: CH 721.
Introduction to acid-base theory and mechanistic organic chemistry as applied to synthetically useful organic reactions.

Prerequisite: (CH 223 or CH 227) and CH 433 or CH 435.
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.

CH 727 Mass Spectrometry 3.
Prerequisite: CH 223 or CH 227.
Interpretation of mass spectra emphasizing characterization of organic molecules. Instrumentation topics: types of mass analyzers such as magnetic sector, quadrupole and time-of-flight; hybrid instruments such as GC/MS, LC/MS and MS/MS; and ionization methods including EI, CI, laser desorption and fast atom bombardment. Applications: quantitation, environmental analysis, and peptide and DNA sequencing.

CH 730 Advanced Physical Chemistry 3.
Prerequisite: Graduate standing.
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.

CH 732 Advanced Physical Chemistry in Biological Applications 3.
Prerequisite: CH 431 and CH 433 and BCH 453 or equivalent.
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.

CH 734 Spectroscopic Methods in Chemical Biology 3.
Prerequisite: CH 331 or CH 431, CH 433 or equivalent.
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.

CH 735 Magnetic Resonance in Chemistry 3.
Prerequisite: CH 331 or CH 431, CH 433 or equivalent.
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.
CH 736 Chemical Spectroscopy 3.
Prerequisite: CH 435.
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.

CH 737 Quantum Chemistry 3.
Prerequisite: MA 301, CH 435 or PY 407.
Elements of wave mechanics applied to stationary energy states and time-dependent phenomena. Applications of quantum theory to chemistry, particularly chemical bonds.

CH 743 Electrochemistry 3.
Prerequisite: CH 431 or CH 433.
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 in production/storage of energy and in chemical analysis.

CH 745 Chemical Separation 3.
Prerequisite: CH 415, CH 416. Corequisite: CH 610 OR 810.
Basic principles of methods in chemical separation including gas chromatography, liquid chromatography, etc. Theory, instrumentation and applications of various chromatographic and electrophoretic techniques.

CH 747 Nanobiotechnology 3.
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.

Prerequisite: CH 723, CH 433.
Effects of structure and substituents on direction and rates of organic reactions.

CH 757 Combinatorial Bioorganic Synthetic Chemistry 3.
Prerequisite: BCH 453 or equivalent.
Modern topics in synthetic chemistry that underpin bioorganic chemistry including peptide synthesis, nucleic acid synthesis, and diverse methods for combinatorial syntheses of such biomolecules and analogues.

CH 759 Natural Products 3.
Prerequisite: CH 723 and CH 725.
Illustrative studies of structure determination, synthesis and biosynthesis of natural substances. Stress upon modern physical methods and fundamental chemical concepts. Examples from such classes as alkaloids, terpenes, steroids and antibiotics.

CH 765 Chemistry of Materials 3.
Prerequisite: CH 201 or equivalent.
Detailed examination of the relationship between chemical structure and physical properties of materials with potential use in applications. Different classes of molecules and materials requirements for several applications will be emphasized.

CH 770 Bioinorganic Chemistry 3.
Prerequisite: CH 401.
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 metallo drugs.

CH 772 Solid State Chemistry 3.
Prerequisite: CH 701 or equivalent.
Selected topics in solid-state chemistry including: extended symmetry, structure, bonding, characterizations, and special topics. Graduate standing in Chemistry required.

CH 795 Special Topics in Chemistry 1-4.

CH 801 Seminar 1.
Prerequisite: Graduate standing in CH.
Review and discussion of scientific articles, progress reports on research and special problems of interest to chemists.

CH 810 Special Topics in Chemistry 1-3.
Detailed study of a particular problem or technique pertaining to chemistry.

CH 815 Advanced Topics In Chemistry 1-3.
Critical study in one of branches of chemistry.

CH 877 Advanced Chemistry Projects 1-3.
Prerequisite: Graduate standing in CH. 1-3.
Independent literature study of a current subject in chemistry. Required written critical review paper of selected subject.

CH 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

CH 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

CH 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.
CHE - Chemical Engineering Courses

Prerequisite: Grade of C or better in MA 241, PY 205, and (CH 201 or CH 221 or CH 225).
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.

CHE 225 Introduction to Chemical Engineering Analysis 3.
Prerequisite: C- or better in CHE 205 and MA 242; Corequisite: MA 341.
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. Material and energy balances on transient processes and their solution using analytical and numerical methods. Introduction to microscopic material and energy balances using the "shell balance" approach to develop the governing differential equations. Solutions to steady-state boundary value problems in heat conduction and Fickian diffusion.

CHE 311 Transport Processes I 3.
Prerequisite: Grade of C- or better in both CHE 225 and MA 341.
Fundamental aspects of momentum and heat transfer, and the use of these fundamentals in solving problems in transport operations.

CHE 312 Transport Processes II 3.
Prerequisite: Grade of C- or better in CHE 311.
Fundamental aspects of mass transfer and the use of these basic principles in solving problems in transport operations.

CHE 315 Chemical Process Thermodynamics 3.
Prerequisite: Grade of C- or better in CHE 225.
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.

CHE 316 Thermodynamics of Chemical and Phase Equilibria 3.
Prerequisite: Grade of C- or better in CHE 315.
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.

CHE 330 Chemical Engineering Lab I 4.
Prerequisite: CHE 311.
Laboratory experiments in unit operations of heat transfer and fluid flow. Laboratory safety, technical report writing, statistics, experimental design, error analysis and instrumentation.

CHE 331 Chemical Engineering Lab II 2.
Prerequisite: CHE 312, CHE 330.
Laboratory experiments in mass transfer and reaction kinetics. Experimental planning, technical report writing and oral presentations are emphasized.

CHE 395 Professional Development Seminar 1.
Professional development and topics of current interest in chemical engineering.

Prerequisite: (MA 341 and TE 205) or CHE 312.
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.

CHE 446 Design and Analysis of Chemical Reactors 3.
Prerequisite: CHE 316.
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.

CHE 447 Bioreactor Engineering 3.
Prerequisite: BCH 451, CHE 312, CHE 316.
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.

CHE 450 Chemical Engineering Design I 3.
Prerequisite: CHE 312.

CHE 451 Chemical Engineering Design II 3.
Prerequisite: CHE 450, and (CHE 446 or CHE 447).
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.

CHE 455 Polymer Technology and Engineering 3.
Prerequisite: MSE 380.
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.

CHE 460 Nano-Electronic Materials 3.
Prerequisite: CHE 311 and CHE 315.
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.

CHE 461 Polymer Sciences and Technology 3.
Prerequisite: (CH 223 or CH 227) and CHE 316.
Concepts and techniques for polymerization of macromolecules. Structure, properties, and applications of commercially important polymers.
Prerequisite: MA 241 and PY 208 and (CH 223 or CH 227).
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.

CHE 463 Fermentation of Recombinant Microorganisms 2.
Prerequisite: CH 223 or CH 227; Corequisite: (BIT 410 or BCH 452 or MB 352 or BEC 363).
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.

CHE 464 Protein Purification 2.
Prerequisite: BIT 410 or BIT 510 or BCH 454.

CHE 465 Colloidal and Nanoscale Engineering 3.
Prerequisite: C- or better in CHE 311 and CHE 315.
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.

CHE 467 Polymer Rheology 3.
Prerequisite: CHE 311.
Theoretical principles and experimental techniques associated with flow and deformation of polymer systems. Systems include: melts and solutions, suspension, gels, emulsions, and thixotropic materials.

CHE 468 Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems 3.
Prerequisite: E 304.
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.

CHE 475 Advances in Pollution Prevention: Environmental Management for the Future 3.
Prerequisite: PY 208, MA 341.
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 more efficient processes.

CHE 488 Animal Cell Culture Engineering 2.
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, and single-use (disposal) bioreactors. This is a half-semester course.

CHE 495 Honors Thesis Preparation 1.
Prerequisite: CHE 497, Senior standing.
Development and presentation of Honors Thesis in Chemical Engineering and discussion of graduate school selection and preparation.

CHE 497 Chemical Engineering Projects I 3.
Prerequisite: Junior standing.
Introduction to chemical engineering research through experimental, theoretical and literature studies. Oral and written presentation of reports.

CHE 498 Chemical Engineering Projects II 1-3.
Prerequisite: Junior standing.
Projects in research, design or development in various areas of chemical engineering.

CHE 525 Process System Analysis and Control 3.
Prerequisite: CHE 312.
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.

CHE 543 Polymer Science and Technology 3.
Prerequisite: CHE 223, CHE 316.
Concepts and techniques for polymerization of macromolecules. Structure, properties, and applications of commercially important polymers.

CHE 546 Design and Analysis of Chemical Reactors 3.
Prerequisite: CHE 316.
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.

CHE 551 Biochemical Engineering 3.
Prerequisite: CHE 312 and (CHE 446 or CHE 447).
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.

CHE 560 Chemical Processing Of Electronic Materials 3.
Prerequisite: CHE 312 and CHE 446.
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.

CHE 563 Fermentation of Recombinant Microorganisms 2.
Introduction to fermentation and protein chemistry. Theory behind laboratory techniques and overview of industrial scale expression systems. Laboratory session involves use of microbial expression vectors, fermentation systems, and large-scale purification of recombinant protein. Half semester course, first part.
CHE 568 Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems 3.
Prerequisite: Graduate Standing or Permission of the Instructor.
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.

CHE 575 Advances in Pollution Prevention: Environmental Management 3.
Prerequisite: PY 208, MA 341.
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 more efficient processes. Credit will not be given for CHE 475 and CHE 575.

CHE 577 Advanced Biomanufacturing and Biocatalysis 3.
Graduate standing in engineering or life-science graduate program.
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.

CHE 596 Special Topics in Chemical Engineering 1-3.

CHE 597 Chemical Engineering Projects 1-3.
Prerequisite: Graduate standing.
Independent study of some phase of chemical engineering or related field.

CHE 601 Seminar 1.
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

CHE 610 Special Topics 1-3.

CHE 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

CHE 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

CHE 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

CHE 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

CHE 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

CHE 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.

CHE 697 Advanced Chemical Engineering Projects 1-12.
Prerequisite: Graduate standing in CHE.
Independent study of some phase of chemical engineering or related field.

Prerequisite: Master's student.
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.

CHE 701 Introduction to Chemical Engineering Research 2.
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.

CHE 702 Chemical Engineering Research Proposition 2.
Prerequisite: CHE 701.
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.

CHE 711 Chemical Engineering Process Modeling 3.
Prerequisite: (CHE 312, MA 301 or MA 341) or equivalent.
Applications of methods of mathematical analysis to formulation and solution of problems in transport phenomena, process dynamics and chemical reaction engineering.
CHE 713 Thermodynamics I 3.
Prerequisite: CHE 316 or equivalent.
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 thermodynamic properties.

CHE 715 Transport Phenomena 3.
Prerequisite: CHE 311 or equivalent.
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.

CHE 717 Chemical Reaction Engineering 3.
Prerequisite: CHE 446 or CHE 447 or equivalent.
Rates and mechanisms of homogeneous and heterogeneous reactions. Design, analysis and scale-up of batch and continuous chemical reactors.

CHE 718 Advanced Chemical Reaction Engineering 3.
Prerequisite: CHE 717.
Topics relating to design, analysis and operation of homogeneous and heterogeneous chemical reactors.

CHE 719 Electrochemical Systems Analysis 3.
Prerequisite: CHE 715, 717.
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.

CHE 725 Separation Processes For Biological Materials 3.
Prerequisite: CHE 721 or CHE 551.
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.

CHE 761 Polymer Blends and Alloys 3.
Prerequisite: CHE 316 or MAT 301.
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.

CHE 775 Multi-Scale Modeling of Matter 3.
Prerequisite: Graduate level thermodynamics, and differential and integral calculus.
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.

CHE 796 Special Topics In Chemical Engineering 1-3.
Prerequisite: Graduate standing.
Directed reading of chemical engineering literature, introduction to research methodology, and lectures and seminar discussion on topics which vary from term to term.

CHE 797 Chemical Engineering Projects 1-3.
Prerequisite: Graduate standing.
Independent study of some phase of chemical engineering or related field.

CHE 798 Advanced Chemical Engineering Projects 1-3.
Prerequisite: Graduate standing in CHE.
Independent study of some phase of chemical engineering or related field.

CHE 801 Seminar 1.
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

CHE 810 Special Topics 1-3.

CHE 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

CHE 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

CHE 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

CL - Comparative Literature Courses

CL 495 Special Topics in Comparative Literature 3.
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.

CLA - Foreign Language-Classical Studies Courses

CLA 110 Greek and Latin Roots of English 3.
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.).
COM 110 Public Speaking 3.
Research skills, topic selection, speech organization, skills in speech delivery. Listening for analysis and evaluation of in-class speech presentation.

COM 112 Interpersonal Communication 3.
Interpersonal communication competence: self-concept, self-disclosure, active listening, verbal and nonverbal communication, and conflict management.

Credit is not allowed for both COM 200 and COM 250 if COM 250 is completed first.
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. Students who have already take COM 250 cannot get credit for COM 200. For communication majors this course may only be used as a free elective.

COM 201 Introduction to Persuasion Theory 3.
Impacts of persuasive communication on attitudes and behavior. Uses humanistic and social scientific theories to explain the persuasive process.

COM 202 Small Group Communication 3.
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.

COM 211 Argumentation and Advocacy 3.
Theory-based analysis of public argument in specialized settings of law, politics, academic debate, business and organizations, and interpersonal relations.

COM 226 Introduction to Public Relations 3.
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.

COM 230 Introduction to Communication Theory 3.
R: Communication Majors.
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.

COM 240 Communication Inquiry 3.
Prerequisite: Communication Majors.
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 for research-based information.

COM 250 Communication and Technology 3.
Prerequisite: Communication Majors. Credit is not allowed for both COM 250 and COM 200.
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.

CLA 115 Medical Terminology 3.
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.

CLA 210 Classical Mythology 3.
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.

CLA 215 The Ancient World in Modern Media 3.
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.

CLA 320 Masterpieces of Classical Lit 3.
R: Sophomore Standing.
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.

CLA 325 Gender, Ethnicity & Identity in the Ancient World 3.
R: Sophomore Standing.
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.

CLA 395 Special Topics in Classical Studies 3.
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.
R: Sophomore Standing.
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.

CNR - College of Natural Resources Courses

CNR 295 Special Topics in College of Natural Resources 1-3.
Special topics in the College of Natural Resources at the 200 level for offering of courses on an experimental basis.

CNR 490 Senior Honors Seminar 2.
Prerequisite: 4 credit hours of Independent Study.
Oral presentations of the results of the senior honors projects. Additional special seminars and group discussions to enrich and broaden student perspectives.

CNR - College of Natural Resources Courses

NC State University 243
COM 257 Media History and Theory 3.
Prerequisite: COM 230.
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.
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.

COM 296 Communication Internship-Non-Local 1.
R: Communication Majors.
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.

COM 298 Special Projects in Communication 1-3.
A special projects course to be utilized for guided research or experimental classes at the sophomore level, topic determined by instructor.

COM 301 Presentational Speaking 3.
Prerequisite: COM 110.
Design, organization and delivery of oral presentations for policy determination, policy implementation, and sales.

COM 302 Managing Meetings 3.
Rules and customs of meetings in committees, assemblies and organizations; meeting management and group leadership; parliamentary motions and strategies.

COM 307 Digital Audio Production 3.
Prerequisite: COM 267.
Basic principles of digital audio production, including studio operation, performing, writing and producing.

COM 315 Phonetics 3.
Articulatory and acoustic phonetics; application of the International Phonetic Alphabet with vocal and ear training.

COM 316 Public Relations Writing 3.
Prerequisite: COM 226 and ENG 316.
Communication processes and procedures of public relations programs. Media techniques, preparation of materials, channels of distribution.

COM 317 Television Production 3.
Prerequisite: COM 267.
Basic techniques of television studio production, including producing, writing, directing and electronic graphics production.

COM 321 Survey of Rhetorical Theory 3.
Prerequisite: Sophomore standing and above.
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.

COM 322 Nonverbal Communication 3.
Prerequisite: COM 112.
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.

COM 325 Anatomy and Physiology of Speech 3.
Anatomy and physiology of the speech mechanism including the muscular, skeletal, and nervous system structures involved in respiration, phonation, and articulation.

COM 327 Critical Analysis of Communication Media 3.
Prerequisite: COM 240 and COM 257. Corequisite: COM 240.
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.

COM 332 Relational Communication 3.
Prerequisite: COM 112.
Communication patterns in the development and deterioration of interpersonal relationships. Functional and dysfunctional communication behaviors in family relationships.

COM 335 Language Development 3.
Syntactic, semantic, morphologic, and pragmatic development from birth through adolescence. The influence of cognitive and social development on language development. First language acquisition versus second language learning.

COM 336 Newsletter Writing and Production 3.
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.

COM 342 Qualitative Research Methods in Communication 3.
Prerequisite: COM 240.
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.

COM 346 Case Studies in Public Relations 3.
Prerequisite: COM 226 and COM 230.
Application of theory, principles, and problem-solving techniques used in public relations to organizational case studies.

COM 357 Digital Video Production 3.
Prerequisite: COM 267.
Principles of producing, directing, and editing techniques for digital video. Students script, storyboard, shoot, and edit short video projects.

COM 362 Communication and Gender 3.
Prerequisite: Junior standing, COM 112.
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.
COM 364 History of Film to 1940 3.
Prerequisite: Sophomore standing and above.
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.

COM 367 Multimedia Production and Digital Culture 3.
Prerequisite: COM 267.
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.

COM 374 History of Film From 1940 3.
Prerequisite: Sophomore standing and above.
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.

COM 385 Speech Science 3.
Prerequisite: COM 325.
Acoustic properties of speech sounds and the dynamics of speech sound production. Initial experience with basic clinical instrumentation used to measure respiratory, phonatory, and articulatory movements and the acoustic events that result from these movements. Lab assignments using basic instrumentation and computer software are completed outside of class.

COM 386 Quantitative Communication Research Methods 3.
Prerequisite: COM 240.
Design and implementation of communication research methods, including experimental and survey research procedures. Use of computer software for statistical analysis.

COM 392 International and Crosscultural Communication 3.
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.

COM 395 Studies in Rhetoric and Digital Media 3.
Prerequisite: ENG 101.
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.

COM 402 Advanced Group Communication 3.
Prerequisite: COM 202.
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.

COM 407 Advanced Digital Audio 3.
Prerequisite: COM 307.
Advanced multichannel techniques for audio production. Studio acoustics, audio signal processing, and advanced microphone techniques, writing, and performing.

COM 411 Rhetorical Criticism 3.
Prerequisite: Junior standing.
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.

COM 417 Advanced Topics in Communication and Race 3.
Prerequisite: COM 257, Corequisite: COM 250.
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.

COM 421 Communication Law 3.
Prerequisite: Junior standing.
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.

COM 427 Game Studies 3.
Prerequisite: COM 250 or STS 214.
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 reality games. Discussion of inter-connections among games, education, and art. Jr/Sr Standing.

COM 431 Communication in Political Campaigns 3.
Prerequisite: COM 110 or COM 201.
Roles of analysis and criticism of oral communication in political campaigns; analysis of special political communication situations; ghostwriting, news conferences, negative advertising.

COM 436 Environmental Communication 3.
Prerequisite: COM 230 or STS 214.
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 Junior/Senior standing.

COM 437 Advanced Digital Video 3.
Prerequisite: COM 357.
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.

COM 441 Ethical Issues in Communication 3.
Prerequisite: COM 110, 112.
Critical analysis of ethical problems in interpersonal and public communication practices.
COM 442 Communication and Conflict Management 3.
Prerequisite: COM 112.
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.

COM 444 Film Production 3.
Prerequisite: COM 267 or ENG 330.

COM 447 Communication and Globalization 3.
Corequisite: COM 327.
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.

Prerequisite: COM 201 or COM 321.
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.

COM 456 Organizational Communication 3.
Prerequisite: COM 230.
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.

COM 457 Media and the Family 3.
Corequisite: COM 327.
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 distribution of media messages designed for children and families. Consideration of both pro- and anti-social impacts.

COM 466 Nonprofit Leadership & Development 3.
Nonprofit Leadership and Development is a service-learning course in which students will be expected to make a 20-hour commitment to service in a local nonprofit organization. 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.

COM 467 Advanced Topics in Gender and Communication 3.
Prerequisite: COM 327 or COM 362.
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.

COM 476 Public Relations Campaigns 3.
Prerequisite: COM 226, COM 316, COM 386 and Corequisite: COM 346 (Note: COM 346 may be taken as a prerequisite or co-requisite).
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.

COM 477 Mobile Communication 3.
Prerequisite: COM 250 or STS 214.
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.

COM 484 Advanced Television Production 3.
Prerequisite: COM 317.
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.

COM 487 Internet and Society 3.
Prerequisite: COM 250 or COM 257 or STS 214.
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.

COM 493 Advanced Topics in Public Relations 3.
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.

COM 496 Communication Internship 3.
Prerequisite: Junior standing, Communication Majors.
Directed work experience for Communication majors with supervision from the work site and the University.

COM 498 Advanced Topic in Communication 1-3.
Prerequisite: Junior or senior standing.
Advanced study of contemporary theories, methods, practices, processes, or issues related to the field of communication. Topic varies.

COM 499 Advanced Independent Research 1-3.
Prerequisite: Nine credits in Communication courses. Junior standing or Senior standing in Communication.
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.
COM 506 Verbal Data Analysis 3.
Prerequisite: ENG 513 or ENG 527 or COM 541 or COM 542.
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, 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.

COM 508 Emerging Technologies and Society 3.
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.

COM 514 History Of Rhetoric 3.
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.

COM 516 Rhetorical Criticism: Theory and Practice 3.
Prerequisite: Graduate Standing or the equivalent of COM/ENG 321 or COM/ENG 411.
Development, achievements, limitation of major critical methods in the 20th century, including neo-Aristotelian, generic, metaphorical, 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.

COM 521 Communication and Globalization 3.
Prerequisite: Graduate standing.
Economic, political, cultural dimensions of globalization. Role of information and communication technologies, networks, institutions, and practices in human social organization.

COM 522 Critical Approaches to Organizational Communication 3.
Prerequisite: Graduate standing.
Overview of critical and interpretive organizational communication research studies. Application of insights to enriching and transforming working lives.

COM 523 International and Intercultural Communication 3.
Prerequisite: Graduate standing.
Survey of intercultural, cross-cultural, and international communication theories and issues.

COM 524 Political Communication in Organizations 3.
Prerequisite: Graduate standing.
Explore effects of modern communication techniques on political life in organizations. Examine formulation and articulation of political messages for private organizations and governmental institutions.

COM 525 Group/Team Communication 3.
Prerequisite: Graduate standing.
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.

COM 526 Media Ownership 3.
Prerequisite: Graduate standing.
Identify major media companies worldwide areas of dominance. Examine commercial, cultural, social, political implications of contemporary media ownership patterns.

COM 527 Seminar in Organizational Conflict Management 3.
Prerequisite: Graduate standing.
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.

COM 528 Communication Culture and Technology 3.
Prerequisite: Graduate standing.

COM 529 Communication Campaigns 3.
Prerequisite: Graduate standing.
Presents 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.

COM 530 Interpersonal Communication in Science and Technology Organizations 3.
Prerequisite: Graduate standing.
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.

COM 532 Communication Consulting 3.
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 and to link communication theory and research to organizational practice. Graduate standing required.

COM 536 Environmental Communication 3.
Research and critical analysis of environmental discourse in organizational, media, political, cultural, and international contexts. Investigates public participation in environmental advocacy and deliberation; environmental conflict management; rhetorical constructions of nature, human relationships with nature; environmental justice, environmental risk communication; and competing ecological paradigms. Graduate standing required.

COM 537 Gaming and Social Networks 3.
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.
COM 538 Risk Communication 3.
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.

COM 539 Fund Development 3.
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.
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.

COM 541 Quantitative Research Methods in Applied Communication 3.
Prerequisite: Graduate standing.
Introduction to research methods in applied communication. Knowledge of design, implementation, and analysis of various quantitative research methods.

COM 542 Qualitative Research Methods in Applied Communication 3.
Prerequisite: Graduate standing.
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.

COM 543 Visual Content Analysis 3.
Research methods class in social science-orientated 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.

COM 546 Nonprofit Marketing and Public Relations 3.
Survey of the marketing and public relations principles and practices applicable to nonprofit organizations.

COM 547 Mobile Technologies and Social Practices 3.
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 Contemporary Rhetorical Theory 3.
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.

COM 556 Seminar In Organizational Communication 3.
Prerequisite: Advanced Undergraduate standing or Graduate standing.
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.

COM 561 Human Communication Theory 3.
Prerequisite: Graduate standing or PBS status.
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.

COM 562 Communication and Social Change 3.
Prerequisite: Graduate standing.
Examine persuasive theories and methods including compliance gaining techniques. Evaluate effectiveness of public communication campaigns directed at social change.

COM 563 Public Relations Theory 3.
Study the theoretical body of knowledge in public relations and its application to practice. Graduate Standing required.

COM 566 Seminar In Crisis Communication 3.
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.

R: Graduate Students Only.
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.

COM 585 Teaching College Communication 3.
Prerequisite: Graduate standing.
Introduction to communication education theory and research. Course divided into primary parts: 1)education theory and philosophy and 2)instructional design theory and practice.

COM 598 Special Topics In Communication 1-3.
Detailed investigation of a special topic in communication. No more than 6 hrs. may be used as credit toward graduation with master's degree.

COM 630 Independent Study In Communication 1-3.
Prerequisite: Graduate standing.
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.

COM 650 Communication Internship 1-6.
Prerequisite: Acceptance into MS in Communication Program.
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.
COM 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

COM 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

COM 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.
Thesis Research.


COM 798 Special Topics in Communication 3.
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.

COM 810 Directed Readings in Communication 1-6.
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.

COM 896 Summer Dissert Res 1.

COP - Cooperative Education Courses
COP 100 Co-Op Work Ist Alt 0.
COP 101 Co-Op Work Ist Par 0.
COP 200 Co-Op Work 2nd Alt 0.
COP 201 Co-Op Work 2nd Par 0.
COP 300 Co-Op Work 3rd Alt 0.
COP 301 Co-Op Work 3rd Par 0.
COP 400 Co-Op Work 4th Alt 0.
COP 401 Co-Op Work 4th Par 0.
COP 500 Co-Op Work Graduate Alt 0.
COP 501 Co-Op Work Graduate PAR 0.

COS - College of Sciences Courses
COS 100 Perspectives in Learning 1.
Undergraduates in College of Sciences. The campus computing and information environment; levels of learning; recognition and application of good reasoning; academic and career resources and opportunities.

COS 295 Special Topics in the College of Sciences 1-3.
Special topics in the College of Sciences at the early undergraduate level. Available as directed individual or group study.

COS 295A Critical Thinking in Life Sciences 1-2.
Critical Thinking in Life Sciences.

COS 498 Spec Topics in the College of Sciences 2 3.
Special Topics for advanced undergraduates will be selected from the mathematical, physical, and biological sciences.

CRD - Communication Rhetoric Digital Media Courses
CRD 701 History and Theory of Communication Technology 3.
Prerequisite: Doctoral student.
Intensive study of the evolution of communication systems and of essential historical, theoretical, and critical accounts of such systems and their implications. Foundation course for doctoral study.

CRD 702 Rhetoric and Digital Media 3.
Prerequisite: COM/ENG 514 or 516 or ENG 515, Doctoral student.
Intensive critical study and evaluation of the conceptual vocabulary of rhetoric and its application to digital communication and digital media. Focus may include the following concepts: community, genre, figuration, argument, narrative, dialogue, deliberation, topoi, pathos, ethos, kairos.

CRD 703 Communication in Networked Society 3.
Prerequisite: Doctoral student.
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.

CRD 704 Technologies and Pedagogies in the Communication Arts 3.
Prerequisite: Doctoral student.
Theories, research, and practices using technologies in the teaching and learning of the communication arts in higher education. Design and implementation of instructional strategies, design and management of technology facilities, ethical and professional issues.

CRD 790 Issues in Communication, Rhetoric, and Digital Media 3.
Prerequisite: CRD 701, 702, 703, 704, Doctoral student.
A seminar examining problems and issues of interdisciplinary inquiry in the context of digital media. Synthesis of research and scholarship from multiple disciplinary perspectives as it applies to issues in communication, rhetoric, and digital media. Emphasis on developing collaborative research projects drawing on multiple disciplinary perspectives.

CRD 791 Special Topics in Communication, Rhetoric, and Digital Media 3.
Prerequisite: CRD 701.
An intensive seminar examining a particular topic or issue in the communication and rhetoric of digital media.

CRD 809 Colloquium in Communication, Rhetoric, and Digital Media 1.
Prerequisite: Doctoral student.
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.
CRD 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

CRD 890 Doctoral Preliminary Exam 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

CRD 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

CS - Crop Science Courses

CS 101 Field Crop and Turfgrass Management Orientation 1.
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.

CS 103 Introductory Topics in Crop, Soil and Turfgrass Sciences 1.
Introduction to the scope, purpose, and objectives of a university education with an emphasis on areas related to Crop, Soil and Turfgrass Sciences. Students will explore university, college and departmental resources, academic policies and procedures, opportunities for minors, career opportunities, and current trends and issues in our related disciplines. Students cannot receive credit for both CS 103 and ALS 103. Freshman Only; PAA, PAB, PAC, PAE, PCB, SST, TFG.

CS 111 Field Crop Production 4.
Management of field crops, including growth and development, establishment, pest management, environmental considerations, rotations of crops and chemicals, harvesting, storage and marketing. SPEARS.

CS 121 Turfgrasses and Their Uses 3.
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.

CS 122 Principles of Turfgrass Management 3.
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.

CS 124 Agriculture and Seeds 2.
This course will explore seeds, their importance in local and global agriculture, new biotechnology applications for agriculture, how biotechnology has changed the seed industry and agriculture, how seeds deliver new AG biotechnology discoveries and how seeds and biotechnology are addressing world hunger issues. Field trip is required.

CS 151 Forage Production 3.
Characteristics of major forage crops and their response to agronomic and animal management factors. Utilization methods, growth and quality characteristics related to animal performance. GREEN.

CS 152 Weed Control in Field Crops 3.
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. JORDAN.

CS 153 Turfgrass and Ornamental Weed Control 3.
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. YELVERTON.

CS 154 Turf Weed and Disease Management 3.
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.

CS 155 Advanced Turf Management 3.
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. PEACOCK.

CS 162 Flue-Cured Tobacco Production 1.
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.

CS 163 Peanut Production 1.
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.
CS 164 Soybean Production 1.
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.

CS 165 Cotton Production 1.
Cotton production, marketing, and improvement. Emphasis on current information regarding varieties, fertilization, disease, insect and weed control, cultural practices, equipment, harvesting and marketing. EDMISTEN.

CS 166 Corn Production 1.
Growth, management, and markets for corn in North Carolina.

CS 167 Wheat Production 1.
Practical approach to growing wheat and other small grain crops. Topics will include growth, management, and markets for small grains in North Carolina.

CS 190 Turf Seminar 1.
Discussions of the operations, opportunities, and problems existing in various phases of the turf industry by leaders in the various facets of the industry.

CS 191 Field Crops Seminar 2.
Guest speakers, student 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.

CS 200 Introduction to Turfgrass Management 4.
Prerequisite: BIO 181(preferred) or ZO 160(alternate) BO 200, or CS 213. 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.

CS 210 Lawns and Sports Turf 3.
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.

CS 211 Plant Genetics 3.
Prerequisite: BIO 183 or ZO 160.
Fundamentals 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.

CS 213 Crops: Adaptation & Production 4.
Prerequisite: BIO 181(preferred) or ZO 160(alternate) or BO 200.
Fundamental structure and reproductive features of crops. Their adaptation and importance in global agriculture. Practices and inputs needed for economic production of a quality product and interaction of these factors within the constraints of climate, soils, and topography in maintaining a quality environment.

CS 216 Oilseed Crop Production 3.
Fundamental agronomic practices associated with the production of oilseed crops (soybean, peanuts and cotton). Discussions will include crop growth and development stages, variety characteristics, planting strategies, fertility and pest management programs, harvest and storage options, and the use of technologies associated with the production and maintenance of quality oilseed crops.

CS 218 Cereal Grain Crop Production 2.
Fundamental agronomic practices associated with the production of cereal grain crops (corn and small grains). 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 grain.

CS 224 Seeds, Biotechnology and Societies 3.
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.

CS 230 Introduction to Agroecology 3.
Prerequisite: BIO 105 or BIO 181 or BIO/ZO 160 or BO 200 or BO 250 or HS 201 or CS 213.
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.

CS 290 Professional Development in Plant & Soil Sciences 1.
This course is designed to prepare students for careers in Plant and Soil Sciences. Student discussions with faculty and industry professionals will center on structure and requirements for internships and jobs, research and extension opportunities, resume building and writing, professionalism and professional development, interpersonal skills, undergraduate program management, and career planning. Student development of an e-portfolio is required. Must hold sophomore or junior standing in: TAA, TAB, TAC, TSS, TFG.

CS 312 Grassland Management for Natural Resources Conservation 3.
Prerequisite: BIO 181(preferred) or ZO 160(alternate) CS 213, SSC 200.
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.

CS 398 Independent Study in Crop Science 1-3.
Individualized study in the areas of crop science. Topic and credit hours will be determined by the instructor and student. This course may be taken a maximum of two times, provided the topics of study are 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.
Topics include: golf course design considerations, fertilizer characteristics and application techniques, irrigation programming, construction of high use turfgrass areas, calibration of spreaders and sprayers, aeration, pesticide fate and development of effective management systems.

**CS 413 Plant Breeding 2.**
Prerequisite: PB 321 or PB 421.
Discussion of reproductive systems of higher plants; the genetic basis for plant improvement and the selection, evaluation, and utilization of crop varieties.

**CS 414 Weed Science 4.**
Prerequisite: CH 220.
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 in cropland and non-cropland situations.

**CS 415 Integrated Pest Management 3.**
Prerequisite: BIO 181(preferred) or ZO 160(alternate) or BO 200 or BO 250.
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.

**CS 424 Seed Physiology 3.**
Prerequisite: (CH 220 or CH 221 or CH 225) and (PB 321 or PB 421 or FOR 303).
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.

**CS 430 Advanced Agroecology 4.**
P: CS 230.
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.

**CS 462 Soil-Crop Management Systems 3.**
Prerequisite: CS 213, CS 414, SSC 342, SSC 452, Senior standing.
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.

**CS 465 Turf Management Systems and Environmental Quality 3.**
Prerequisite: CS 400 and Senior standing.
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 cannot be received for both CS 465 and CS 565. Senior standing.

**CS 470 Advanced Turfgrass Pest Management 2.**
Prerequisite: C- or better in CS 200.
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.

**CS 490 Senior Seminar in Crop Science and Soil Science 1.**
Prerequisite: Senior standing in Agronomy, Plant and Soil Sciences, or Turfgrass Science.
Review and discussion of current topics in crop science, soil science, agronomy and natural resource management. Preparation and presentation of scientific information in written and oral format. Senior standing in Agronomy, Plant and Soil Sciences, or Turfgrass Science.

**CS 492 External Learning Experience 1-6.**
Prerequisite: Sophomore standing.
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.

**CS 493 Special Problems in Crop Science 1-6.**
Prerequisite: Sophomore standing.
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.

**CS 495 Special Topics in Crop Science 1-6.**
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

**CS 502 Plant Disease: Methods & Diagnosis 2.**
Prerequisite: PP 315.
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 areréquired.

**CS 524 Seed Physiology 3.**
Prerequisite: (CH 220 or CH 221 or CH 225) and (PB 321 or PB 421 or FOR 303).
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.
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time enrollment for the master's degree and are writing and defending their thesis.

CS 714 Crop Physiology: Plant Response to Environment 3.
Prerequisite: (PB 321 or PB 421) and CH 223 or CH 227.
Examines interactions between plants and the environment. Light environment, plant canopy development, photosynthesis, sorption/desorption, soil reactivity, movement, volatilization, 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 by last day of 3rd week of minicourse.

CS 720 Molecular Biology In Plant Breeding 3.
Prerequisite: CS(GN,HS) 741, GN 701, GN 702, GN 703.
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.

CS 725 Pesticide Chemistry 1.
Prerequisite: (CH 201 or CH 203) and (CH 221 or CH 225).
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.

CS 726 Advanced Topics In Quantitative Genetics and Breeding 3.
Prerequisite: ST 511, Corequisite: ST 512.
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.

CS 727 Pesticide Behavior and Fate In the Environment 2.
Prerequisite: CS(HS,SSC,TOX) 725, SSC 200.
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 minicourse.
CS 729 Herbicide Behavior In Plants 2. 
Prerequisite: BO 751 and BO 752 and CS(HS,SC) 725.
Chemical, physiological and biochemical actions of herbicides in plants including uptake, translocation, metabolism and mechanism of action.

CS 745 Quantitative Genetics In Plant Breeding 1. 
Prerequisite: CS(GN, HS) 541, ST 712, course in quantitative genetics recommended.
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.

CS 746 Breeding Methods 2. 
Prerequisite: CS (GN, HS) 741, ST 535.
Theory and principles of plant breeding methodology including population improvement, selection procedures, genotypic evaluation, cultivar development and breeding strategies.

CS 795 Special Topics 1-3.
CS 801 Seminar 1. 
Prerequisite: Graduate standing.
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.

CS 820 Special Problems 1-3. 
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 860 Plant Breeding Laboratory 1. 
Prerequisite: CS(GN,HS)/741.
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.

CS 861 Plant Breeding Laboratory 1. 
Prerequisite: CS(GN,HS)/741.
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.

CS 885 Doctoral Supervised Teaching 1-3. 
Prerequisite: Doctoral student.
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.

CS 890 Doctoral Preliminary Examination 1-9. 
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

CS 896 Summer Dissertation Research 1. 
Prerequisite: Doctoral student.
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.
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.

CSC - Computer Science Courses

CSC 111 Intro to Computing: Python 3. 
C: (E 115 or COS 100) and MA 141; R: Civil, Construction, and Environmental Engineering Majors Only.
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.

CSC 112 Introduction to Computing-FORTRAN 3. 
Corequisite: (E115 or PAMS 100) and (MA 121 or MA 131 or MA 141). 
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.

CSC 113 Introduction to Computing - MATLAB 3. 
Corequisite: (E 115 or COS 100) and (MA 121 or MA 131 or MA 141). 
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.

CSC 114 Introduction to Computing-C++ 3. 
Corequisite: (E115 or PAMS 100) and (MA 121 or MA 131 or MA 141). 
An introductory course in computing in C++. Emphasis on algorithm development and problem solving. Particular elements include: careful and methodical development of C++ programs from specifications; documentation and style; appropriate use of control structures, data types and subprograms; data abstraction and verification; numeric and nonnumeric applications; introduction to object-oriented programming and design.

CSC 116 Introduction to Computing - Java 3. 
Corequisite: (E115 or PAMS 100) and (MA 121 or MA 131 or MA 141). 
An introductory course in computing in Java. Emphasis on algorithm development and problem solving. Careful and methodical development of Java applications and applets from specifications; documentation and style; appropriate use of control structures; classes and methods; data types and data abstraction; object-oriented programming and design; graphical user interface design.

CSC 200 Introduction to Computers and Their Uses 3. 
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.
CSC 214 Programming Concepts 3.
Prerequisite: CSC 114 with a grade of C- or better.
Software design in a high-level language: abstract data types, modular programming, management of large programs. Dynamic memory management: linked lists, pointers, allocation and deallocation. Alternate programming paradigms: recursive list processing, object-oriented programming.

CSC 216 Programming Concepts - Java 3.
Prerequisite: CSC 116 with a grade of C or better.
The second course in computing, intended for majors. Emphasis is placed on interpretation of inductive definitions (functions and data types); testing strategies; specification and implementation of finite-state machine; encapsulation; polymorphism; inheritance; class invariants; and resource management.

CSC 224 Applied Discrete Mathematics 3.
Prerequisite: MA 101 or equivalent completed in high school.

CSC 226 Discrete Mathematics for Computer Scientists 3.
Prerequisite: MA 101 or equivalent completed in high school; CSC, CSU Majors and minors; CPE, CPU Majors.

CSC 230 C and Software Tools 3.
Prerequisite: CSC 216 with a C or better and CSC or CSU Majors and Minors.
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.

CSC 234 Computer Organization and Assembly Language 3.
Prerequisite: CSC 214 with a grade of C- or better.
Number systems, von Neuman machines, instruction sets and machine code, data representation, assemblers and assembly language programming, compilers, external and internal processor organization, memory, I/O organization and devices. Detailed study of a contemporary processor architecture.

CSC 236 Computer Organization and Assembly Language for Computer Scientists 3.
Prerequisite: CSC 216 with a C or better and CSC or CSU Majors and Minors.
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.

CSC 244 Concepts and Facilities of Operating Systems 3.
Corequisite: CSC 234.
The history and evolution of operating systems, concepts of process management, memory addressing and allocation, files and protection, deadlocks and distributed systems.

Prerequisite: CSC 230; Corequisite: CSC 236; CSC and CSU Majors and Minors.
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.

CSC 251 Web Page Development 1.
Prerequisite: E 115 or equivalent knowledge of EOS/Unity system.
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.

CSC 252 Introduction to Software Testing 1.
Prerequisite: CSC 112 or CSC 114 or CSC 116.
Introduction to software testing provides an understanding of what software testing is and its key role in determining the quality of a software application for the customer. It covers the software test life cycle phases; test planning, acquisition and execution, how the software test life cycle aligns with the software development life cycle, and the different levels of software testing.

CSC 255 String Processing Languages 1.
Prerequisite: Programming knowledge.
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.

CSC 257 Introduction to Java 1.
Prerequisite: CSC 214.
Introduction to the Java programming language. Object-oriented techniques and language syntax. Java class libraries including strings, graphical interfaces, events, exceptions, arguments, threads, file I/O, and networking.

CSC 281 Foundations of Interactive Game Design 3.
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.

CSC 295 Special Topics in Computer Science 1-3.
Special topics in CSC at the early undergraduate level.

CSC 302 Introduction to Numerical Methods 3.
Prerequisite: CSC 116 and MA 305, CSC Majors or 2.75 GPA.
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 differentiation and integration; linear systems of equations; curve fitting; solutions of non-linear equations; numerical solutions of ordinary differential equations.
CSC 314 Data Structures 3.
Prerequisite: CSC 214 and CSC 224 with a grade of C- or better.
A survey of fundamental abstract data types along with efficient implementations for each. Emphasizes asymptotic running time as a measure of program performance. Lists, stacks, queues, sparse arrays, binary trees, heaps, balanced search trees, and hash tables. Illustrative applications such as graph, text-processing, or geometric algorithms.

CSC 316 Data Structures for Computer Scientists 3.
Prerequisite: CSC 216 and CSC 226 with a grade of C or better; CSC, CSU Majors and Minors and CPE Majors.
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.

CSC 326 Software Engineering 3.
Prerequisite: CSC 230 and either CSC 314 or CSC 316.
Application of product engineering methods to software: quality assurance, project management, requirements analysis, specifications, design, development, testing, production and maintenance.

CSC 333 Automata, Grammars, and Computability 3.
Prerequisite: Grade of C or better in CSC 226, CSC Majors or 2.75 GPA.
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.

CSC 340 Information Systems Management 3.
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.

CSC 342 Applied Web-based Client-Server Computing 3.
Prerequisite: CSC 216 with a grade of C- or better.
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 delivery.

CSC 379 Ethics in Computing 1.
Prerequisite: Junior standing, CSC Majors or 2.7 minimum GPA.
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 case studies to relate to ethical theory. Ethical and legal use of software. Conflicts of interest.

CSC 401 Data and Computer Communications Networks 3.
Prerequisite: ST 370 and CSC 246.
Basic concepts of data communication networking and computer communications architectures, including packet/circuit/virtual-circuit switching, layered communication architecture and OSI layers, general description of DLC, network and transport layers, some detailed protocol study of Ethernet, ATM and TCP/IP. Credit is not allowed for both CSC 401 and ECE 407.

CSC 402 Network Projects 3.
Prerequisite: CSC 401.
Under the supervision of faculty members, students engage in projects that may include communication architecture implementation, networking technology assessment, network performance evaluation, and network administration. Comprehensive written and oral project report required. No auditing.

CSC 405 Introduction to Computer Security 3.
Prerequisite: CSC 246.
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.

CSC 411 Introduction to Artificial Intelligence 3.
Prerequisite: CSC 316.
Survey of fundamental topics in 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.

CSC 413 Electronic Commerce Technology 3.
Prerequisite: CSC 316.
An introduction to the technologies underlying electronic commerce. Topics include Web protocols and languages, Web mining, product ontologies, security anonymity, privacy, recommendation systems, personalization, auctions, trading agents, and intellectual property.

CSC 416 Introduction to Combinatorics 3.
Prerequisite: MA 225 or CSC 226.
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.

CSC 417 Theory of Programming Languages 3.
Prerequisite: CSC 316.
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.

CSC 422 Automated Learning and Data Analysis 3.
Prerequisite: ST 370 and MA 305, and a grade of C- or better in either CSC 226 or LOG 201.
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.
CSC 423 Information Resources Management 3.
Prerequisite: CSC/BUS 340.
Information Resources Management as a process that encompasses strategic planning, the implementation of new technology, dramatic changes to both the corporate Management Information Services and traditional information systems architecture, and the emerging role of end user computing to enable a business enterprise to operate effectively. May not be used as a CSC restricted elective.

CSC 425 Engineering Knowledge- Based Services 3.
Prerequisite: CSC 316.
Applied knowledge representation and reasoning, including formal methods for explicit representation of knowledge, pragmatics of methods for acquiring knowledge from experts, and reasoning methods organized to support configuration, diagnosis, scheduling, information, integration and interpretation, and other major service types. Credit is not allowed for both CSC 425 and CSC 525.

CSC 427 Introduction to Numerical Analysis I 3.
Prerequisite: MA 301 and programming language proficiency.
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.

CSC 428 Introduction to Numerical Analysis II 3.
Prerequisite: MA 405 and programming language proficiency; MA (CSC) 427 is not a prerequisite.
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.

CSC 431 File Organization and Processing 3.
Prerequisite: CSC 230 and CSC 316.
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 trees. Dynamic hashing techniques. Structures including grid files. Applying file structures to practical problems.

CSC 440 Database Management Systems 3.
Prerequisite: CSC 316, CSC Majors.
Introduction to database concepts. This course examines the 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.

CSC 441 Introduction to Simulation 3.
Prerequisite: MA 242, ST 372, programming proficiency.
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.

CSC 450 Web Services 3.
Prerequisite: CSC 316.
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 246 or ECE 306) and CSC 230 and CSC 316.
Development of software for wireless computer systems. Software designs for applications and networking in this environment, including algorithms for ad hoc discovery, routing, and secure data transfer. Software interface to related sensors and subsystems including global positioning system. Algorithms for power management. Programming required.

CSC 454 Human-Computer Interaction 3.
Prerequisite: CSC 316.
A survey of concepts and techniques for user interface design and human computer interaction. Emphasizes user-centered design, interface development techniques, and usability evaluation.

CSC 456 Computer Architecture and Multiprocessors 3.
Prerequisite: CSC 236 and CSC 316.
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: MA 305, CSC 230 and CSC 316.
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: CSC 461, CSC Majors.
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.

CSC 467 Multimedia Technology 3.
Prerequisite: CSC 246.
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.
CSC 474 Network Security. 3.
Prerequisite: CSC 230.
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.

CSC 481 Game Engine Foundations. 3.
Prerequisite: CSC 316.
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.

CSC 482 Advanced Computer Game Projects. 3.
Prerequisite: CSC 481.
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.

CSC 484 Building Game AI. 3.
Prerequisite: CSC 316.
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.

CSC 485 Innovating in Technology. 3.
Prerequisite: CSC 316.
Importance of innovation to the success of the technical individual, State, and Nation. Techniques for becoming more innovative. Innovations important to recent generations. Innovations needed to help humankind. Applying new technologies, e.g. search engines and the Internet, to innovation. Strategies for innovation. Why ideas fail. Why failures are important to successes. Factors influencing success, especially the human interface. Students will develop proof-of-concept prototype or requirements document, write proposal for potential funding, and make oral presentation of innovation. Team work encouraged.

CSC 492 Senior Design Project. 3.
Prerequisite: CSC 326; CSC Majors.
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.

CSC 495 Special Topics in Computer Science. 1-6.
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.

CSC 499 Independent Research in Computer Science. 1-6.
Independent investigation of a research problem under faculty supervision. Departmental Approval Required.

CSC 501 Operating Systems Principles. 3.
Prerequisite: CSC 244, CSC 314 and MA 421.
Fundamental issues related to the design of operating systems. Process scheduling and coordination, deadlock, memory management and elements of distributed systems.

CSC 503 Computational Applied Logic. 3.
Prerequisite: CSC 333 of LOG 335 or LOG 435.
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.

CSC 505 Design and Analysis Of Algorithms. 3.
Prerequisite: CSC 314 and CSC 224.
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).

CSC 506 Architecture Of Parallel Computers. 3.
Prerequisite: CSC 312, or CSC 456, or ECE 406.

CSC 510 Software Engineering. 3.
Prerequisites: CSC 314 and CSC 224.
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.
CSC 512 Compiler Construction 3.
Prerequisite: CSC 314 and 333.
Theory and practice of compiler writing. Lexical analysis, table driven LL(1), LR(1) and LALR(1) parsers, code generation, flow analysis, runtime storage organization and optimization. Writing a compiler using software tools a significant part of course.

CSC 513 Electronic Commerce Technology 3.
Prerequisite: CSC 501.
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.

CSC 515 Software Security 3.
Prerequisite: CSC 510.
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.

CSC 517 Object-Oriented Design and Development 3.
Prerequisite: CSC 326 or ECE 309.
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.

CSC 520 Artificial Intelligence I 3.
Prerequisite: CSC 316 and either CSC 224 or LOG 201 or LOG 335 or background in symbolic logic.
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.

CSC 521 Artificial Intelligence Programming 3.
Prerequisite: CSC 520 or CSC 411.
Introduction to techniques for developing AI systems and programming in a language of AI, Common Lisp. Implementation and extension of systems for problem solving, pattern matching, rule-based processing, machine learning, planning, and related areas.

CSC 522 Automated Learning and Data Analysis 3.
Prerequisite: CSC 226 or LOG 201, ST 370, MA 305.
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.

CSC 525 Engineering Knowledge-Based Services 3.
Prerequisite: CSC 316.
Applied knowledge representation and reasoning, including formal methods for explicit representation of knowledge, pragmatics of methods for acquiring knowledge from experts, and reasoning methods organized to support configuration, diagnosis, scheduling, information, integration and interpretation, and other major service types. Credit is not allowed for both CSC 425 and CSC 525.

CSC 530 Computational Methods for Molecular Biology 3.
P:CSC 316 C:CSC 505.
Computer algorithms supporting genomic research: DNA sequence comparison and assembly, hybridization mapping, phylogenetic reconstruction, genome rearrangement, protein folding and threading.

CSC 540 Database Management Concepts and Systems 3.
Prerequisite: CSC 316.
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.

CSC 541 Advanced Data Structures 3.
P:CSC 316.
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. Trie and related structures including AVL trees, B*trees, tries and dynamic hashing techniques.

CSC 546 Management Decision and Control Systems 3.
Prerequisite: CSC 423 or BUS 541.
Planning, design, and development 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.

CSC 547 Cloud Computing Technology 3.
Prerequisites: CSC 501 and ECE/CSC 570.
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-, and high-performance computing - "as-a-service".

CSC 548 Parallel Systems 3.
Prerequisite: CSC 246 or CSC 451 or CSC 501.
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.

CSC 554 Human-Computer Interaction 3.
P:CSC 316.
CSC 557 Multimedia Computing and Networking 3.
Prerequisite: CSC 501 and CSC/ECE 570.
An introduction to the technologies that support the creation of sound, images, and video on the computer, and transmission across networks. Physical and perceptual properties of each media type. Operations on multimedia, including recording, processing, and playback. Important compression methods and standards, such as JPEG and MPEG. Techniques for providing low-latency, bounded-error, multicast transmission in packet-switched networks.

Prerequisite: CSC Majors.
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 554 or CSC 561.
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.

CSC 565 Graph Theory 3.
Prerequisite: CSC 224 or MA 351.

CSC 566 Enterprise Storage Architecture 3.
Prerequisite: CSC 246 and CSC 401 and CSC 316.
An introduction to storage systems architecture in an enterprise. Begins with a review of the individual components of a system (eg, 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.

CSC 570 Computer Networks 3.
Prerequisite: ECE 206 or CSC 312, ST 371, CSC 258 and Senior standing or Graduate standing.
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.

CSC 573 Internet Protocols 3.
Prerequisite: CSC/ECE 570.
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 fundamental principles applied in practice. Selected examples of networked client/server applications to motivate the functional requirements of internetworking. Project required.

CSC 574 Computer and Network Security 3.
Prerequisite: (CSC 316) and (CSC 401 or CSC/ECE 570).
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.

CSC 575 Introduction to Wireless Networking 3.
Prerequisite: ECE/CSC 570.
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: CSC/ECE 570.
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.

CSC 579 Introduction to Computer Performance Modeling 3.
Prerequisite: CSC 312 or ECE 206 and MA 421.
Workload characterization, collection and analysis of performance data, instrumentation, tuning, analytic models including queuing network models and operational analysis, economic considerations.

CSC 580 Numerical Analysis I 3.
Prerequisite: MA 405; MA 425 or MA 511; high-level computer language.
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.

CSC 582 Computer Models of Interactive Narrative 3.
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.

CSC 583 Introduction to Parallel Computing 3.
Prerequisite: CSC 302 or MA 402 or MA/CSC 428 or MA/CSC 580.
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.
CSC 584 Building Game AI 3.
Prerequisite: CSC 316.
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.

CSC 591 Special Topics In Computer Science 1-6.
Prerequisite: B average in technical subjects.
Topics of current interest in computer science not covered in existing courses.

CSC 600 Computer Science Graduate Orientation 1.
Introduction for new graduate students to (a) information about graduate program, department, and university resources, and (b) research projects conducted by CSC faculty.

CSC 630 Master's Independent Study 1-3.
Individual investigation of topics under the direction of member(s) of the graduate faculty.

CSC 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

CSC 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

CSC 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

CSC 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

CSC 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

CSC 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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: CSC 501.
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.

CSC 707 Automata, Languages and Computability Theory 3.
Prerequisite: CSC 224 required, CSC 333 recommended.
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.

CSC 710 Software Engineering as a Human Activity 3.
Prerequisite: CSC 510.
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.

CSC 712 Software Testing and Reliability 3.
Prerequisite: CSC 510.
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.

CSC 714 Real Time Computer Systems 3.
Prerequisite: CSC 451 or CSC 501.
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-timebenchmarks, case study of a real-time kernel.
CSC 720 Artificial Intelligence II 3.
Prerequisite: CSC 520.
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.

CSC 722 Advanced Topics in Machine Learning 3.
Prerequisite: CSC 520.
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).

CSC 724 Advanced Distributed Systems 3.
Prerequisite: CSC 501 or equivalent. Programming in C++ or Java in Unix environments.
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.

CSC 742 Database Management Systems 3.
Prerequisite: CSC 431 or 541.

CSC 743 Secure Data Management 3.
Prerequisite: CSC/ECE 574 and (CSC 440 or CSC 540). Background in databases and basic security concepts required.
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.

CSC 750 Service-Oriented Computing 3.
Prerequisite: CSC 540: Database Management Concepts and Systems.
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.

CSC 761 Advanced Topics in Computer Graphics 3.
Prerequisite: Graduate standing in Computer Science.
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.

CSC 762 Computer Simulation Techniques 3.
Prerequisite: ST 512 and a scientific programming language.
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.

CSC 766 Code Optimization for Scalar and Parallel Programs 3.
Prerequisite: CSC 512, or CSC 548, or CSC 501.
Advanced research issues in code optimization for scalar and parallel programs; program analysis, scalar and parallel optimizations as well as various related advanced topics.

CSC 772 Survivable Networks 3.
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.

CSC 773 Advanced Topics in Internet Protocols 3.
Prerequisite: CSC/ECE 573.
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.

CSC 774 Advanced Network Security 3.
Prerequisite: CSC/ECE 570, CSC/ECE 574.
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.

CSC 775 Advanced Topics in Wireless Networking 3.
Prerequisite: ECE/CSC 575.
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.
CSC 776 Design and Performance Evaluation of Network Systems and Services 3.
Prerequisite: CSC/ECE 570 and CSC/ECE 579.
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.

CSC 777 Telecommunications Network Design 3.
Prerequisite: CSC/ECE 570.
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.

CSC 778 Optical Networks 3.
Prerequisite: CSC/ECE 573, CSC/ECE 576, CSC/ECE 579, CSC/ECE 570.
A study of optical networks with wavelength division multiplexing (WDM) technology. Topics include: optical fiber and transmission technology; first generation optical networks (SONET); optical access networks; wavelength routing networks; related protocols and standards.

CSC 779 Advanced Computer Performance Modeling 3.
Prerequisite: CSC, ECE or OR 761.
In-depth study of computer performance modeling techniques such as exact and approximate analysis of queuing networks and direct and iterative numerical solutions of queuing systems.

CSC 780 Numerical Analysis II 3.
Prerequisite: MA 580.
Approximation and interpolation, Fast Fourier Transform, numerical differentiation and integration, numerical solution of initial value problems for ordinary differential equations.

CSC 783 Parallel Algorithms and Scientific Computation 3.
Prerequisite: MA/CSC 583, or MA/CSC 580 and some parallel computing. Multiprocessing and vector architectures including current hardware and software. Parallel implementations of numerical linear algebra algorithms for matrix products, linear systems as well as nonlinear algebraic systems and eigenvalue problems. Applications to science and engineering including 3D space and system models.

CSC 791 Advanced Topics In Computer Science 1-6.
Advanced topics of current interest in computer science not covered by existing courses.

CSC 801 Seminar in Computer Science 1-3.
Prerequisite: Graduate standing.
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.

CSC 830 Doctoral Independent Study 1-3.
Individual investigation of advanced topics under the direction of member(s) of the graduate faculty.

CSC 835 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

CSC 890 Doctoral Preliminary Exam 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

CSC 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

D - Design Courses

D 100 Design Thinking I 3.
Design topics including: processes, methods, philosophies, theories and special topics such as making choices in a consensus driven organization or in a collaborative venture. A companion course to the second semester discipline specific Fundamental Studios.

D 101 Design Thinking II 3.
Prerequisite: D100.
This course evolves from the direct application of design thinking principles in the various design disciplines. It is intended to give a variety of perspectives from which to proceed into the design process. Students are expected to write reflections on the material presented in class, to develop a personal philosophy of design statement and to conclude with the construction of a design thought model that represents each student’s thinking process. A review of relevant films and invited lecturers from the design disciplines.

D 102 Design and Performance Evaluation of Network Systems and Services 3.
Prerequisite: CSC/ECE 570.
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.

D 103 Design and Performance Evaluation of Network Systems and Services 3.
Prerequisite: CSC/ECE 570.
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.

D 104 Design and Performance Evaluation of Network Systems and Services 3.
Prerequisite: CSC/ECE 570.
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.

D 105 Design and Performance Evaluation of Network Systems and Services 3.
Prerequisite: CSC/ECE 570.
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.
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.

D 107 Design and Performance Evaluation of Network Systems and Services 3.
Prerequisite: CSC/ECE 570.
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.
D 103 Design Culture and Context II 3.
Prerequisite: D 102.
Design Culture and Context II examines design action and the relationships between design and other systems, chiefly the natural and built environment, society and culture, and technology and economics. Case studies presented by affiliate College of Design faculty, professionals and principle investigators in Universal Design, Natural Learning and Museum Practice will introduce students to the cultural implications of crafting meaningful solutions to current challenges and public needs.

D 104 First Year Studio I 6.
Prerequisite: D 100 and D 102; restricted to Design majors only.
First Year Studio I provides College of Design freshman with a comprehensive introduction to foundational design concepts and methods representative of creative thought and activity across design and artistic disciplines. An integral component of the larger interdisciplinary curricular framework that is a “First Year Experience.” This 4-credit Fall semester course encourages entering freshman to think creatively through design and art, and the world around them, as they secure a skillful level of craftsmanship in the development and making of all studio-based work.

D 105 First Year Studio II 6.
Prerequisite: D 100 and D 104; Corequisite: D 101; Restricted to Design majors only.
First Year Studio II 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 First Year Studio I. Spring semester is an integral component to the larger interdisciplinary curricular framework that is a “First Year Experience”. This four credit Spring semester course encourages First Year Students to think critically about phenomena such as Light Effects, Mechanics and Motion and Human Measurements and Scale. The topics are related to design and students are guided and encouraged to act creatively through design as they secure a skillful level of craftsmanship in the development and making of all studio-based work. In this second semester studio, the students will further exercise their design thinking abilities and improving their skills, methods and knowledge of design practice through assignments related to more focused and smaller scale than the first semester. The st.

D 231 Design History for Engineers and Scientists 3.
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.

D 292 Special Topics in Design 1-3.
Topics of current interest in the college of Design. Used to develop new courses.

D 492 Special Topics in Design 1-6.
Topics of current interest in the College of Design. Used to develop new courses.

D 592 Special Topics in Design 1-6.
Prerequisite: Graduate standing.
Topics of current interest in the College of Design. Used to develop new courses.

D 684 Teaching Design at the College Level 3.
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.

DAN - Dance Courses

DAN 210 Current Trends in Afrocentric and World Dance 1.
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.

DAN 264 Ballet 1.
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.

DAN 272 Dance Composition 1.
Prerequisite: HESD 264 or HESD 274 or permission of instructor.
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; structure; and content. Student will create and perform a complete solo choreographic work in the course. A small fee may be required for dance concert attendance.

DAN 274 Modern Dance I 1.
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.

DAN 275 Modern Dance II 1.
Prerequisite: HESD/DAN 274.
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.

DAN 290 Special Topics in Dance 1-4.
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.
Prerequisite: Audition.
Practical performing experience in a company setting. Rehearsal, performance and production of concert dance.


DAN 498 Independent Study in Dance 1-3.
Prerequisite: DAN 272, DAN 295. Dance Program approval required.
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 Courses” be completed by the student and faculty member prior to registration by the department.
**DDN - Design courses for Graduate Students Courses**

**DDN 685 Master's Supervised Teaching** 1-3.
*Prerequisite: Master's Student.*
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.

**DDN 696 Summer Thesis Res 1.**

**DDN 701 Research Methods in Design** 3.
*Prerequisite: Graduate standing.*
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.

**DDN 702 Research Paradigms in Design** 3.
*Prerequisite: Graduate standing.*
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.

**DDN 771 Design as Cognitive Artifact** 3.
*Prerequisite: Doctoral student, Design Majors, Corequisite: DDN 830 or 831.*
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.

**DDN 772 Design as Cultural Artifact** 3.
*Prerequisite: Doctoral student, Design Majors, Corequisite: DDN 830 or 831.*
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.

**DDN 773 New Information Environments** 3.
*Prerequisite: Doctoral student, Design Majors, Corequisite: DDN 830 or 831.*
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.

**DDN 779 Human Use of the Urban Landscape** 3.
Techniques for documenting and analyzing user needs at cite planning scale. Methods of integrating user needs into design programming in design and redesign projects. Community participation methods. Examples of best practice in design of user-intensive settings in residential, health, education and recreation. Principles of Universal Design. Fieldwork-oriented.

**DDN 795 Special Topics** 3.

**DDN 809 Dissertation Colloquium** 1.
*Prerequisite: Doctoral student.*

**DDN 810 Special Topics** 1-6.

**DDN 830 Independent Study** 1-6.

**DDN 890 Doctoral Preliminary Examination** 1-9.
*Prerequisite: Doctoral student.*
For students who are preparing for and taking written and/or oral preliminary exams.

**DDN 893 Doctoral Supervised Research** 1-9.
*Prerequisite: Doctoral student.*
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

*Prerequisite: Doctoral student.*
Dissertation research.

**DDN 896 Summer Dissertation Research** 1.
*Prerequisite: Doctoral student.*
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.*
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.

**DF - Design Fundamentals Courses**

**DF 101 Design Fundamentals Studio I** 6.
*Prerequisite: Design Majors.*
Introduction to the design disciplines and departments of the College of Design. A studio course examining the techniques and attitudes for dealing with identification, solution and evaluation of problems arising from the design of physical artifacts in the natural and built environment. The design studio process includes the acquisition of languages and skills appropriate to design studies.

**DS - Design Studies Courses**

**DS 101 History of Design I, From Before the Apple to Xia Gui** 3.
DS 101 covers the history of design from caves and 'rude stone monuments' through the Renaissance. It covers both western and European history, as well as the design history of Asia, India, and the Americas. The course will provide students a way of seeing the parallel development of the arts in these various cultures, while providing insight into the impact of early design on later periods of art and design. Required for all Design Studies majors. 15 seats per year will be reserved for Design Studies majors.

**DS 481 Design Studies Senior Research Seminar** 3.
*Prerequisite: Completion of all course work in DS through junior year; Design Studies Majors.*
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.
DS 482 Design Studies Capstone Seminar 1.
Prerequisite: DS 481; Design Studies Majors.
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.
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.

DS 494 Design Studies Internship 1-6.
Prerequisite: Junior or Senior Standing in Design Studies Program; Design Studies Majors.
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.

E - Engineering Courses

E 101 Introduction to Engineering & Problem Solving 1.
Prerequisite: Engineering Majors, Freshman standing.
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.

E 115 Introduction to Computing Environments 1.
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.

E 122 Engineering Academic Success 1.
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.

E 144 Academic and Professional Preparation for Engineering I 1.
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.

E 145 Academic and Professional Preparation for Engineering II 1.
Engineering as a field of study and profession. Career and professional development, goal setting, decision making and effective communication strategies.

E 201 Engineering Transfer to Success 1.
Prerequisite: E101 or Introduction to College Course.
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.

E 298 Special Topics Engineering 1-3.

E 304 Introduction to Nano Science and Technology 3.
Prerequisite: MA 242 and PY 208 with grade of C- or higher.
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: Engineering Majors, Senior standing, Graduate students, or PBS status.
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.

E 497 Engineering Research Projects 1-3.
Prerequisite: Junior standing in College of Engineering, Engineering Scholars Program or Engineering Research Center Scholars.
Projects in research, design or development in engineering or computer science.

E 531 Dynamic Systems and Multivariable Control I 3.
Prerequisite: MA 341, MA 405.
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.

E 731 Dynamic Systems and Multivariable Control II 3.
Prerequisite: OR/MA 531.

EA - Environmental Assessment Courses

EA 502 Environmental Risk Assessment 3.
Prerequisite: Two semester sequence of college biology & college chemistry.
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.
EA 503 Environmental Exposure Assessment 3.
Prerequisite: Two semester sequence of college biology & college chemistry.
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 as 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.

EA 504 Environmental Monitoring and Analysis 3.
Prerequisite: One Year College Biology and One Year College Chemistry.
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.

EA 590 Special Topics in Environmental Assessment 1-3.

EA 665 Professional Project 1-6.
Prerequisite: EA 502, EA 503, and EA 504.
Environmental assessment project conducted under the mentorship of a member of the graduate faculty.

EAC - Adult Higher Education Courses

EAC 301 Introduction to Leadership Fundamentals 3.
Prerequisite: Sophomore standing, Junior standing, or Senior standing.
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.

EAC 496 Special Topics in Adult Learning and Leadership 1-6.
Exploration of specialized areas and topics of current interest in adult learning and leadership.

EAC 517 Current Issues in Higher Education 3.
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.

EAC 522 Foundations of Adult Education 3.
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.

EAC 532 Health Care Delivery Systems and Environments 3.
Prerequisite: Graduate standing.
Organization of health care delivery system, services and recourses. 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.

EAC 536 Issues and Trends In Education For the Health Professions 3.
Prerequisite: Graduate standing.
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.

EAC 538 Instructional Strategies In Adult and Higher Education 3.
Prerequisite: Graduate standing or PBS status.
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.

EAC 539 Teaching in the Online Environment 3.
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.

EAC 540 Foundations of Higher Education and Student Affairs 3.
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.

EAC 541 Administration and Finance of Student Affairs 3.
Prerequisite: EAC 540.
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.

EAC 542 Student Characteristics and the College Environment 3.
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.

EAC 543 Student Development Theory 3.
Prerequisite: EAC 540.
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.

EAC 544 History of the College Student Experience in the United States 3.
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 student experience and the student affairs profession. Graduate standing or PBS status required.
EAC 545 Higher Education Masters Professional Seminar 3.
R: EAC 540 and EAC 542 and EAC 543.
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.

EAC 551 Research in Adult & Higher Education 3.
Prerequisite: Master's students in ACCE.
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.

EAC 552 College Student Retention 3.
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.

EAC 555 Ethics in the Workplace and Education 3.
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.

EAC 556 Organization Change in HRD: Theory & Practice 3.
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.

EAC 559 The Adult Learner 3.
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.

EAC 560 Assessment & Evaluation in Adult & Higher Education 3.
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.

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.

EAC 581 Advanced Instructional Design in Training and Development 3.
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.

EAC 582 Organization and Operation Of Training and Development Programs 3.
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.

EAC 583 Needs Assessment and Task Analysis in Training and Development 3.
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 training programs in business settings. Graduate standing or PBS status required.

EAC 584 Evaluating Training Transfer and Effectiveness 3.
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.

EAC 585 Integrating Technology into Training Program 3.
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/appropriate technologies to support specific training outcomes, adult learner characteristics, and organizational training resources. Graduate standing or PBS status required.

EAC 586 Methods and Techniques Of Training and Development 3.
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.

EAC 587 Marketing for Education and Training Programs 3.
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 mix and formulating marketing plan to guide implementation of strategy.
EAC 595 Special Topics 3.

EAC 602 Seminar In Adult and Higher Education 1-3. 
Prerequisite: Graduate standing. 
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 selected problem. Student acquisition of a broad perspective of issues confronting adult educators and experiences in scientific analysis and solution of specific issues.

EAC 624 Topical Problems In Adult and Community College Education 1-3. 
Prerequisite: Graduate standing or PBS status. 
Study and scientific analysis of problems in adult education and preparation of a scholarly research type of paper. Credits Arranged.

EAC 630 Independent Study in Adult and Community College Education 3. 
Independent study for master’s students in Adult and community College Education. 

EAC 651 Internship In Adult and Community College Education 1-9. 
Prerequisite: Nine hrs. in graduate level courses. 
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.

EAC 685 Master’s Supervised Teaching 1-3. 
Prerequisite: Master’s student. 
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.

EAC 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1. 
Prerequisite: Master’s student. 
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.

EAC 689 Non-Thesis Master Continuous Registration - Full Time Registration 3. 
Prerequisite: Master’s student. 
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.

EAC 692 Research Projects In Education 1-3. 
Prerequisite: EAC 732. 
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.

EAC 693 Master’s Supervised Research 1-9. 
Prerequisite: Master’s student. 
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

EAC 695 Master’s Thesis Research 1-9. 
Prerequisite: Master’s student. 
Thesis research.

EAC 696 Summer Thesis Research 1. 
Prerequisite: Master’s student. 
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.

EAC 699 Master’s Thesis Preparation 1-9. 
Prerequisite: Master’s student. 
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.

EAC 700 Community College and Two-Year Postsecondary Education 3. 
Prerequisite: Graduate standing or PBS status. 
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.

EAC 701 Administrative Concepts and Theories Applied To Adult and Community College Educ 3. 
Prerequisite: EAC 787 or a comparable course(s) on organizational theory. 
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.

EAC 703 The Programming Process In Adult and Community College Education 3. 
Prerequisite: Graduate standing. 
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.

EAC 704 Leadership In Higher and Community College Education 3. 
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 in management improvement and institutional performance in higher education institutions.

EAC 705 Group Process In Adult and Higher Education 3. 
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 applicable to various group situations.

EAC 706 The College and University Presidency 3. 
Prerequisite: EAC 700 or EAC 716. 
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 institutional leader.
EAC 707 The Politics Of Higher Education 3.
Prerequisite: Graduate standing or Management Development Certificate Program and six sem. hrs. of 500-level course work.
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. References to other societies.

EAC 708 Continuing Education for the Professions 3.
Prerequisite: EAC 703, 759.
Theoretical and research literature related to continuing education for the professions. Examination of role of educator in providing and managing continuing professional education.

EAC 710 Adult Education: History, Philosophy, Contemporary Nature 3.
Prerequisite: Advanced Undergraduate standing.
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.

EAC 711 Reflective Practice and Research Inquiry 3.
Initial doctoral seminar to enhance understanding of critically reflective practice, doctoral scholarly inquiry and current issues and debates in adult education scholarship and research.

Prerequisite: Adult Education Doctoral student.
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 development contexts.

EAC 716 History Of Higher Education In the United States 3.
Prerequisite: Six hrs. of grad. ED courses.
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.

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.

EAC 737 The Extension and Public Service Function In Higher Education 3.
Prerequisite: EAC 710.
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.

EAC 743 Adult Development and Learning 3.
Prerequisite: EAC 739.
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.

EAC 745 Death and Dying: A Lifespan Issue 3.
Prerequisite: Graduate standing or PBS status.
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.

EAC 749 Finance in Higher Education 3.
Examination of theory, research, practices and issues in development and management of financial resources in higher education.

EAC 750 The Environment for Learning In Adult and Higher Education 3.
Prerequisite: EAC 710.
Examination of background, history, philosophy and contemporary nature of extension and public service function of institutions of higher education. Specific focus on: general extension, industrial extension, engineering extension, cooperative extension and continuing education.

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.

EAC 755 Adult Development and Learning 3.
Prerequisite: EAC 739.
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.

EAC 759 Adult Learning Theory 3.
Prerequisite: Six semester hours in ED.
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.

EAC 760 Diversity in Higher Education 3.
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.

EAC 761 Gender Studies in Adult Higher Education 3.
Explores 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.
EAC 762 Spirituality in Higher Education 3.

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.

EAC 765 Current Issues in Adult Education 3.
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.

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.

EAC 767 Education Of Special Adult Populations 3.

Analysis and development of adult education responses to needs and characteristics of special adult populations such as nonliterate, unemployed, handicapped and older adults.

EAC 778 Law and Higher Education 3.
Prerequisite: Six hrs. graduate credit.

Constitutional, statutory and case law in relationship to higher education. Emphasis on faculty, student and staff rights and tort liability.

Prerequisite: EAC 703.

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.

EAC 786 Teaching in College 3.

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.


For present and potential administrators interested in increasing their understanding of organizational theories as a basis for administration of effective higher education programs.

EAC 788 Applied Qualitative Data Analysis 3.
Prerequisite: EAC 785.

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.

EAC 790 Advanced Qualitative Research Methods 3.
Prerequisite: EAC 785.

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.

EAC 795 Topical Problems in Adult and Community College Education 1-3.

EAC 802 Seminar In Adult and Higher Education 1-3.
Prerequisite: Graduate standing.

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 selected problem. Student acquisition of a broad perspective of issues confronting adult educators and experiences in scientific analysis and solution of specific issues.

EAC 803 Research Seminar in Adult and Higher Education 3.
Prerequisite: 6 semester hours of course work in research methodology/analysis.

Examination and application of frameworks, processes and compositional approaches in developing research proposals focusing on problems in adult education and higher education.

EAC 824 Topical Problems In Adult and Higher Education 1-3.
Prerequisite: Graduate standing or PBS status.

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.

EAC 830 Independent Study in Adult and Higher Education 3.

Independent study for master’s students in Adult and Higher Education.

EAC 851 Internship In Adult and Higher Education 1-9.
Prerequisite: Nine hrs. in graduate level courses.

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.

EAC 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.

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.

EAC 890 Doctoral Preliminary Exam 1-9.
Prerequisite: Doctoral student.

For students who are preparing for and taking written and/or oral preliminary exams.

EAC 892 Doctoral Research Project 1-3.
Prerequisite: EAC 732.

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: Doctoral student.

Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.

Dissertation research.
EAC 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

EC - Economics Courses

EC 201 Principles of Microeconomics 3.
Credit is not allowed for both EC 201 and EC 205 or ARE 201..
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.

EC 202 Principles of Macroeconomics 3.
Prerequisite: EC 201 or ARE 201 or EC 205.
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.

EC 205 Fundamentals of Economics 3.
Credit is not allowed for both EC 205 and EC 201 or ARE 201 or EC 202..
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.

EC 301 Intermediate Microeconomics 3.
Prerequisite: MA 121 or 131 or MA 141; EC 201 or EC 205 or ARE 201. Credit is not allowed for both EC 301 and EC 310..
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. Credit not allowed in more than one of EC 301, 310, 401.

EC 302 Intermediate Macroeconomics 3.
Prerequisite: (EC 201 or EC 205 or ARE 201) and (MA 121 or MA 131 or MA 141).
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.

EC 305 A Closer Look at Capitalism 3.
Prerequisite: EC 201 or EC 205 or ARE 201..
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: ARE 201 or EC 201 or EC 205.
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 public 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.

EC 337 Introduction to Healthcare Economics 3.
Prerequisite: ARE 201 or EC 201 or EC 205.
This course analyzes changes in health care delivery in the United States in response to complex and changing economic incentives from payers and providers. Impacts of government spending, taxes, deficits on these problems. Trade surpluses/deficits and impact of international events and policies on health care delivery. Credit will not be given for both EC 337 and either ARE 301 or EC 337.

EC 348 Introduction to International Economics 3.
Prerequisite: EC 201 or EC 205 or ARE 201..
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 trade with domestic macroeconomic policies. Current public issues such as economic integration (customs unions and free trade areas), a common European currency, and the role of international trade in economic growth and development.

EC 351 Data Analysis for Economists 3.
Prerequisite: (BUS/ST 350 or ST 302 or ST 361 or ST 370 or ST 372).
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.

Prerequisite: EC 201 or 205 or ARE 201.
The institutional, philosophical and economic foundations of markets. Social and political implications of private property, voluntarism and the forms of social cooperation derived from markets. The effects of market incentives intended to alter the economic outcomes of markets. The morality of markets, legal and institutional settings, cooperation and the nature of exchange, the social function of prices.

Prerequisite: (EC 302 or BUS 320) and (BUS/ST 350, or ST 361, or ST 370, or ST 372). Credit is not allowed for both EC 404 and EC 304..
Roles of money, credit, and financial institutions in the modern economy. Determination of level and structure of interest rates and exchange rates, determination of security prices. Management and regulation of financial institutions. Federal Reserve System and monetary policy. Statistical analysis of financial and monetary data. Credit will not be given for both EC 304 and EC 404.
EC 410 Public Finance 3.
Prerequisite: EC/ARE 301 or EC 310.
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.

EC 413 Competition, Monopoly and Public Policy 3.
Prerequisite: EC/ARE 301 or EC 310.
Current theories of industrial organization with specific reference to such topics as cartels, industrial concentration, vertical integration, franchise contracts, ownership and control of firms, multipart and discriminatory pricing, and tie-in sales. Economic aspects of antitrust law and government regulation of industry.

EC 431 Labor Economics 3.
Prerequisite: EC/ARE 301 or EC 310.
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.

EC 436 Environmental Economics 3.
Prerequisite: EC/ARE 301 or EC 310.
Usefulness of economics in understanding pollution, congestion, conservation and other environmental problems. Relevant economic tools such as pricing schemes, abatement cost curves, damage functions and benefit-cost analysis. Pollution taxes, regulations, marketable permits and subsidies considered in designing alterations, in the incentive system. Current public policy alternatives in the context of non-market decision-making.

EC 437 Health Economics 3.
Prerequisite: EC/ARE 301 or EC 310.
Application of micro-economic tools to the analysis of public and private policy issues concerning health care financing and delivery in the United States.

EC 449 International Finance 3.
Prerequisite: EC/ARE 301 or EC 310.
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.

EC 451 Introduction to Econometrics 3.
Prerequisite: (EC/ARE 301 or EC 310) and EC 302 and EC/ST 351.
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.

EC 452 Forecasting for Business and Economics 3.
Prerequisite: EC 351.
The use of statistical tools to develop forecasts for business and economics. Data collection problems and types of data. Time series approach to forecasting. Use of regressions and surveys for forecasting. Forecast evaluation and presentation of forecasts.

EC 474 Economics of Financial Institutions and Markets 3.
Prerequisite: (MA 121 or MA 131 or MA 141), and [BUS 320 or EC 302]. Management, development and regulation of U.S. financial markets and institutions. Management of major financial intermediaries and their historical development. Analysis of major financial assets and their markets. The role and history of the Federal Reserve and other financial regulators.

EC 480 Introduction to Economic Research 3.
Prerequisite: (EC 301 or EC 310) and (BUS/ST 350, or ST 361, or ST 370, or ST 372).
Finding economic data. Critically analyzing newspaper and journal articles using economic reasoning. Developing, writing, and presenting economic analysis.

EC 489 Research Seminar in Economics 3.
Prerequisite: (EC/ARE 301 or EC 310) and EC 302; and (BUS/ST 350, or ST 302, or ST 361, or ST 370, or ST 372).
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.

EC 491 Economics of Business Strategy 3.
Prerequisite EC 301 or EC 310.
Capstone course for students in the business economics concentration. Application of analytical economics to strategic decisions in business. Students will analyze and present case studies of strategic issues.

EC 495 Special Topics in Economics 1-6.
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.
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/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.

ECD - Counselor Education Courses

ECD 220 College Student Development and Peer Counseling 2.
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 personality inventories and self-assessment instruments. Priority will be given to resident advisors and students active in student organizations or volunteer programs.

ECD 221 Career Planning and Personal Development 3.
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.
ECD 222 Sexual Violence Prevention for Peer Educators 3.
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.

ECD 224 Student Development and Peer Mentoring 2.
Prerequisite: Selection as a Peer Mentor.
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.

ECD 225 Foundations of Cultural Competence 3.
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.

ECD 296 Special Topics in Education: Counselor Education 1-3.
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.

ECD 510 Introduction To Counseling 3.
Prerequisite: Six hrs. in ED or PSY.
Introduction to counseling with a focus on three settings: schools, college and community agencies. Exploration of issues of theory, practice and research with regard to children, adolescents, college students and adults. Personal and professional exploration encouraged through use of psychological tests.

ECD 524 Career Counseling and Development 3.
Prerequisite: Six hrs. in ED or PSY.
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.

ECD 525 Cross Cultural Counseling 3.
Prerequisite: Six hrs. in ED or PSY, Corequisite: ECD 530.
Theory and practice of counseling culturally different 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.

ECD 530 Theories and Tech of Counseling 4.
Prerequisite: Six hrs. in ED or PSY.
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.

ECD 533 Int Sch Counseling 4.
Prerequisite: Graduate standing.
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.

ECD 534 Guidance and Counseling In Elementary and Middle Schools 4.
Prerequisite: Graduate standing.
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 for elementary and middle schools.

ECD 535 Student Development In Higher Education 4.
Prerequisite: Graduate standing or PBS status.
Student development theory, research and practice as well as overview of profession. Three main professional roles of counselor, administrator and student development educator. Discussion of cognitive, psychosocial, topological and person-environment theories and various functions in student affairs. Instruction in and design of structured group work in laboratory.

ECD 536 Community Service Agencies 4.
Prerequisite: Graduate Standing.
Issues, functions and scope of work being done in various human service agency programs; overview of helping approaches with selected client populations; related professional concerns. Instruction in and design of structured group work in laboratory.

ECD 539 Group Counseling 3.
Prerequisite: ECD 530 and one of the following: ECD 510, 534, 535 or 536.
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.

ECD 540 Gender Issues In Counseling 3.
Prerequisite: Graduate standing or Six hrs. in ED or PSY.
Exploration of gender as primary identity and social construct. Emphasis on gender dynamics in counseling, client empowerment and preventive approaches.

ECD 543 Introduction to College Counseling 3.
Prerequisite: ECD 535 or Doctoral student.
A course designed for investigation of college counseling services and strategies. Assessment and research in student development, and students design and implement a developmental intervention based on Knefelkamp and Wells’ Practice-to-Theory-to-Practice model.
ECD 560 Research and Assessment In Counseling 3.
Prerequisite: Graduate standing.
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.

ECD 561 Strategies for Clinical Assessment in Counseling 3.
R: Graduate Students Only.
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.

ECD 562 Techniques in Counseling 4.
Prerequisite: ECD 530.
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.

ECD 590 Special Problems In Guidance 1-6.
Prerequisite: Six hrs. grad. work in dept.
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.

ECD 620 Special Problems In Guidance 1-6.
Prerequisite: Six hrs. grad. work in dept.
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.

ECD 641 Introductory Practicum in Counseling 1.
Prerequisite: ECD 530, 525.
Student participation in introductory supervised individual and group counseling experiences in laboratory setting.

ECD 642 Practicum In Counseling 6.
Prerequisite: ECD 641.
Student participation in individual and group counseling and consultation experiences under supervision in a school, college or agency setting.

ECD 651 Internship In School Counseling 1-9.
Prerequisite: ECD 642.
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 fo school counselors. Weekly meetings with faculty and on-site supervisors.

ECD 652 Internship In College Student Development 1-9.
Prerequisite: ECD 642.
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.

ECD 653 Internship In Agency Counseling 1-9.
Prerequisite: ECD 642.
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: Master's student.
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.

ECD 659-U Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

ECD 692 Research Projects in Counselor Education 1-3.
Prerequisite: ELP 532.
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.

ECD 693 Master's Supervised Research 1-6.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

ECD 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

ECD 731 Career Development Theory and Research 3.
Prerequisite: ECD 524, ELP 532 and PSY 535.
Analysis of theory and research in career development and work adjustment as basis for intervention (career counseling, curricular, organizational) as research.

ECD 733 Cognitive-Behavioral Theory, Research, and Practice 3.
Prerequisite: ECD 737, Corequisite: ST 700.
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.
ECD 735 Counseling Supervision: Theory and Research 3.  
Prerequisite: Doctoral student.
Examination of conceptual and methodological issues relating to supervision and evaluation of novice counselors. Special emphasis on developmental supervision approaches.

ECD 736 Advanced Assessment in Counseling 3.  
Prerequisite: PSY 535 or equivalent.
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.

ECD 737 Cognitive Developmental Theory, Research and Practice 3.  
Prerequisite: Doctoral student; PSY 535, ST 507, Corequisite: ST 508.

ECD 738 Research in Counselor Education 3.  
Prerequisite: Doctoral student; ST 507; PSY 535, Corequisite: ST 508.
Instruction in required skills and knowledge to conduct research in counselor education, including narrative and quantitative integration of research, experimental and quasi-experimental designs, analysis 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.

ECD 740 Advanced Psycho-Social Identity Development: Race, Gender, and Culture 3.  
Prerequisite: ECD 540; ECD 525; Post-master's degree students.
Meansings 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.

ECD 790 Special Problems In Guidance 1-6.  
Prerequisite: Six hrs. grad. work in dept.
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.

ECD 820 Special Problems In Guidance 1-6.  
Prerequisite: Six hrs. grad. work in dept.
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.

ECD 843 Advanced Counseling Practicum 3.  
Prerequisite: Doctoral student, ECD 642.
Participation of doctoral-level students with previous counseling experience in advanced, supervised counseling experience.

ECD 847 Counseling Supervision: Practicum 3.  
Prerequisite: ECD 735.
A supervised practicum for doctoral students in assisting with the supervision of first-year students in laboratory and practicum experiences in individual and group counseling and consultation.

ECD 850 Doctoral Internship 1-9.  
Prerequisite: Nine hrs. in grad. level courses.
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.

ECD 860 Professional Issues In Counseling 1-3.  
Prerequisite: Doctoral student.
Consideration of contemporary issues, trends and recent research in field of counseling.

ECD 886 Supervised Practice Teaching in Counselor Education 3.  
Prerequisite: Doctoral student.
Participation of doctoral students in Counselor Education in teaching of approved master's level or undergraduate courses with graduate faculty members serving as mentors.

ECD 892 Doctoral Research Projects 1-3.
Prerequisite: Doctoral student.
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: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

ECD 896 Summer Dissertation Research 1.  
Prerequisite: Doctoral student.
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.
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.

ECE - Electrical and Computer Engineering Courses

ECE 109 Introduction to Computer Systems 3.
Introduction to key concepts in computer systems. Number representations, switching circuits, logic design, microprocessor design, assembly language programming, input/output, interrupts and traps.
ECE 200 Introduction to Signals, Circuits and Systems 4.
Prerequisite: Cum GPA 2.5 or above, C or.
Ohm's law and Kirchhoff's laws; circuits with resistors, photocells, 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.

ECE 209 Computer Systems Programming 3.
Prerequisite: Grade of C- or better in ECE 109.
Computer systems programming using the C language. Translation of C into assembly language. Introduction to fundamental data structures: array, list, tree, hash table.

ECE 211 Electric Circuits 4.
Prerequisite: C- or better in ECE 200 and Corequisite: ECE 220.
Introduction to theory, analysis and design of electric circuits. Voltage, current, power, energy, resistance, capacitance, inductance. Kirchhoff's laws, nodal analysis, mesh analysis, Thevenin's theorem, Norton's theorem, steady state and transient analysis. AC, DC, Phasors, operational amplifiers, transfer functions.

ECE 212 Fundamentals of Logic Design 3.
Prerequisite: C- or better in ECE 109.
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.

ECE 220 Analytical Foundations of Electrical and Computer Engineering 3.
Prerequisite: C- or better in ECE 200.
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.

ECE 292 Special Topics in Electrical and Computer Engineering 1-3.
Special topics in electrical and computer engineering at the early undergraduate level.

ECE 301 Linear Systems 3.
Prerequisite: C- or better in ECE 211 and ECE 220.

ECE 302 Microelectronics 4.
Prerequisite: A grade of C- or better in ECE 211.
Introduction to the physics of semiconductors, PN junctions, BJT 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.

ECE 303 Electromagnetic Fields 3.
Prerequisite: A grade of C- or better in ECE 211 and ECE 220.
This course prepares 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.

ECE 305 Principles of Electromechanical Energy Conversion 3.
Prerequisite: C- or better in ECE 211 or ECE 331.
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.

ECE 306 Introduction to Embedded Systems 3.
Prerequisite: C- or better in ECE 209 and ECE 212.
Introduction to designing microcontroller-based embedded computer systems using assembly and C programs to control input/output peripherals. Use of embedded operating system.

ECE 308 Elements of Control Systems 3.
Prerequisite: (ECE 220 and ECE 211) or BME 311; Co-requisite: ECE 301.
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.

ECE 309 Object-Oriented Programming for Electrical and Computer Engineers 3.
Prerequisite: C- or better in ECE 209.

ECE 310 Design of Complex Digital Systems 3.
Prerequisite: A grade of C- or better in ECE 212.
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 descriptions. Design and test of increasingly complex systems.
ECE 331 Principles of Electrical Engineering 3.
Prerequisite: Grade of C or better MA 241, PY 208.
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.

ECE 380 Engineering Profession for Electrical Engineers 1.
Prerequisite: ECE 212, ECE 301, and ECE 302.
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.

ECE 381 Engineering Profession for Computer Engineers 1.
Prerequisite: ECE 212, ECE 301, and ECE 302.
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.

ECE 383 Introduction to Entrepreneurship and New Product Development 1.
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 design and implementation of the prototype product.

ECE 402 Communications Engineering 3.
P: ECE 301 and ST 371; R: EE and CPE Majors Only.
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.

ECE 403 Electronics Engineering 3.
Prerequisite: ECE 301, ECE 302.
Design and analysis of CMOS integrated circuits, from single transistor stages to operational amplifiers. Feedback in operational amplifier circuits, compensation and stability. ECE majors only.

ECE 404 Introduction to Solid-State Devices 3.
P: ECE 302 or E 304; C: EE, CPE, NanoScience and Technology Majors Only.
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 applications.

ECE 407 Introduction to Computer Networking 3.
Prerequisite: ECE 301.
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.

ECE 420 Wireless Communication Systems 3.
Prerequisite: ECE 402.
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.

ECE 421 Introduction to Signal Processing 3.
Prerequisite: ECE 301.

ECE 422 Transmission Lines and Antennas for Wireless 3.
Prerequisite: ECE 303.
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.

ECE 423 Introduction to Photonics and Optical Communications 3.
Prerequisite: ECE 303 or Permission of the Instructor.
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.

ECE 434 Fundamentals of Power Electronics 3.
Prerequisite: ECE 302 or equivalent.
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.

ECE 435 Elements of Control Systems 3.
Prerequisite: ECE 301.
Analogue 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.

ECE 436 Digital Control Systems 3.
Prerequisite: ECE 435.
Discrete systems 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 analyses. Design and implementation of digital controllers.

ECE 442 Integrated Circuit Technology and Fabrication 3.
Prerequisite: ECE 404.
Semiconductor device and integrated-circuit processing and technology. Wafer specification and preparation, oxidation, diffusion, ion implantation, photolithography, design rules and measurement techniques.
ECE 445 Frontiers of Nanoelectronics 3.
Prerequisite: ECE 302.
This course will discuss frontiers of nanoelectronics including fundamentals of silicon based devices and their impact on scaled logic and memory devices as well as organic based devices such as carbon nanotubes and molecular electronics. Additional topics include recent uses of polymer films for memory and photovoltaic applications, quantum confinements in 1D, 2D, and 3D, quantum dots, nanowires and resonant tunneling devices. Included are methods to create and measure nanostructures.

ECE 451 Power System Analysis 3.
Prerequisite: ECE 305.
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 or ECE 331.
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.

ECE 453 Electric Motor Drives 3.
Prerequisite: A grade of C or better in ECE 305.
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.

ECE 455 Industrial Robotic Systems 3.
Prerequisite: ECE 308.
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.

ECE 456 Mechatronics 3.
Prerequisite: ECE 435.
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.

ECE 461 Embedded System Design 3.
Prerequisite: Grade of C- or better in ECE 306.
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.

ECE 463 Advanced Microprocessor Systems Design 3.
Prerequisite: ECE 406.
Advanced topics in microprocessor systems design, including processor architectures, virtual-memory systems, multiprocessor systems, and single-chip microcomputers. Architectural examples include a variety of processors of current interest, both commercial and experimental. Major design project.

ECE 464 ASIC Design 3.
Prerequisite: ECE 406, ECE 302.
Design of digital application specific integrated circuits (ASICs) based on hardware description languages (Verilog, VHDL) and CAD tools. Emphasis on design practices and underlying algorithms. Introduction to deep sub-micron design issues like interconnections and low power and to modern applications including multi-media, wireless. Telecommunications and computing. Required design project.

ECE 466 Compiler Optimization and Scheduling 3.
Prerequisite: ECE 306 and either ECE 309 or CSC 316.
Provide insight into current compiler designs dealing with present and future generations of high performance processors and embedded systems. Investigate dataflow analysis and memory disambiguation, classical and parallelism enhancing optimizations, scheduling and speculative execution, and register allocation. Review of techniques used in current research compilers.

ECE 468 Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems 3.
Prerequisite: E 304.
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.

ECE 470 Internetworking 3.
Prerequisite: ECE 407 or CSC 401.
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.

ECE 480 Senior Design Project in Electrical Engineering 3.
Prerequisite: ECE 301, ECE 302, ECE 303, ECE 380, and any two ECE specialization Courses.
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.
ECE 481 Senior Design Project in Computer Engineering 3.
Prerequisite: ECE 381, ECE 301, ECE 302, ECE 303, ECE 406 and an ECE specialization elective.
Application of engineering and basic sciences to the total design of computer 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.

ECE 482 Engineering Entrepreneurship and New Product Development I 3.
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.

ECE 483 Engineering Entrepreneurship and New Product Development II 3.
Prerequisite: ECE 301, ECE 302, ECE 303, and any two ECE specialization courses.
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.

ECE 484 Electrical and Computer Engineering Senior Design Project I 3.
Prerequisite: ECE 380 and ECE 301 and ECE 302 and ENG 331; Coreq: One 400-level ECE Elective.
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.

ECE 485 Electrical and Computer Engineering Senior Design Project II 3.
Prerequisite: ECE 484.
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.

ECE 492 Special Topics in Electrical and Computer Engineering 1-4.
Offered as needed for development of new courses in electrical and computer engineering.

ECE 495 Individual Study in ECE 1-3.
P: Appropriate 300-level Course; R: EE and CPE Majors Only. Department Approval Required.
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 member prior to registration by the department.

ECE 506 Architecture Of Parallel Computers 3.
Prerequisite: ECE 406.

ECE 511 Analog Electronics 3.
Prerequisite: ECE403.
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 switched-capacitor filters. Strong emphasis on use of computer modeling and simulation as design tool. Students required to complete an independent design project.

ECE 513 Digital Signal Processing 3.
Prerequisite: ECE 421, B average in ECE and MA; Signals and Linear Systems.
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.

ECE 514 Random Processes 3.
Prerequisite: Statistics 371; Signals and Linear Systems; Linear Algebra; Calculus.
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.

ECE 515 Digital Communications 3.
Prerequisite: ECE 514, ST 371, Signals and Linear Systems; Linear Algebra.
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.
ECE 516 System Control Engineering 3.
Prerequisite: ECE 435 or ECE 301.
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.

ECE 517 Object-Oriented Design and Development 3.
Prerequisite: CSC 326 or ECE 309.
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.

ECE 520 Digital Asic Design 3.
Prerequisite: ECE 212 and Senior or Graduate standing.
Design of digital Application Specific Integrated Circuits (ASICs) based on Hardware Description Languages (Verilog, VHDL) and CAD tools, particularly login synthesis. Emphasis on design practices and underlying algorithms. Introduction to timing-driven design, low-power design, design-for-test and ASIC applications. Project.

ECE 521 Computer Design and Technology 3.
Prerequisite: ECE 306.
Design of general-purpose computers through cost-performance analysis. Emphasis on making design decisions regarding the instruction set architecture and organization of single-processor computer. Discussion of design choices, role of compiler and techniques for analysis, simulation and implementation. Consideration of relationships between architecture, organization and technology.

ECE 522 Medical Instrumentation 3.
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.

ECE 523 Photonics and Optical Communications 3.
Prerequisite: Graduate standing or Senior standing; Engineering Majors or Physics Majors.
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.

ECE 530 Physical Electronics 3.
Prerequisite: ECE 303, B average in ECE and MA.
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.

ECE 531 Principles Of Transistor Devices 3.
Prerequisite: ECE 404.
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 MISFET'S, HEMT's, Bipolar transistors, PBT's, heterojunction BJ'T's and SIT's.

ECE 532 Principles Of Microwave Circuits 3.
Prerequisite: ECE 422.
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 millimeter-wave frequencies. Discussion of circuit components operating at these frequencies.

ECE 534 Power Electronics 3.
Prerequisite: ECE 302.
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.

ECE 535 Design of Electromechanical Systems 3.
Prerequisite: MA 341.
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.

ECE 536 Digital Control Systems 3.
Prerequisite: ECE 435 and Graduate Standing in Engineering.
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.

ECE 538 Integrated Circuits Technology and Fabrication 3.
Prerequisite: ECE 404.

ECE 540 Electromagnetic Fields 3.
Prerequisite: ECE 422.
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.
ECE 452 Neural Networks 3.
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.

ECE 454 Design Of Electronic Packaging and Interconnects 3.
Prerequisite: ECE 302.
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.

ECE 456 VLSI Systems Design 3.
Prerequisite: ECE 302.
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.

ECE 457 Cloud Computing Technology 3.
Prerequisites: CSC 501 and ECE/CSC 570.
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-, and high-performance computing - “as-a-service”.

ECE 459 RF Design for Wireless 3.
Prerequisite: ECE 303, ECE 302.
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.

ECE 551 Smart Electric Power Distribution Systems 3.
Prerequisite: ECE 451.
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 305 or ECE 331.
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.

ECE 553 Semiconductor Power Devices 3.
Prerequisite: ECE 404.
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.

ECE 555 Computer Control of Robots 3.
Prerequisite: ECE 435; ECE 436; ECE 456.
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 456 and 555.

ECE 556 Agent-based Mechatronics Systems 3.
Prerequisite: ECE 301.
Agent and systems concepts to study sensors, actuators, controllers and communication networks, as well as their interactions. Theory, design and control of the integration of sensors, interfaces, actuators, microcontrollers. Use of computer networks as communication media in the mechatronics systems integration and control. Use of unmanned vehicle path tracking and teleoperation to illustrate the mechatronics agent and system concept and integration. Students can either take ECE 456 or ECE 556, but not both. These two courses are piggy-backed and cover similar material, yet ECE 556 has more demanding homeworks, project, and an exam that are at the graduate level.

ECE 557 Principles Of MOS Transistors 3.
Prerequisite: ECE 404.
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.

ECE 558 Digital Imaging Systems 3.
Prerequisites: ECE 301 and ST 372.
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.

ECE 561 Embedded System Design 3.
Prerequisite: ECE 306.
Design and implementation of embedded computer systems. The student will extend previous knowledge of the use of microcontrollers, C and assembly programming, real-time methods, computer architecture, simulation, 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.
ECE 566 Code Generation and Optimization 3.
Prerequisite: ECE 306 and CSC 316.
Provide insight into current compiler designs dealing with present and future generations of high performance processors and embedded systems. Investigate dataflow analysis and memory disambiguation, classical and parallelism enhancing optimizations, scheduling and speculative execution, and register allocation. Review of techniques used in current research compilers. Students may not take both 466 and 566 for credit.

ECE 568 Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems 3.
Prerequisite: Graduate Standing or Permission of the Instructor.
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.

ECE 570 Computer Networks 3.
Prerequisite: ECE 206 or CSC 312, ST 371, CSC 258 and Senior standing or Graduate standing.
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.

ECE 573 Internet Protocols 3.
Prerequisite: CSC/ECE 570.
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 fundamental principles applied in practice. Selected examples of networked client/server applications to motivate the functional requirements of internetworking. Project required.

ECE 574 Computer and Network Security 3.
Prerequisite: (CSC 316) and (CSC 401 or CSC/ECE 570).
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.

ECE 575 Introduction to Wireless Networking 3.
Prerequisite: ECE/CSC 570.
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: CSC/ECE 570.
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.

ECE 577 Introduction to Computer Performance Modeling 3.
Prerequisite: CSC 312 and MA 421.
Workload characterization, collection and analysis of performance data, instrumentation, tuning, analytic models including queuing network models and operational analysis, economic considerations.

ECE 581 Electric Power System Protection 3.
Prerequisite: ECE 451.
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.

ECE 582 Wireless Communication Systems 3.
Prerequisite: Senior level digital communications course, e.g., ECE402, Corequisite: ECE 714.
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 multipathchannel, 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.

ECE 583 Electric Power Engineering Practicum I 3.
Prerequisite: ECE 451.
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 to both expert and novice audiences in project management reports and presentations. Restricted to Master of Science in Electric Power Systems Engineering.

ECE 584 Electric Power Engineering Practicum II 3.
Prerequisite: ECE 583.
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 451.
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.
ECE 586 Communication and SCADA Systems for Smart Grid 3.  
R: Graduate Students Only.  
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.

ECE 591 Special Topics In Electrical Engineering 3.  
Prerequisite: B average in technical subjects.  
Two-semester sequence to develop new courses and to allow qualified  
students to explore areas of special interest.

ECE 592 Special Topics In Electrical Engineering 1-3.  
Prerequisite: B average in technical subjects.  
Two-semester sequence to develop new courses and to allow qualified  
students to explore areas of special interest.

ECE 600 ECE Graduate Orientation 1.  
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 starting graduate studies. Overview  
of on-going research projects by faculty members. Must hold graduate  
standing.

ECE 633 Individual Topics In Electrical Engineering 1-3.  
Prerequisite: B average in technical subjects.  
Provision of opportunity for individual students to explore topics of special  
interest under direction of a member of faculty.

ECE 634 Individual Studies In Electrical Engineering 1-3.  
Prerequisite: Graduate standing.  
The study of advanced topics of special interest to individual students  
derived from direction of faculty members.

ECE 685 Master's Supervised Teaching 1-3.  
Prerequisite: Master’s student.  
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.

ECE 688 Non-Thesis Masters Continuous Registration - Half Time  
Registration 1.  
Prerequisite: Master’s student.  
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.

ECE 689 Non-Thesis Master Continuous Registration - Full Time  
Registration 3.  
Prerequisite: Master’s student.  
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.

ECE 690 Master's Exam 1-6.  
ECE 693 Master's Supervised Research 1-9.  
Prerequisite: Master's student.  
Instruction in research and research under the mentorship of a member  
of the Graduate Faculty.

Prerequisite: Master's student.  
Thesis research.

ECE 696 Summer Thesis Research 1.  
Prerequisite: Master's student.  
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.  
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.

ECE 703 Integrated Bioelectronic Circuits 3.  
Prerequisite: ECE 511, ECE 546.  
Analog and mixed-signal integrated circuits in design of biomedical  
applications; detailed discussion of circuit blocks such as voltage  
and current references, current sources, amplifiers, regulators, filters,  
switched capacitor circuits, A/D, and D/A converters, as well as low-  
power, low-noise, and wireless circuit design techniques with emphasis  
on biomedical applications. Research project and presentation required.

ECE 705 Memory Systems 3.  
Prerequisite: ECE 521, Computer Design and Technology.  
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.

ECE 706 Advanced Parallel Computer Architecture 3.  
Prerequisite: ECE/CSC 506, ECE 521.  
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.

ECE 712 Integrated Circuit Design for Wireless Communications 3.  
Prerequisite: ECE 511.  
Analysis, simulation, and design of the key building blocks of an  
integrated radio: amplifiers, mixers, and oscillators. Topics include  
detailed noise optimization and linearity 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.

ECE 718 Computer-Aided Circuit Analysis 3.  
Prerequisite: ECE 511.  
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.
ECE 719 Microwave Circuit Design Using Scattering Parameters 3.  
Prerequisite: ECE 540, ECE 549.
Development and examination of techniques for design of microwave and millimeter wave components and systems. Specific topics include mixer, oscillator and amplifier performance and design. This course will focus on the use of S-parameters to aid in the design of circuits used in mm-wave and microwave circuits. Emphasis will be made on the microwave/mm-wave properties of transistors, matching networks and how these properties are utilized for design for noise, power, mixer or oscillator performance. Computer aided design techniques will be addressed.

ECE 720 Electronic System Level and Physical Design 3.  
Prerequisite: ECE 520.
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.

ECE 721 Advanced Microarchitecture 3.  
Prerequisite: ECE 521.
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.

ECE 722 Electronic Properties of Solid-State Materials 3.  
Prerequisite: ECE 530.
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.

ECE 723 Optical Properties Of Semiconductors 3.  
Prerequisite: ECE 530.
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.
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.

ECE 725 Quantum Engineering 3.  
Prerequisite: ECE 530, and PY 401.
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.

ECE 726 Advanced Feedback Control 3.  
Prerequisite: ECE 516.
Advanced topics in dynamical systems and multivariable control. Current research and recent developments in the field.

ECE 727 Semiconductor Thin Film Technology 3.  
Prerequisite: ECE 404.
Techniques and processes encountered in growth and characterization of epitaxial semiconductor thin films. Interactions of gases at solid interfaces and gas phase dynamics related to epitaxial processes. Example of growth techniques are: solution growth, molecular beam epitaxy and chemical vapor deposition. Film characterization includes electrical, structural, optical, and chemical techniques. Issues involved in epitaxial growth such as: lattice match, critical layer thickness, heterostructures, superlattices and quantum wells.

ECE 732 Dynamics and Control of Electric Machines 3.  
Prerequisite: ECE 453 or ECE 592.
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.

ECE 733 Digital Electronics 3.  
Prerequisite: ECE 546.
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.

ECE 734 Power Management Integrated Circuits 3.  
Prerequisite: ECE 511 and ECE 534.
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.

ECE 736 Power System Stability and Control 3.  
Prerequisite: ECE 451 and ECE 750.

ECE 739 Integrated Circuits Technology and Fabrication Laboratory 3.  
Prerequisite: ECE 538.
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.

ECE 743 High Performance Multicomputer Architecture 3.  
Prerequisite: ECE 506.
ECE 745 ASIC Verification 3.
Prerequisite: ECE 520.
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 513, Corequisite: ECE 520.
Design of parallel algorithms and special purpose architectures for digital signal and image processing applications with emphasis on high-speed communications and computational engineering. Mapping digital signal and image processing algorithms to pipeline arrays, systolic arrays, wave-front arrays and other parallel architectures. Register transfer level design of application-specific and special-purpose digital processing systems.

ECE 751 Detection and Estimation Theory 3.
Prerequisite: ECE 514, ECE 421.
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; Bayesien methods, including Wiener, Kalman and MAP filters; performance measures; applications to both continuous and discrete systems.

ECE 752 Information Theory 3.
Prerequisite: ECE 514; Random Processes.
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.

ECE 755 Advanced Robotics 3.
Prerequisite: ECE 555; MAE 544.
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.

ECE 756 Advanced Mechatronics 3.
Prerequisite: ECE 456 or ECE 556 with a Grade B+ and above.
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.

ECE 759 Pattern Recognition 3.
Prerequisite: ECE/CSC 514, ST 371, B average in ECE and MA.
Image pattern recognition techniques and computer-based methods for scene analysis, including discriminant functions, feature extraction, classification strategies, clustering and discriminant analysis. Coverage of applications and current research results.

ECE 761 Design Automation For VLSI 3.
Prerequisite: ECE 546 VLSI Systems Design.
VLSI CAD (computer-aided-design) tools research: physical design automation—layout, module generator, silicon compiler; optimization techniques: graph theory, simulated evolution, simulated annealing. Projects required.

ECE 762 Advanced Digital Communications Systems 3.
Prerequisite: ECE 515.
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.

ECE 763 Computer Vision 3.
Prerequisite: ECE 558 and ECE 514.
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, shape representation, 3-D object recognition including graph matching.

ECE 766 Signal Processing for Communications & Networking 3.
Prerequisite: Graduate standing.
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; multi-user 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.

ECE 767 Error-Control Coding 3.
Prerequisite: ECE 514 Random Processes; linear algebra at the undergraduate level is strongly recommended.
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.

ECE 772 Survivable Networks 3.
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.
ECE 773 Advanced Topics in Internet Protocols 3.
Prerequisite: CSC/ECE 573.
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.

ECE 774 Advanced Network Security 3.
Prerequisite: CSC/ECE 570, CSC/ECE 574.
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.

ECE 775 Advanced Topics in Wireless Networking 3.
Prerequisite: ECE/CSC 575.
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.

ECE 776 Design and Performance Evaluation of Network Systems and Services 3.
Prerequisite: CSC(ECE) 570 and CSC(ECE) 579.
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.

ECE 777 Telecommunications Network Design 3.
Prerequisite: ECE 570, ECE 579.
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.

ECE 778 Optical Networks 3.
Prerequisite: CSC/ECE 573, CSC/ECE 576, CSC/ECE 579, CSC/ECE 570.
A study of optical networks with wavelength division multiplexing (WDM) technology. Topics include: optical fiber and transmission technology; first generation optical networks (SONET); optical access networks; wavelength routing networks; related protocols and standards.

ECE 779 Advanced Computer Performance Modeling 3.
Prerequisite: CSC, ECE or OR 761.
In-depth study of computer performance modeling techniques such as exact and approximate analysis of queuing networks and direct and iterative numerical solutions of queuing systems.

ECE 781 Special Studies In Electrical Engineering 3.
Opportunity for small groups of advanced graduate students to study topics in their special fields of interest under direction of members of graduate faculty.

ECE 782 Special Studies In Electrical Engineering 3.
Opportunity for small groups of advanced graduate students to study topics in their special fields of interest under direction of members of graduate faculty.

ECE 783 Computer Engineering Research Presentation 1.
Prerequisite: Two semesters of ECE 803.
Students work with instructor to prepare and give a technical research presentation at the level similar to those given at an international research symposium. Students may not be enrolled in both 783 and 803 in the same semester.

ECE 785 Topics in Advanced Computer Design 3.
Prerequisite: ECE 520, ECE 521.
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.

ECE 786 Topics in Advanced Computer Architecture 3.
Prerequisite: ECE 521, ECE/CSC 506.
In-depth study of research topics in computer architecture; mechanisms and their implementations; advantages and disadvantages of various mechanisms; technology shifts, trends, and constraints.

ECE 791 Special Topics In Electrical Engineering 3.
Prerequisite: B average in technical subjects.
Two-semester sequence to develop new courses and to allow qualified students to explore areas of special interest.

ECE 792 Special Topics In Electrical Engineering 3.
Prerequisite: B average in technical subjects.
Two-semester sequence to develop new courses and to allow qualified students to explore areas of special interest.

ECE 801 Seminar in Electrical and Computer Engineering 1-3.

ECE 803 Seminar in Computer Engineering 1-3.

ECE 804 Seminar in Comm/Sig PR 1-3.

ECE 805 Seminar in Solid State 1-3.

ECE 833 Individual Topics In Electrical Engineering 1-3.
Prerequisite: B average in technical subjects.
 Provision of opportunity for individual students to explore topics of special interest under direction of a member of faculty.

ECE 834 Individual Studies In Electrical Engineering 1-3.
Prerequisite: Graduate standing.
The study of advanced topics of special interest to individual students under direction of faculty members.

ECE 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

ECE 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking write and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student.
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.

ECG - Graduate Economics Courses

ECG 505 Applied Microeconomic Analysis 3.
Prerequisite: EC 301 and MA 121.

ECG 506 Applied Macroeconomic Analysis 3.
Prerequisite: EC 302 and MA 121.
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.

ECG 512 Law and Economics 3.
Prerequisite: EC(ARE) 301 or EC(ARE) 401.
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.

ECG 515 Environmental and Resource Policy 3.
Prerequisite: EC(ARE) 301 or 401.
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.

ECG 528 Asset Pricing 3.
Prerequisite: MA 301, MA 305 and MA 421.
Introduction to major fundamental assets (stocks and bonds), interest rates, and derivative assets, such as put and call options. Arbitrage theorem, present value, risk aversion, hedging, duration, properties of derivative assets, binomial trees, elementary stochastic calculus, Black-Scholes option pricing formula, implied volatility, capital asset pricing model. Emphasis on mathematical methods used to price derivative assets.

ECG 537 Health Economics 3.
Prerequisite: EC(ARE) 401 or ECG 700.
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.

ECG 540 Economic Development 3.
Prerequisite: EC(ARE) 301 or 401.
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 301.
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.

ECG 561 Intermediate Econometrics 3.
Prerequisite: ST 514.
Formalization of economic hypotheses into testable relationships and application of appropriate statistical techniques. Major attention to procedures applicable for single equation stochastic models expressing microeconomic and macroeconomic relationships. Statistical considerations relevant in working with time series and cross sectional data in economic investigations. Survey of simultaneous equation models and the available estimation techniques.

ECG 562 Topics in Applied Econometrics 3.
Prerequisite: ECG(ST) 561.
Application of advanced econometric techniques to selected issues in economics. Practice in presenting econometrics results in professional fashion, in written or oral form.

ECG 580 Writing in Economics 3.
Corequisite: ECG 505 or ECG 700; ECG 506 or ECG 703; and ECG 561.
Developing, writing and presenting economic analyses of empirical issues chosen by each student.

ECG 590 Special Economics Topics 1-6.
Examination of current problems on a lecture-discussion basis. Course content varies as changing conditions require new approaches to deal with emerging problems.

ECG 630 Independent Study 1-3.

ECG 685 Master’s Supervised Teaching 1-3.
Prerequisite: Master’s student.
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.

ECG 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master’s student.
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.
ECG 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

ECG 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.
Theory research.

ECG 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

ECG 700 Fundamentals of Microeconomics 3.
Prerequisite: MA 131 and EC(ARE)301.

ECG 701 Microeconomics I 3.
Prerequisite: ECG 700, MA 231.

ECG 702 Microeconomics II 3.
Prerequisite: ECG 701.

ECG 703 Fundamentals of Macroeconomics 3.
Prerequisite: EC(ARE) 301, EC 302, BUS(ST)/350, MA 131.
Fundamental topics in macroeconomics, including consumption, investment, government purchases, taxation, government debt, output supply, money and inflation, unemployment, elementary economic growth. Emphasis is on the macroeconomic foundations of macroeconomics. Economic intuition is stressed.

ECG 704 Macroeconomics I 3.
Prerequisite: ECG 561, ECG 703, MA 242.
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.

ECG 705 Macroeconomics II 3.
Prerequisite: ECG 704.
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.

ECG 706 Industrial Organization 3.
Prerequisite: ECG 700.
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.

ECG 707 Topics In Industrial Organization 3.
Prerequisite: ECG 700.
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.

ECG 715 Environmental and Resource Economics 3.
Prerequisite: ECG 700.
Theoretical tools and empirical techniques necessary for understanding of 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.

ECG 716 Topics In Environmental and Resource Economics 3.
Prerequisite: ECG 715.
Advanced study of selected topics in environmental and resource economics. Topics vary with interests of instructor and students.

ECG 730 Labor Economics 3.
Prerequisite: ECG 700 and one of the following: ECG(ST) 561, ST 422, ST 512, ST 708.
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.

ECG 731 Policy and Research Issues In Labor Economics 3.
Prerequisite: ECG 700 and one of the following: ECG(ST) 561, ST 422, ST 512, ST 708 policy-related issues in labor economics, including trade union behavior.
Survey of current literature on policy-related issues in labor economics, including trade union behavior, unemployment, macroeconomic aspects of labor market adjustment, discrimination, regulation of wages and benefits and public-sector labor markets. Examples from labor markets in U.S. and developing countries. Recent research developments in labor economics; topics vary according to interests and needs of students.
ECG 739 Economics Growth and Development I 3.
Prerequisite: ECG 701 and ECG 705, Corequisite: ECG 751.
Macroeconomic issues of economic development, principally the
economics of growth. Review of neoclassical growth theory, followed
by extensive study of endogenous growth models. Two-sector models,
models with intermediate inputs (both variety and quality-ladder models),
endogenous labor and population, trade and growth, and the diffusion of
technology across countries. Approximately equal time devoted to theory
and evidence.

ECG 740 Economic Growth and Development II 3.
Prerequisite: ECG 701 and ECG 705, Corequisite: ECG 751.
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.

ECG 741 Agricultural Production and Supply 3.
Prerequisite: ECG 700.
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.

ECG 742 Consumption, Demand and Market Interdependency 3.
Prerequisite: ECG 700.
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.

ECG 743 Theory of International Trade 3.
Prerequisite: ECG 700, 703.
Consideration of specialized body of economic theory dealing with
international movement of goods, services, capital and payments. A
theoretically oriented consideration of policy.

ECG 744 Monetary Aspects of International Trade 3.
Prerequisite: ECG 703.
Macroeconomic problems of an open economy including balance of
payments adjustment mechanism, alternative exchange rate systems,
effects of monetary and fiscal policy, optimum currency areas and
international monetary reform.

ECG 750 Introduction to Econometric Methods 3.
Prerequisite: ST 421; Corequisite: ST 422.
Introduction to principles of estimation of linear regression models, such
as ordinary least squares and generalized least squares. Extensions to
state 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.

ECG 751 Econometric Methods 3.
Prerequisite: ST 421, ST 422.
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.

ECG 752 Time Series Econometrics 3.
Prerequisite: ECG(ST) 751.
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; vector
autoregressive (VAR) models. Linear models for nonstationary data:
deterministic and stochastic trends; cointegration. Methods for capturing
volatility of financial time series such as autoregressive conditional
heteroscedasticity (ARCH) models. Generalized Method of Moments
estimation of nonlinear dynamic models.

ECG 753 Microeconometrics 3.
Prerequisite: ECG 751.
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. Panel data models: balanced
and unbalanced panels; fixed and random effects; dynamic panel data
models; limited dependent variables and panel data analysis.

ECG 754 Advanced Macroeconomics 3.
Prerequisite: (ECG 701 and ECG 705, Corequisite: ECG 751.
Macroeconomic issues of economic development, principally the
economics of growth. Review of neoclassical growth theory, followed
by extensive study of endogenous growth models. Two-sector models,
models with intermediate inputs (both variety and quality-ladder models),
endogenous labor and population, trade and growth, and the diffusion of
technology across countries. Approximately equal time devoted to theory
and evidence.

ECG 755 Advanced Macroeconomics 3.
Prerequisite: ECG 704.
Advanced study of macroeconomics. 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.

ECG 756 Monetary Economics 3.
Prerequisite: ECG 705.
Field course for students desiring a specialization in monetary economics
or macroeconomics. Survey of current topics in monetary theory and
policy.
**ECG 790 Avanced Special Topics 1-6.**
**ECG 830 Independent Study 1-3.**
**ECG 885 Doctoral Supervised Teaching 1-3.**
*Prerequisite: Doctoral student.*
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.

**ECG 890 Doctoral Preliminary Examination 1-9.**
*Prerequisite: Doctoral student.*
For students who are preparing for and taking written and/or oral preliminary exams.

**ECG 895 Doctoral Dissertation Research 1-9.**
*Prerequisite: Doctoral student.*
Dissertation research.

**ECG 896 Summer Dissertation Research 1.**
*Prerequisite: Doctoral student.*
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.

**ECG 899 Doctoral Dissertation Preparation 1-9.**
*Prerequisite: Doctoral student.*
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.

**ECI - Curriculum and Instruction Courses**

**ECI 102 Introduction to Middle Grades Education 2.**
*Prerequisite: MSL Majors and unclassified students in MSL.*
Introduction to the Middle Grades Academy and middle school teaching from the perspective of “What do I bring to teaching?” Students will formulate an initial teaching philosophy as well as engage in an introspective examination of their beliefs, attitudes, talents, strengths, and weaknesses in relation to teaching early adolescents. Students are required to provide their own transportation.

**ECI 201 Intro to Instructional Technology for Educators 3.**
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.

**ECI 204 Intro to Teaching 1-2.**
*Prerequisite: Sophomore standing; Corequisite: ED 204.*
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.

**ECI 205 Introduction to Teaching Humanities and social Sciences 3.**
*Prerequisite: Sophomore standing.*
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.

**ECI 296 Special Topics in Education 1-3.**
Individual or group study of particular areas of education at the freshman and sophomore levels. Specific topics will vary from semester to semester.

**ECI 305 Principles of Teaching Diverse Populations 3.**
*Prerequisite: ED 204.*
Impact of cultural factors on experiences of teachers and students in contemporary schools. Teaching techniques and development of instructional plans to enhance schooling experiences of culturally diverse students.

**ECI 306 Middle Years Reading 3.**
*Prerequisite: Six hours in ED or PSY.*
Reading skills in middle years education developed with emphasis on application of the reading process to content area.

**ECI 307 Teaching Writing Across the Curriculum 3.**
*Prerequisite: ENG 112.*
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.

**ECI 309 Teaching in the Middle Years 3.**
*Prerequisite: Six hours in ED or PSY.*
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.

**ECI 332 Health Promotion and Disease Prevention 3.**
*Prerequisite: For credentialed health professionals only.*
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.

**ECI 333 Health Care Delivery 3.**
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.**
*Prerequisite: For Certification Majors: EOE 101, 205; For Non-Certification Majors: EOE 101. For credentialed health professionals.*
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.
ECI 336 Strategies for Teaching a Health Occupations Course 3.
Prerequisite: For credentialed health professionals.
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.

ECI 405 Literature for Adolescents 3.
Prerequisite: Junior standing.
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.

ECI 414 Human Relations and Discipline in the Classroom 3.
Prerequisite: PSY 304 or EDP 304 and 6 hours of education.
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.

ECI 416 Teaching Exceptional Students in the Mainstreamed Classroom 3.
Prerequisite: Six hours in ED or PSY.
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.

ECI 423 Methods and Materials in Teaching Modern Foreign Languages 4.
Prerequisite: Admission to Professional Semester, Corequisite: ECI 424.
Methods and materials of teaching French or Spanish grades K-12 with an emphasis on lesson and unit planning, second language acquisition, national standards, and demonstrations/practice teaching in micro-lessons. This course provides opportunities for prospective French and Spanish teachers to integrate knowledge of their language with effective materials, strategies, and methods of instruction to prepare students for K-12 French or Spanish 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.

ECI 424 Student Teaching in French or Spanish 12.
Prerequisite: Admission to Professional semester, Corequisite: ECI 423.
Teaching experience for prospective teachers of French or Spanish 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 Teacher Education Candidacy or admission to ESL Licensure Program.
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.

ECI 430 Methods and Materials for Teaching Language Arts in the Middle Grades 4.
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.
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.

ECI 435 Methods and Materials for Teaching Social Studies in the Middle Grades 4.
Prerequisite: Admission to professional semester.
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.

ECI 438 Medical Law and Ethics 3.
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.

ECI 440 Internship in Teaching English as a Second Language 3.
Prerequisite: Admission to ESL Licensure Program, Corequisite: Teacher Licensure in any primary area.
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.

ECI 442 Field Experience in Business and Marketing Education 3.
Prerequisite: Junior standing.
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 education. 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.
ECI 444 Administration of Business and Marketing Education 3.
Prerequisite: ED 204 and ECI 204 and MKE Business and Marketing Education Major.
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: Senior Standing; Corequisite: ECI 430 and ECI 435.
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.

ECI 446 Curriculum and Methods of Teaching Business and Marketing Education 4.
Prerequisite: Admission to Teacher Education Candidacy ; MKE Business and Marketing Education Majors.
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.

ECI 447 Student Teaching in Business and Marketing Education 9.
Prerequisite: Admission to Professional Semester ; MKE Business and Marketing Education Majors, Corequisite: ECI 494.
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.

ECI 448 E-Business Applications in Business and Marketing Education 3.
Prerequisite: Junior standing.
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.

ECI 450 Methods and Materials in Teaching English 4.
Prerequisite: ECI 205, ELP 344, PSY 304 or EDP 304; Senior standing and admission to Teacher Education candidacy with a Major in English. 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.

ECI 451 Teaching Reading Across Disciplines 3.
Prerequisite: Six hours in ED or PSY.
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.

ECI 454 Student Teaching in English/Language Arts 1-12.
Prerequisite: Admission to Student Teaching Professional Semester ; For MSL students: ECI 430; 416, 464. For LTN students: ECI 450.
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. LTN and MSL majors only.

Prerequisite: ECI 205, ELP 344, Sr. standing and admission to professional semester with a major in either history, sociology, political science.
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.

ECI 464 Student Teaching in Social Studies 1-8.
Prerequisite: Admission to professional semester, Corequisite: For LTH, LTP, LTS students: ECI 460. For MSL students: ECI 454, 430, 416.
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.

ECI 471 Educational Implications of Learning and Developmental Theory 3.
Prerequisite: NC TEACH Participants.
Topics related to human psychological development. Cognitive, social, physical changes, and their interaction among adolescence. Departmental Approval Required.

ECI 472 Interaction of Classroom Management and Instruction 3.
Prerequisite: ECI 471; NC TEACH Participants.
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.

ECI 473 Subject Specific Methods 3.
Prerequisite: ECI 472; NC TEACH Participants, Corequisite: ECI 474.
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 school experiences of culturally diverse students. Departmental Approval Required.
ECI 474 Curriculum and Instruction Practices 1-3.
Prerequisite: ECI 472; NC TEACH participants, Corequisite: ECI 473.
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.

ECI 475 Peer Mentoring in Alternative Licensure 3.
Prerequisite: ECI 474; NC TEACH Participants, Corequisite: ECI 476.
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.

ECI 476 Curriculum and Instruction Practices 2 3.
Prerequisite: ECE 474; NC TEACH Participants, Corequisite: ECI 475.
Topics related to inquiry, activity based instruction, and constructivist principles. Analysis of principles, strategies and application of new teaching approaches. Departmental Approval Required.

ECI 494 Senior Seminar in Business and Marketing Education 3.
Prerequisite: Admission to Professional Semester; MKE Business and Marketing Education Majors, Corequisite: ECI 447.
Discussion and analysis of problems, trends, and issues experienced while student teaching in the public schools.

ECI 496 Special Topics in Education 1-3.
Prerequisite: Junior standing or Senior standing.
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.

ECI 500 Theory and Practice In Teaching Diverse Populations 3.
Prerequisite: Graduate standing.
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 in K-12 settings.

Prerequisite: 12 sem. hrs. graduate ED and PSY.
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.

ECI 502 Continuous Improvement of School Technology Initiatives 3.
Introduction to the models, strategies, and tools for evaluating and making informed decisions about technology initiatives; examination of technology evaluation case studies, evaluation proposals, and stakeholder reports.

ECI 505 Issues and Trends in Foreign Language Education: Theory & Practice 3.
Prerequisite: Graduate standing.
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.

ECI 506 Instructional Technology in Foreign Language Education: Addressing the National 3.
Prerequisite: Graduate standing.
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 coursework. 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.

ECI 507 Social Justice Education 3.
Prerequisite: ECI 500.
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 framework in scholarship and professional practice.

ECI 508 Teachers as Leaders 3.
Prerequisite: Graduate standing.
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.

ECI 509 Special Problems in Curriculum and Instruction 1-6.
Prerequisite: Six hours of ED or PSY.
In-depth study of topical problems in curriculum and instruction selected from areas of current concern to practitioners in education.

ECI 510 Research Applications In Curriculum and Instruction 3.
Prerequisite: ST 507, Doctoral student, C and I Major.
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.

ECI 511 Technology Integration Theory and Practice 3.
Prerequisite: Graduate standing.
Foundational study of technology integration standards, models, and conditions informed by research. Analysis of micro classroom and macro school/institutional technology plans, and development of sample technology plans and projects representative of integration across curricular areas.

ECI 512 Emerging Technologies for Teaching and Learning 3.
Examination of emerging technologies as applied in educational settings with a focus on related research, case studies, theoretical underpinnings, and strategies for effective integration.

ECI 513 Teaching and Learning with Digital Video 3.
Prerequisite: Graduate standing.
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.

ECI 514 Multimedia Design and Applications in Instruction 3.
Prerequisite: Graduate standing.
Examination of learning theories and research-based principles for multimedia design to select/apply appropriate digital resources and create maximally effective educational products.
ECI 515 Online Collaborations in Education 3.
Examination of models of collaboration, sample online collaborative strategies and projects, tools supportive of cross-classroom collaborations, and research findings from collaborative initiatives.

ECI 516 Design and Evaluation Of Instructional Materials 3.
Prerequisite: Graduate standing.
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 and theory concerning learning to design of instructional materials. Structured projects and practical experiences used to transfer design principles and evaluate instructional products.

ECI 517 Theoretical Foundations of Advanced Learning Environments 3.
Examination and application of behavioral, cognitive, and constructivist theoretical frameworks underlying the design and development of advanced technology-enhanced learning environments.

ECI 518 Digital Learning Program and Staff Development 3.
Prerequisite: ECI 511, ECI 514, ECI 515, ECI 642.
Study and application of principles related to digital learning program planning, facilities and resource management, and staff development in K-12 settings.

ECI 519 Special Problems in Digital Learning and Teaching 1-6.
Prerequisite: Six hours of ED or PSY.
In-depth study of topical problems in digital learning and teaching selected from areas of current concern to practitioners in education.

ECI 520 The Teaching Of Composition 3.
Prerequisite: 9 hrs. of ED, PSY and/or ENG.
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.

ECI 521 Teaching Literature For Young Adults 3.
Prerequisite: Senior standing or Graduate standing or PBS status.
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.

ECI 522 Trends and Issues in English Language Arts Education 3.
Prerequisite: Graduate standing.
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.

ECI 523 Teacher as Researcher 3.
Prerequisite: Graduate standing.
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.

ECI 524 Theory and Research in Global Learning 3.
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 and opportunities present in our interconnected world.

ECI 525 Contemporary Approaches In the Teaching Of Social Studies 3.
Prerequisite: Advanced Undergraduate standing or Graduate standing.
Analysis of principles, strategies and application of new teaching approaches. Structured projects and practical experiences.

ECI 526 Theory and Research On Teaching and Learning Social Studies 3.
Prerequisite: ECI 530 or ECI 525.
A critical analysis of the literature relating to the teaching and learning of social studies and the drawing of implications for instructional practices.

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.

ECI 530 Social Studies In the Elementary School 3.
Prerequisite: Six hrs. in ECI.
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.

ECI 531 Advanced Writing in Education 3.
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 532 Methods and Materials for Teaching Social Studies in the Middle Grades 3.
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.

ECI 537 Teaching Children's Literature 3.
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.

ECI 540 Reading In the Elementary School 3.
Prerequisite: Six hrs. ED or PSY.
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.
ECI 541 Reading In the Content Areas 3.
Prerequisite: Six hours in ED or PSY.
Methods in instruction for applying reading to content areas, with emphasis on means of improving comprehension, vocabulary and learning strategies in subject matter classrooms.

ECI 543 Diagnosis Of Reading Disabilities 3.
Prerequisite: ECI 540 or ECI 541.
Formal and informal instruments for diagnosing reading disabilities including completion of a diagnostic case study describing reading performance of a disabled reader.

ECI 544 Remediation Of Reading Disabilities 3.
Prerequisite: ECI 543.
Advanced approaches to reading remediation including theory and research related to remedial instructional strategies, analyses of instructional designs and evaluations of effectiveness of intervention programs.

ECI 545 Theory and Research in Literacy 3.
Prerequisite: ECI 540.
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, maturing behavior and related language processes.

ECI 546 New Literacies & Media 3.
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.

ECI 547 Knowledge Construction: Implications for Multicultural Education 3.
Prerequisite: ECI 500.
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.

ECI 548 E-Business Applications in Business and Marketing Education 3.
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.

ECI 549 Special Problems in Reading 1-6.
Prerequisite: Six hours of ED or PSY.
In-depth study of topical problems in reading education selected from areas of current concern to practitioners in education.

ECI 550 Foundations Of Middle Years Education 3.
Prerequisite: 6 hours of ED or PSY.
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, curriculum design and content, (d) teaching methods and (e) school organization. Emphasis on both theoretical understandings and effective classroom strategies.

ECI 551 Teaching/Learning Approaches For Emerging Adolescents 3.
Prerequisite: ECI 550; Graduate standing.
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.

ECI 552 Program Development & Evaluation in Youth & Family Settings 3.
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.

ECI 553 Applied Concepts in Child and Youth Development 3.
The 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 Youth theories & practice.

ECI 554 Collaborations & Partnerships in Family & Youth Settings 3.
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.

ECI 556 Organizational Systems in Youth and Family Settings 3.
Prerequisite: ECI 506.
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.

ECI 557 Volunteerism in Youth and Family Settings 3.
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 volunteerism; and future trends in volunteerism. Restricted to graduate and post-baccalaureate students only.

ECI 560 Professional Development in Business and Marketing Education 3.
Prerequisite: Graduate standing.
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.
ECI 561 Curriculum and Instruction in Business and Marketing Education 3.
Prerequisite: Graduate standing.
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 the curriculum and meet educational needs of middle and high school students. For ED & MKZ students only. Requires instructor approval.

ECI 562 Program Management in Business and Marketing Education 3.
Prerequisite: ECI 561.
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.

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.

ECI 566 Advanced Instructional Strategies in Business and Marketing 3.
Prerequisite: ECI 561.
Advanced strategies and techniques related to teaching and learning in the business and marketing education curricula, classrooms, work places, and technology environments in middle and secondary education. MKZ students only.

ECI 567 Career and Technical Education Fundamentals and Program Administration 3.
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.

ECI 568 Designing College and Career Ready Programs 3.
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.

ECI 569 Special Problems in Business and Marketing Education 1-6.
In-depth study of topical problems in business and marketing education selected from areas of current concern to practitioners in education.

ECI 570 Learning Disabilities 3.
Prerequisite: ECI 585.
Field of learning disabilities, including definitions, prevalence, etiology, characteristics and current educational trends for educating students with learning disabilities.

ECI 571 Methods and Materials In Learning Disabilities 3.
Current methods and materials for the teaching students with learning disabilities in elementary and/or secondary schools, including curriculum and instructional techniques. Focus on examination of commercial materials and development of teacher-made materials for use with students with learning disabilities.

ECI 572 Resource Teaching In Special Education 3.
Prerequisite: ECI 585.
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.

ECI 573 Applied Behavior Analysis for Teachers 3.
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.

ECI 574 Intellectual Disabilities 3.
Prerequisite: ECI 585.
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.

ECI 575 Communication Disorders In the Classroom 3.
Prerequisite: ECI 570.
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.

ECI 576 Teaching Functional and Life Skills to Students with Disabilities 3.
Prerequisite: ECI 585 and ED 574.
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.

ECI 577 Education Of Severely Handicapped 3.
Prerequisite: ECI 585 or ECI 574.
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.

ECI 579 Organization and Behavioral Management of Inclusive Classrooms 3.
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.
ECI 580 Transition Program For Students With Mild Disabilities 3.
Prerequisite: ECI 585.
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.

ECI 581 Educational Diagnosis and Prescription For Children With Exceptionalities 3.
Prerequisite: ECI 585.
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.

ECI 583 Behavior Disorders 3.
Prerequisite: ECI 585.
Definitions, etiology, characteristics, philosophies and approaches to educational programming for children and youth with behavior disorders, including emotionally handicapped, autistic and socially maladjusted.

ECI 584 Intervention for Behavior Problems of Students with Disabilities 3.
Prerequisite: ECI 583.
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.

ECI 585 Education Of Exceptional Children 3.
Prerequisite: 9 hrs. of ED or PSY.
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; and educational settings and strategies employed in special education. Review of current educational laws and policies affecting special education.

ECI 603 Advanced Seminar In Literacy Research 3.
Prerequisite: ECI 648.
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.

ECI 606 Seminar on Teacher as Learner: Developmental Theory, Research and Practice 3.
Prerequisite: Graduate standing (6 hrs course work at 500-level).
Analysis of major contemporary theories and research of learning and development as a basis for individual and organizational change and development in educational settings.

ECI 607 Advanced Seminar in Multicultural Education 3.
Prerequisite: Graduate standing and ECI 500.
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.

ECI 620 Special Problems In Curriculum and Instruction 1-6.
Prerequisite: Six hrs. of ED or PSY.
In-depth study of topical problems in curriculum and instruction selected from areas of current concern to practitioners in education.

ECI 630 Independent Study in Curriculum and Instruction 1-6.
Independent study or research project in curriculum and instruction.

ECI 640 Practicum In Curriculum and Instruction 1-6.
Prerequisite: Graduate standing in Col. of ED and PSY.
Supervised practical experiences in schools and area agencies concerned with curriculum and instruction or educational supervision.

ECI 641 Practicum In Mentoring and Coaching 1-6.
Prerequisite: ECI 705, Graduate standing in College of ED and PSY.
Supervised practical experiences in which participants become mentor to a student teacher or a teacher in a school system.

ECI 645 Diagnostic-Prescriptive Practicum in Reading 3.
Prerequisite: ECI 540, ECI 541 and ECI 543; Graduate standing in College of ED and PSY.
Supervised teaching experience with students using diagnostic test data to prescribe remedial programs for reading-disabled individuals, implementing instructional prescriptions and evaluating success of remedial plans.

ECI 647 Practicum in Business and Marketing Education 3.
Prerequisite: ECI 569.
Supervised practical experiences in schools and area agencies concerned with business and marketing education.

ECI 648 Practicum in Special Education 1-6.
Prerequisite: Graduate standing in College of ED and PSY.
Supervised practical experiences in schools and area agencies concerned with teaching children and adolescents with disabilities.

ECI 650 Internship in Curriculum and Instruction 1-6.
Prerequisite: Graduate standing in Col. of ED and PSY.
Supervised opportunities for advanced professional development in contexts concerned with curriculum development and/or educational supervision.

ECI 652 Field-Based Applications of Digital Learning and Teaching 1-6.
Prerequisite: Graduate standing in Col. of ED and PSY.
Supervised opportunities to design, test, and revise digital learning and teaching solutions in authentic, field-based settings.

ECI 654 Internship In Elementary Education 1-6.
Prerequisite: 3 hrs. grad.-level elementary education course work, Graduate standing in Col. of ED and PSY.
Supervised opportunities for advanced professional development in contexts concerned with elementary grades education.

ECI 656 Internship In Middle Grades Education 1-6.
Prerequisite: ECI 550, ECI 551, Graduate standing in College. of ED and PSY.
Supervised opportunities for advanced professional development in contexts concerned with the education of young adolescents.

ECI 657 Internship in Business and Marketing Education 1-6.
Prerequisite: ECI 561.
Supervised opportunities for advance professional development in contexts concerned with business and marketing education. Requires instructor approval.

ECI 658 Internship In Special Education 1-6.
Prerequisite: Graduate standing in Col. of ED and PSY.
Supervised opportunities for advanced professional development in contexts concerned with special education.
ECI 681 Seminar in Special Education Literacy 3.
Prerequisite: ECI 540 or ECI 541 and ECI 581, ECI 585.
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 585.
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.

ECI 683 Seminar in Special Education Learning Strategies 3.
Prerequisite: ECI 585.
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.

ECI 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

ECI 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

ECI 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

ECI 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

ECI 692 Research Projects In Curriculum and Instruction 1-3.
Prerequisite: ELP 532.
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.

ECI 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

ECI 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

ECI 700 Curriculum Theory and Development 3.
Prerequisite: 9 sem. hrs. graduate PSY, ECI 502, ECI 514.
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 and provision of an application opportunity.

ECI 705 Instructional Coaching and Supervision Of Teachers 3.
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.

ECI 709 Special Problems In Curriculum and Instruction 1-6.
Prerequisite: Six hrs. of ED or PSY.
In-depth study of topical problems in curriculum and instruction selected from areas of current concern to practitioners in education.

ECI 710 Research Applications In Curriculum and Instruction 3.
Prerequisite: ST 507, Doctoral student in C and I.
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.

ECI 711 Computer Applications and Curriculum Integration 3.
Prerequisite: Graduate standing.
Use and evaluation of existing educational software, research findings with respect to integration of computers and new technologies in instruction.

ECI 714 Multimedia Design and Applications in Instruction 3.
Prerequisite: Six hrs. ED or PSY.
Emphasis on use and evaluation of existing educational software and research findings with respect to uses of computers in instruction.
ECI 715 Internet Applications and Web Page Design in Instruction 3. 
Prerequisite: Six hrs. ED or PSY.
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.

ECI 716 Design and Evaluation Of Instructional Materials 3. 
Prerequisite: Graduate standing.
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 and theory concerning learning to design of instructional materials. Structured projects and practical experiences used to transfer design principles and evaluate instructional products.

ECI 717 Advanced Multimedia Design and Applications in Instruction 3. 
Prerequisite: ECI 511, ECI 514.
Advanced study and application of instructional design principles underlying development, evaluation, and integration of multimedia and hypermedia in K-12 settings.

ECI 718 Digital Learning Program and Staff Development 3. 
Prerequisite: ECI 511, ECI 514, ECI 515, ECI 642.
Study and application of principles related to digital learning program planning, facilities and resource management, and staff development in K-12 settings.

ECI 719 Special Problems in Digital Learning and Teaching 1-6. 
Prerequisite: Six hours of ED or PSY.
In-depth study of topical problems in digital learning and teaching selected from areas of current concern to practitioners in education.

ECI 720 The Teaching Of Composition 3. 
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.
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.

ECI 721 Special Problems in Social Studies Education 1-6. 
Prerequisite: Six hours of ED or PSY.
In-depth study of topical problems in social studies education selected from areas of current concern to practitioners in education.

ECI 722 Special Problems in English Education 1-6. 
Prerequisite: Six hours of ED or PSY.
In-depth study of topical problems in English education selected from areas of current concern to practitioners in education.

ECI 745 Literacy Theory and Research 3. 
Prerequisite: ECI 540.
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.

ECI 801 Seminar In Curriculum and Instruction 1-3. 
Prerequisite: Doctoral student.
Consideration of contemporary issues, trends and recent research and development findings in curriculum and instruction.

ECI 803 Advanced Seminar In Literacy 3. 
Prerequisite: ECI 545.
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.

ECI 804 Seminar On Attention Deficit Hyperactivity Disorder, Research and Treatment 3. 
Prerequisite: 9 hrs. grad. credit in PSY or SPE.
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.

ECI 805 Seminar On Teacher as Learner: Developmental Theory, Research and Practice 3. 
Prerequisite: Graduate standing (6 hrs course work at 500-level). Analysis of major contemporary theories and research of learning and development as a basis for individual and organizational change and development in educational settings.

ECI 807 Advanced Seminar In Multicultural Education 3. 
Prerequisite: Graduate standing and ECI 500.
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.

ECI 820 Special Problems In Curriculum and Instruction 1-6. 
Prerequisite: Six hrs. of ED or PSY.
In-depth study of topical problems in curriculum and instruction selected from areas of current concern to practitioners in education.

ECI 821 Independent Study in Curriculum and Instruction 1-6. 
Prerequisite: Doctoral student.
Independent curriculum or research project in curriculum and instruction.

ECI 840 Practicum In Curriculum and Instruction 1-6. 
Prerequisite: Graduate standing in Col. of ED and PSY.
Supervised practical experiences in schools and area agencies concerned with curriculum and instruction or educational supervision.

ECI 841 Practicum In Mentoring and Coaching 1-6. 
Prerequisite: ECI 705, Graduate standing in College of ED and PSY. 
Supervised practical experiences in which participants become mentor to a student teacher or a teacher in a school system.

ECI 847 Practicum in Business and Marketing Education 1-6.
Supervised practical experiences in schools and area agencies concerned with business and marketing education.

ECI 850 Internship In Curriculum and Instruction 1-6. 
Prerequisite: Graduate standing in Col. of ED and PSY.
Supervised opportunities for advanced professional development in contexts concerned with curriculum development and/or educational supervision.

ECI 851 Internship In Mentoring 1-6. 
Prerequisite: ECI 845 and ECI 705, Graduate standing in Col. of ED and PSY.
Supervised opportunities teaching educational personnel in local school systems how to serve as mentors to their colleagues.
ECI 880 Directed Study in Curriculum and Instruction 1-6.
Curriculum or research project in curriculum and instruction under the
direct supervision of a faculty member.

ECI 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

ECI 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral
preliminary exams.

ECI 892 Research Projects In Curriculum and Instruction 1-3.
Prerequisite: ELP 732.
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: Doctoral student.
Instruction in research and research under the mentorship of a member
of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

ECI 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

ECO - Ecology Courses

ECO 601 Ecology Seminar 1.
Prerequisite: Graduate standing.
Scientific articles, progress reports and special problems of interest
to ecologists are reviewed and discussed. Minimum of one seminar
presentation required for credit.

ED - Education Courses

ED 100 Intro to Education 2
This course serves as an introduction to teaching and learning in
21st century K-12 classrooms and as an orientation to the College
and University experience, through technology-assisted plenary and
small group seminars, students will examine the knowledge, skills and
dispositions necessary to become globally aware, ethical, reflective
teachers of diverse populations in the 21st century. Topics include
academic skills, student success strategies, standards for teachers, and
programs in the College of Education. This course is restricted to Teacher
Education majors only.

ED 101 Freshman Teaching Fellows Forum I 1.
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.

ED 102 Freshman Teaching Fellows Forum II 1.
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.

ED 150 Students Advocating for Youth I 1.
Building upon a passion for advocacy. Investigating issues related to
youth in today’s North Carolina. Exploring youth advocacy and ethics.
Exploring youth advocacy and diversity. Exploring youth advocacy
as a vocation. Practical youth advocacy field work. Participation in
field experiences required. Restricted to students admitted to the SAY
program.

ED 151 Students Advocating for Youth II 1.
Prerequisite: ED 150.
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 field work. Participation
in field experiences required. Field experience may extend beyond
normal class time. Restricted to students admitted to the SAY program.

ED 201 Sophomore Teaching Fellows Forum I 1.
Prerequisite: Students in Teaching Fellows Program.
Topics related to educational issues and requirements of the Teaching
Fellows program. Topics will include current practices, policies and
research in education.

ED 202 Sophomore Teaching Fellows Forum II 1.
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.

ED 204 Introduction to 21st Century Teaching 2.
Prerequisite: Sophomore standing; Corequisite: ECI 204 or EMS 204, or
EMS 205, or TDE 202.
Overview of teaching as work and a profession in the 21st century.
Course focuses on establishing a respectful environment for a diverse
student population, dispositions and practices required for effective
teaching, and processes and outcomes of collaborative lesson study.
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 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.

ED 296 Special Topics in Education 1-3.
Individual or group study of particular areas of education at the freshman
and sophomore levels. Specific topics will vary from semester to
semester.

ED 301 Junior Teaching Fellows Forum I 1.
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.
ED 302 Junior Teaching Fellows Forum II 1.
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.

ED 310 Tutoring Adolescents 1.
Prerequisite: ECI 205 or EOE 207, Corequisite: EMS 203.
Developing skills in tutoring adolescent students. Emphases include identifying adolescent learning difficulties, using a variety of tutoring methods and a tutorial self-evaluation process. Requires off-campus field work.

ED 311 Classroom Assessment Principles and Practices 1.
Prerequisite: Admission to Teacher Education Candidacy; Co-requisite: ED 312.
This course will enable students to understand and use appropriate classroom assessment practices to promote positive student achievement. Students will apply 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. 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 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.

ED 312 Classroom Assessment Principles and Practices Professional Learning Lab 1.
Prerequisite: Admission to Teacher Education Candidacy; Co-requisite: ED 311.
This course is a co-requisite professional learning lab to ED 311, Classroom Assessment Principles and Practices. It will enable students to engage in the application of assessments using both case study and classroom data sets. The course will help students understand and use appropriate formative and summative classroom assessment in a learning community/learning team to improve student learning. Students will explore best practices in assessment through the guidance of professional educators and the use of commercially available products for formative and summative assessment. 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 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.

ED 403 Teaching Fellows Senior Seminar 1.
Prerequisite: Senior standing.
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.

ED 496 Special Topics in Education 1-3.
Prerequisite: Junior standing or Senior standing.
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.

ED 507 Principles of Developing and Interpreting Assessment 2.
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.

ED 508 Exploring Diversity in Classroom and Community 3.
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).

ED 569 Teaching Internship: MAT 4.
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.

ED 570 Classroom Action Research 1.
Provides a brief introduction to educational research focusing specifically on classroom action research. Requires admission to MAT; completion of 6 hours in the program.

ED 571 Inquiry and Professional Development 1.
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.

ED 572 Teacher Leadership 1.
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.

ED 590 Special Problems in Teaching and Learning 1-6.
In-depth study of topical problems in teaching and learning of current and special interest to K-12 Classroom teachers.

ED 605 Special Problems in Teaching 1-3.
Prerequisite: Graduate standing.
In-depth study of topical problems in teaching selected from areas of current concern to K-12 teachers.

ED 700 Introduction to Research Design in Education 3.
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.
ED 710 Applied Quantitative Methods in Education I 3.
Prerequisite: ED 700, or ECI 510, or ELP 532, or ST 507.
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.

ED 711 Applied Quantitative Methods in Education II 3.
Prerequisite: ED 710.
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.
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.

ED 730 Introduction to Qualitative Research in Education 3.
Design of qualitative studies, conduct of field work including open-ended interviews and participant observation, analysis of data and understanding of the theoretical and philosophical background of this research approach.

ED 731 Advanced Qualitative Research and Data Analysis in Education 3.
Prerequisite: ELP 736, EAC 785 or ED 730.
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.

ED 750 Mixed Methods Research in Education 3.
Prerequisite: ED 711, ED 730, ST 507, ELP736 or equivalent and/or permission of the instructor.
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.

ED 795 Special Topics in Education Research 3.
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.

EDP - Educational Psychology Courses

EDP 304 Educational Psychology 3.
Prerequisite: Sophomore standing.
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.

EDP 370 Applied Child Development 3.
Prerequisite: Sophomore standing.
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.

EDP 476 Psychology of Adolescent Development 3.
Prerequisite: PSY 200 or EDP 304.
Theories, principles, and issues of human psychological development emphasizing adolescence. Cognitive, social, and physical changes; their interaction. Implications for teaching and parenting adolescents.

EDP 504 Advanced Educational Psychology 3.
Prerequisite: Graduate standing.
A critical appraisal of current psychological findings relevant to educational practice and theory.

Prerequisite: Graduate standing.
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.

EDP 575 Multicultural Lifespan Development 3.
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.

EDP 582 Adolescent Development 3.
Prerequisite: 6 hours in PSY.
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.

EDP 590 Special Problems in Educational Psychology 1-3.
In-depth study of topical problems in cognition, motivation, assessment, or other educational psychology area of current and special interest to educators.
EDP 605 Special Problems in Educational Psychology 1-3.
In-depth study of topical problems in educational psychology selected from areas of current concern to educators.

EDP 696 Summer Thesis Res 1.

EDP 704 Theories and Research in Educational Psychology 3.
Doctoral students only (DR).
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.

EDP 723 Motivation in Education 3.
P: ED 700 or equivalent.
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.

EDP 750 Mixed Methods Research in Education 3.
Prerequisite: ED 711; ED 730; ST 507; ELP 736 or equivalent and/or permission of the instructor.
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.

EDP 896 Summer Dissert Res 1.

EGM - Engineering - Mechatronics Courses

EGM 180 Introduction to Mechatronics Laboratory 2.
The objective of this course is to introduce students to the mechatronic engineering discipline as a synergistic combination of mechanical and electrical engineering, computer science, control and information technology. Foundational concepts in mechatronics are addressed including analog and digital electronics, sensors, actuators, microprocessors, and microprocessor interfacing to electromechanical systems through hands-on laboratory exercises. Offered only at UNCA.

EGM 360 Advanced Mechatronics Design Laboratory 1.
Prerequisite: EGM 180.
An introduction to the design and construction of microprocessor-controlled electromechanical systems, this laboratory course builds on fundamental mechatronics concepts. The course is project and design oriented to provide hands-on working knowledge of real-time software, real-time programming, computer interfacing, mechanical design fabrication and control system design and the integration of these areas. For EGM students only; offered only at UNCA.

EGM 482 Senior Design Project in Mechatronics Engineering 4.
Prerequisite: EGM 360, senior standing.
Applications of engineering and basic sciences to the total design of electro-mechanical systems. Consideration of the design process including feasibility study, preliminary design detail, cost effectiveness, along with the development and evaluation of a prototype accomplished through design-team activity. Complete written and oral engineering report required. For EGM students only; offered only at UNCA.

EGM 484 Senior Design Project in Mechatronics Engineering II 3.
Prerequisite: EGM 360.
In this laboratory course, students will be exposed to the fundamentals of the engineering design process via the construction of a prototype mechatronic system in a team environment.

EGM 485 Senior Design Project in Mechatronics Engineering II 1.
Prerequisite: EGM 484.
In this laboratory course, students will develop and refine oral, written and graphical communication skills as their senior design project is finalized, presented and demonstrated. The course is conducted in a team environment.

EGR - EGR-Engineering Master's Courses

EGR 590 Special Topics in Engineering 1-3.
Discussion of special topics in engineering. Identification of various specific topics and prerequisites for each section from term to term.

EGR 688 Non-Thesis Masters Continuous Registration-Half Time Registration 1.
Prerequisite: Master's student.
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.

EGR 689 Non-Thesis Masters Continuous Registration-Full Time Registration 3.
Prerequisite: Master's student.
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.

EI - Entrepreneurship Initiative Courses

EI 201 Exploring Interdisciplinary Entrepreneurial Thinking 3.
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.

EI 331 Interdisciplinary Entrepreneurial Thinking I: Skills and Planning Basics 3.
Prerequisite: EI 201.
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 travel might be required. Students are responsible for their own transportation to off campus activities. This course will be offered at least once per semester.

ELM - Elementary Education Courses

ELM 250 Introduction to Elementary Education in a Global Society 3.
Prerequisite: Sophomore standing.
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. Students interested in Elementary Education.
ELM 310 Children’s Thinking and Additive Reasoning 3.
Prerequisite: ELM 250, Junior standing, Elementary Education Majors.
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 may be required in lieu of lecture on occasion. Students are responsible for transportation to and from their school based experiences.

ELM 320 Teaching Science in the Primary Grades 3.
Prerequisite: ELM 250, Junior standing, Elementary Education Majors.
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 may be required in lieu of lecture on occasion. Students are responsible for transportation to and from their school based experiences.

ELM 330 Teaching Reading in Elementary School: K-2 3.
Prerequisite: ELM 250, Junior standing, Elementary Education Majors.
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.

ELM 335 Teaching Reading in the Elementary School: 3-5 3.
Prerequisite: ELM 330, Junior standing, Elementary Education Majors.
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.

ELM 340 Children Design, Create and Invent 3.
Prerequisite: ELM 370, Junior standing, Elementary Education Majors.
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.

ELM 350 Assessment of Learning and Behavior 3.
Prerequisite: ELM 250, Junior standing, Elementary Education Majors.
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.

ELM 370 Connections Seminar I The Elementary Classroom and School Community 3.
Prerequisite: ELM 250, Junior standing, Elementary Education Majors.
First of four seminars required for undergraduate elementary education majors. This course introduces preservice teachers to the world of public school classrooms, the tasks of teaching, and to their perspectives regarding a career in teaching. Examines relationships between theory and practice of teaching in mathematics, science, literacy, and assessment. 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.

ELM 375 Connections Seminar II Cultural Identity, Social Justice and Diverse Learners 3.
Prerequisite: ELM 370; Junior standing. Elementary Education majors.
This seminar is the second of four seminars required for undergraduate elementary education majors who are pursuing K-6 teacher licensure. The purpose of the course is to help prospective elementary grades teachers develop competencies for increasing student achievement by focusing on multicultural education, teaching to diversity, and understanding the classroom culture. 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.

ELM 400 Connections Seminar III Instructional Design and Assessment 3.
Prerequisite: ELM 375, Senior standing, Elementary Education Majors.
This seminar is the third of four semesters required for undergraduate elementary education majors who are pursuing K-6 teacher licensure. 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. Candidates will complete a capstone project that will be taught during their student teaching experience. Weekly fieldwork in schools and related settings is required. Students are responsible for transportation to and from their school based experience.

ELM 410 Children’s Thinking and Multiplicative Reasoning 3.
Prerequisite: ELM 310, Junior standing, Elementary Education Majors.
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 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.

ELM 420 Teaching Science in the Intermediate Grades 3.
Prerequisite: ELM 320, Senior standing, Elementary Education Majors.
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 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.

ELM 430 Teaching Language Arts in the Elementary School 3.
Prerequisite: ELM 335, Senior standing, Elementary Education Majors.
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 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.
ELM 440 Teaching Children with Special Needs in the Elementary Classroom 3.
Prerequisite: ELM 350, ELM 375, Senior standing, Elementary Education Majors, Corequisite: ELM 420.
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 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 experiences.

ELM 450 The Arts for Elementary Education 3.
Prerequisite: ELM 375, Senior standing, Elementary Education Majors.
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.

ELM 460 Social Studies for the Young Learner 3.
Prerequisite: ELM 370, Junior standing, Elementary Education Majors.
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 400, Elementary Education Majors, Admission to the Professional Semester, Corequisite: ELM 484.
ELM 480 Connections Seminar IV is designed as the Capstone Course in the Elementary Education Program. Preservice teachers will meet weekly to reflect on the student teaching experience and connect new learning to previous university coursework. In addition, preservice teachers will complete their Integrated INTASC and technology portfolios. Successful completion of student teaching and portfolio requirements will lead to licensure in the elementary grades; K-6.

ELM 484 Student Teaching in Elementary Education 9.
Prerequisite: ELM 480, ELM 400, Elementary Education Majors, Admission to the Professional Semester.
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.

ELM 515 Instructional Practice in Schools I 1.
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.

ELM 516 Instructional Practice in Schools II 2.
Corequisite: ELM 572, ELM 573, ELM 575.
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.

ELM 520 Methods of Teaching Elementary School Science 3.
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.

ELM 524 Issues in Elementary School Teaching 3.
Analysis of contemporary elementary school environments, developmental trends of childhood affecting teaching of elementary age students, nature of professionalism among elementary school teachers including pedagogical skills and subject matter knowledge, and ways to improve teaching effectiveness in elementary classrooms settings.

ELM 530 Social Studies In the Elementary School 3.
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.
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.

ELM 537 Teaching Children's Literature 3.
Instructions for educators in quality children's literature, specific needs of young reader, genres of children's literature, strategies for constructing children's literature, ways to target reader's interests, and design of literature units.

ELM 539 Special Problems in Elementary School 1-6.
In-depth study of topical problems in elementary education selected from areas of current concern to practitioners in education.

ELM 540 Reading In the Elementary School 3.
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.

ELM 555 Number Systems and Operations: K-5 Mathematical Tasks 3.
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.

Focus on rational number concepts through learning trajectories at the K-5 level; attention also given to problem solving and content knowledge.

ELM 557 Data Analysis and Measurement: K-5 Classroom Interactions 3.
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.
ELM 558 Algebraic Reasoning: K-5 Discourse and Questioning 3.
Focus on the early algebra concepts of functional thinking and generalized arithmetic in relationship to pedagogical practices centered on questioning in the mathematics classroom.

ELM 559 Geometry and Spatial Visualization: K-5 Assessment 3.
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.

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.

ELM 571 Language Arts, New Literacies and Media for Initial License 3.
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.

ELM 572 Methods for Teaching Reading in the Elementary Classroom for Initial License 3.
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.

ELM 573 Methods for Teaching Elementary School Science for Initial License 3.
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. Restricted to ELM MAT students.

ELM 574 Methods for Teaching Mathematics in the Elementary Classroom for Initial License 3.
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 enrolled in MAT Elementary Education program.

ELM 575 Social Studies in the Elementary School for Initial License 3.
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.

ELM 590 Special Problems in Elementary Education 1-3.
In-depth study of topical problems in teaching and learning of current and special interest to elementary education practitioners.

ELM 605 Special Problems in Elementary Teaching 1-3.
In-depth study of topical problems in teaching selected from areas of current concern to K-6 teachers.

ELM 644 Practicum in Elementary Education 1-6.
Supervised practical experiences in schools and area agencies concerned with education of elementary-age students.

ELM 654 Internship in Elementary Education 1-6.
Supervised opportunities for advanced professional development in contexts concerned with elementary grades education.

ELP - Educ Leadership Program Eval Courses

ELP 296 Special Topics in Education: General Studies 1-3.
Individual or group study of particular areas of education at the freshman and sophomore levels. Specific topics will vary from semester to semester.

ELP 344 School and Society 3.
Prerequisite: Junior standing.
The interrelationship between the school and other institutions, values, and patterns of thought in American society.

ELP 496 Special Topics in Education: General Studies 1-3.
Prerequisite: Junior standing or Senior standing.
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.

ELP 515 Education and Social Diversity 3.
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.

ELP 518 Introduction To Education Law 3.
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.

ELP 532 Introduction To Educational Inquiry 3.
Prerequisite: Graduate standing or PBS status.
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/particular area of study.

ELP 534 Ethics and Educational Decision Making 3.
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; punishment and due process; and leadership and rationality.

ELP 550 Principles of Educational Leadership and Empowerment 3.
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.
ELP 551 Context and Challenges of School Improvement 3.
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.

ELP 552 School-Based Planning, Management, and Evaluation in
Professional Learning Communities 3.
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.

ELP 553 Organizational Management I: Human Resource
Management in K-12 Education 3.
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.

ELP 554 Organizational Management II: Resource Support and
Sustainability in K-12 Education 3.
Corequisite: ELP 553.
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.

ELP 595 Special Topics 1-3.
ELP 620 Special Problems In Education 1-3.
Prerequisite: Graduate standing or PBS status.
Opportunity for graduate students in education to study problem areas in
professional education under direction of member of graduate faculty.

ELP 641 Practicum In Education Administration 1-6.
Supervised experience in appropriate educational setting to enable
student to gain practice in applying concepts, principles and theories of
education administration.

ELP 651 Internship In Educational Leadership and Program
Evaluation 1-9.
Prerequisite: Nine hrs. in grad.-level courses.
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.

ELP 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

ELP 688 Non-Thesis Masters Continuous Registration - Half Time
Registration 1.
Prerequisite: Master's student.
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.

ELP 689 Non-Thesis Master Continuous Registration - Full Time
Registration 3.
Prerequisite: Master's student.
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.

ELP 692 Master's Research Projects In Educational Leadership and
Program Evaluation 1-3.
Prerequisite: ELP 532.
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.

ELP 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of
the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

ELP 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

ELP 720 Cases In Educational Administration 3.
Prerequisite: Graduate standing.
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. Student expected
to make decisions after considering alternative courses of action and
after projecting probable consequences.

ELP 724 Contemporary Educational Thought 3.
Reading and discussion of 20th-century works in educational philosophy.
Consideration of such movements as pragmatism, reconstruction,
perennialism and existentialism.
ELP 728 School Law For the Administrator 3.
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.

ELP 729 Educational Finance 3.
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.

ELP 735 Policy Research in Education 3.
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.

ELP 736 Qualitative Research In Education and Policy Analysis 3.
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.

ELP 737 Advanced Qualitative Applications in School Administration and Policy 3.
Prerequisite: ELP 736.
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.

ELP 742 Applied Research Methods In Education 3.
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.

ELP 751 Politics of P-12 Education 3.
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 standing required.

ELP 752 Theories Framing curriculum Inquiry 3.
Prerequisite: Graduate standing.
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.

ELP 753 Data Decision Making for School Administrators 3.
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.

ELP 756 Organizational Leadership & Management for School Leaders 3.
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.
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.

ELP 780 Evaluation Theory and Practice In Education 3.
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.

ELP 789 Personnel Recruitment, Selection, Development and Appraisal in Education 3.
Issues, models, theories, research and applications in the evolving field of educational personnel and human resources administration with emphasis on recruitment, selection, and development.

ELP 795 Special Topics 1-3.
Special Topics in Educational Research and Leadership.

ELP 820 Special Problems In Education 1-3.
Prerequisite: Graduate standing or PBS status.
Opportunity for graduate students in education to study problem areas in professional education under direction of member of graduate faculty.

ELP 841 Practicum In Education Administration 1-6.
Supervised experience in appropriate educational setting to enable student to gain practice in applying concepts, principles and theories of education administration.

ELP 851 Internship In Educational Leadership and Program Evaluation 1-9.
Prerequisite: Nine hrs. in grad.-level courses.
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.
ELP 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

ELP 890 Doctoral Preliminary Exam 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

ELP 891 Problems Of Research Design In Education 1-3.
Prerequisite: ELP 742.
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.

ELP 892 Research Projects In Educational Leadership and Program Evaluation 1-3.
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: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

ELP 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

EMA - Entrepreneurship in Music and the Arts Courses

EMA 293 Independent Study in Arts Entrepreneurship 1-3.
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 Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

EMA 365 Foundations in Arts Entrepreneurship 3.
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.

EMA 370 Practical Arts Entrepreneurship 3.
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 grantsmanship, arts policy, creative economy efforts, the role of geography, demand and infrastructure considerations in entrepreneurial decision-making, competition analysis and marketing.

EMA 375 Understanding the Arts Economies 3.
Prerequisite: EMA 370.
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.

EMA 430 Capstone Experience in Arts Entrepreneurship 3.
Prerequisite: EMA 375.
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 sustain arts ventures and focuses on constructing innovative solutions to common problems arts and arts-related entrepreneurs encounter. Information gained from the prerequisite courses will be put to authentic use in either a non- or for-profit setting. Transportation and some costs may be required for project work.

EMA 493 Advanced Independent Study in Arts Entrepreneurship 1-3.
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 Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

EMS - Math Science Education Courses

EMS 101 Orientation to Mathematics and Science Education 0.
Overview of departmental expectations and procedures and introduction to practical aspects of academic life. Opportunity for interaction of students with advisors and with other undergraduates who are nearing completion of programs. Open only to students in Math and Science Education.

EMS 102 Introduction to Middle Grades Education 2.
Introduction to the Middle Grades Academy and middle school teaching from the perspective of "What do I bring to teaching?" Students will formulate an initial teaching philosophy as well as engage in an introspective examination of their beliefs, attitudes, talents, strengths, and weaknesses in relation to teaching early adolescents. Students are required to provide their own transportation.

EMS 203 Introduction to Teaching Mathematics and Science 3.
Introduces prospective teachers to the teaching of mathematics and science in the middle school and high school. As an important part of the course, students serve as teacher assistants to a classroom teacher. Ideas and questions arising from this experience provide an integral part of the classroom instruction on campus.
EMS 204 Introduction to Mathematics Education. 2.
Prerequisite: ED 100; Corequisite: ED 204.
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 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.

EMS 205 Introduction to Teaching Science. 2.
Prerequisite: Sophomore standing; Corequisite: ED 204.
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.

EMS 296 Special Topics in Education 1-3.
Individual or group study of particular areas of education at the freshman and sophomore levels. Specific topics will vary from semester to semester.

EMS 373 Instructional Materials in Science. 3.
Prerequisite or Corequisite: EMS 205 and ED 204.
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.
Prerequisite: EMS 205, ED 204.
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 inquiry-based learning environments.

EMS 470 Methods and Materials for Teaching Mathematics. 3.
Prerequisite: Admission to professional semester.
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. 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.

EMS 474 Teaching Mathematics Topics in the Middle Grades. 3.
Prerequisite: EMS 480 passed with a C or better.
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.

EMS 475 Methods of Teaching Science II. 3.
Prerequisite: EMS 375.
Goals, methods, curricula, and evaluation practices in teaching the physical and biological sciences at the middle and secondary school levels. Taught during the fall.

EMS 476 Student Teaching in Science. 1-12.
Prerequisite: EMS 475; and Corequisite: EMS 495.
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.

EMS 480 Teaching Mathematics with Technology. 3.
Prerequisite: EMS 204 with a B- or better; MA 131 or 141.
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.

EMS 490 School Mathematics from an Advanced Perspective. 3.
Prerequisite: MA 403 or MA 407, MA 308 or MA 408, MA 205 or MA 305 or MA 405.
This course will serve as a culminating experience for all students majoring in mathematics education and intending to become high school 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 funtion basis, connections between linear algebra and the high school presentation of matrices, and other topics. For Math Education majors only.

EMS 495 Senior Seminar in Mathematics and Science Education. 1-3.
Prerequisite: Advanced Undergraduate standing.
In-depth investigation of one or more teaching areas in mathematics or science education.

EMS 496 Special Topics in Education. 1-3.
Prerequisite: Junior or senior standing.
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.

EMS 501 Readings in Science Education. 1-1.
Prerequisite: Graduate standing.
Explores the evolution of science education and science education research with special emphasis on current trends. Reviews latest national reports on trends and standards in science education. Develops research support for best science teaching practices and examines recent innovations in science teacher education programs.
EMS 502 Readings in Science Education II 3.
Prerequisite: Graduate standing, EMS 501.
Historical overview of science education practices and research and illustrations of the forces which influenced changes in these fields through seminal papers. Studies the changing goals of science instruction through the 20th and into the 21st century. Examines historical trends in how students learn, role of the teacher, goals for learning science and the dynamic interactions between these factors.

EMS 505 Methods of Teaching Science I 3.
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.

EMS 506 Methods of Teaching Science II 3.
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.

EMS 510 Interactions In the Mathematics Classroom 3.
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.

EMS 512 Teaching and Learning Elementary and Middle Grades Mathematics 3.
Prerequisite: EMS 471.
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.

EMS 513 Teaching and Learning of Algebraic Thinking 3.
Prerequisite: EMS 471 or equivalent teaching experience.
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 Algebra I.

EMS 514 Teaching and Learning of Geometric Thinking 3.
Prerequisite: EMS 471 and either MA 308 or MA 408.
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.

EMS 519 Teaching and Learning of Statistical Thinking 3.
Prerequisite: ST 507 or ST 511.
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.

EMS 521 Advanced Methods in Science Education I 3.
Prerequisite: Graduate standing in Science Education.
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.

EMS 522 Advanced Methods in Science Education II 3.
Prerequisite: EMS 521 and graduate standing in Science Education.
Examines science instruction through analysis of curriculum, instructional practices, current research on science learning and teaching. Five areas of interest: curriculum, instruction, assessment, diversity, learning environments and technology in science education.

EMS 531 Introduction to Research in Science Education 3.
Prerequisite: Graduate standing in Science Education.
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, and communicate research findings in both oral and written form.

EMS 532 Methods and Materials for Teaching Mathematics 3.
Prerequisites: MA 421 and either MA 308 or MA 408.
Focus 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: Graduate standing or alternative license program.
Project-based course to improve the understanding and use of technology tools useful in science teaching. Computer and calculator based laboratory probeware and software, imaging and presentation technologies. Research-based evaluation of tool use in the science laboratory and classroom.
EMS 575 Foundations Of Science Education 3.
Prerequisite: EMS 475.
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.

EMS 577 Improving Classroom Instruction In Science 3.
Prerequisite: EMS 475.
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.

EMS 580 Teaching Mathematics with Technology 3.
Prepares 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. Credit not allowed for both EMS 480 and EMS 580.

EMS 581 Advanced Applications of Technology in Mathematics Education 3.
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.

EMS 592 Special Problems In Mathematics Teaching 1-3.
Prerequisite: EMS 471.
In-depth investigation of topical problems in mathematics teaching chosen from areas of curriculum, methodology, technology, supervision and research.

EMS 594 Special Problems In Science Teaching 1-6.
Prerequisite: EMS 476.
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.

EMS 605 Special Problems In Teaching 1-3.
In-depth study of topical problems in teaching from areas of current concern to K-12 teachers.

EMS 621 Special Problems In Mathematics Teaching 1-3.
Prerequisite: EMS 471.
In-depth investigation of topical problems in mathematics teaching chosen from areas of curriculum, methodology, technology, supervision and research.

EMS 622 Special Problems In Science Teaching 1-6.
Prerequisite: EMS 476.
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.

EMS 630 Independent Study in EMS 1-6.
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.

EMS 641 Practicum In Science and Mathematics Education 1-6.
Prerequisite: EMS 770 or EMS 775.
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.

EMS 651 Internship In Mathematics And Science Education 1-9.
Prerequisite: Nine hrs. in grad. level courses.
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.

EMS 675 Portfolio Development 1.
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.

EMS 685 Master's Supervised Teaching 1-4.
Prerequisite: Master's student.
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.

EMS 686 Teaching In College 3.
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.

EMS 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

EMS 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

EMS 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.
EMS 692 Research Projects In Mathematics and Science Education 3.
Prerequisite: ELP 532.
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.

EMS 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
The thesis research.

EMS 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

EMS 703 Teaching Mathematics and Science In Higher Education 3.
Prerequisite: EMS 770, 621 or 622, Graduate standing.
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.

EMS 704 Curriculum Development and Evaluation In Science and Mathematics 3.
Prerequisite: 500-level statistics, PSY 535.
Critical study of elements of curriculum design and theory in mathematics education and science education and examination of evaluation procedures for assessing educational innovations.

EMS 705 Education and Supervision Of Teachers Of Mathematics and Science 3.
Prerequisite: EMS 770 or 621 or 622.
Critical analysis of theories, programs and techniques designed to promote interpersonal interactions leading to more effective teaching of science and mathematics.

EMS 711 Research on the Teaching and Learning of Math at Secondary and Early College Levels 3.
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.

EMS 712 Teaching Mathematics In Elementary and Junior High School 3.
Prerequisite: EMS 471.
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.

EMS 730 Trends and Issues in Science Education 3.
Prerequisite: Graduate standing.
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 a review of literature and the formation of research questions specific to science education.

EMS 731 Fundamentals of Research in Science Education: Qualitative and Quantitative Inqiu 3.
Prerequisite: Graduate standing and ST 507 or 511, Corequisite: ST 508 or 512.
Analyze 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.

EMS 732 Theoretical and Critical Perspectives of Science Education 3.
Prerequisite: Graduate standing.
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.

EMS 733 Theoretical and Critical Perspectives of Science Education 3.
Prerequisite: Graduate standing.
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.

EMS 734 Theoretical and Critical Perspectives of Science Education 3.
Prerequisite: EMS 471.
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.

EMS 777 Improving Classroom Instruction In Science 3.
Prerequisite: EMS 475.
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.
EMS 786 Teaching in College 3.
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.

EMS 792 Special Problems in Math Teaching 3.
In-depth investigation of topical problems in mathematics teaching chosen from areas of curriculum, methodology, technology, supervision and research.

EMS 794 Special Problems in Science Teaching 3.
Prerequisite: EMS 476.
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.

EMS 802 Seminar In Mathematics Education 1-12.
Prerequisite: Departmental Majors.
In-depth examination and analysis of literature and research in a particular topic(s) in mathematics education.

EMS 803 Seminar In Science Education 2.
Prerequisite: Departmental Majors.
In-depth examination and analysis of literature and research in a particular topic(s) in science education.

EMS 821 Special Problems In Mathematics Teaching 1-3.
Prerequisite: EMS 471.
In-depth investigation of topical problems in mathematics teaching chosen from areas of curriculum, methodology, technology, supervision and research.

EMS 822 Special Problems In Science Teaching 1-6.
Prerequisite: EMS 476.
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.

EMS 832 Research Applications in Science Education 3.
Prerequisite: EMS 730, EMS 731, ST 508.
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.

EMS 841 Practicum In Science and Mathematics Education 1-6.
Prerequisite: EMS 770 or EMS 775.
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.

EMS 851 Internship In Mathematics and Science Education 1-9.
Prerequisite: Nine hrs. in grad. level courses.
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.

EMS 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

EMS 890 Doctoral Preliminary Exam 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

EMS 892 Research Projects In Mathematics and Science Education 1-3.
Prerequisite: ELP 532.
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: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

EMS 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

ENG - English Courses

ENG 100 Introduction to Academic Writing 4.
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 ENG 101. Credit for ENG 100 is not allowed if student has prior credit for ENG 101.
ENG 101 Academic Writing and Research 4.
Prerequisite: Placement via English Department guidelines.
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.

ENG 105 Writing and Research in the Disciplines 1.
Restricted to: Transfer students with a transferring first-year writing course.
Examination of inquiry and writing across a range of academic disciplines, laying the foundation for further writing development in college-level writing across the curriculum. Refinement of basic principles of rhetoric and how those connect to writing in disciplinary communities. Restricted to transfer students with a transferring first-year writing course. Successful completion of ENG 105 requires a grade of C- or better. Together with approved transfer credit hours, this course satisfies the Introduction to Writing component of the General Education Program.

ENG 1GEP 100 Level English Composition 3.
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 201 Writing Literary Analysis 3.
Writing about literature for a variety of audiences. Strategies for writing close textual analysis - including attention to versification, narrative technique, and dramatic structure - and for articulating biographical, literary-historical, and cultural-historical contexts. Conventional genres of literary analysis, including "close readings," reviews, and editorial introductions; conventions of organization and prose style in both academic and professional literary discourse; MLA conventions for prose style and documentation.

ENG 206 Studies In Drama 3.
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.

ENG 207 Studies in Poetry 3.
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.

ENG 208 Studies In Fiction 3.
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.

ENG 209 Introduction to Shakespeare 3.
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.

ENG 210 Introduction to Language and Linguistics 3.
Prerequisite: ENG 101.
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.

ENG 214 Introduction to Editing 3.
Prerequisite: ENG 101.
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.

ENG 216 Technologies for Texts 3.
Prerequisite: ENG 101.
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.

ENG 219 Studies in Great Works of Non-Western Literature 3.
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.

ENG 220 Studies in Great Works of Western Literature 3.
Credit is not allowed for both ENG 220 and ENG 221 or ENG 222.
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.

ENG 221 Literature of the Western World I 3.
Credit is not allowed for both ENG 221 and ENG 220.
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.

ENG 222 Literature of the Western World II 3.
Credit is not allowed for both ENG 222 and ENG 220.
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.

ENG 223 Contemporary World Literature I 3.
Twentieth-century literature of some of the following cultures: Russian, Eastern European, Western European, Latin American, Canadian, Australian.

ENG 224 Contemporary World Literature II 3.
Twentieth-century literature of some of the following cultures: Asian, Arabian, African, Caribbean, Native-American.
ENG 232 Literature and Medicine 3.
Study of literature about illness, epidemics, and the science and practice of medicine. Readings will include works by authors such as Boccaccio, Defoe, George Eliot, Kafka, William Carlos Williams, Susan Sontag, and Tony Kushner.

ENG 233 The Literature of Agriculture 3.
A study of writings on the role of farming in the creation of culture and on the connection between the attention to words necessary for good writing and the attention to the land necessary for good farming. Readings may include ancient and modern texts from a variety of cultures and genres. Possible authors include Virgil, Jefferson, Hardy, Cather.

ENG 246 Literature of the Holocaust 3.
Fictional and nonfictional versions of the Holocaust, focusing on themes of survival, justice, theology, and the limits of human endurance.

ENG 249 Native American Literature 3.
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-Sioux), Harjo (Creek), and Erdrich (Anishinaabe).

ENG 251 Major British Writers 3.
Credit is not allowed for ENG 251 and ENG 261 or ENG 262.
Significant British authors chosen from among such figures as Chaucer, Shakespeare, Milton, Swift, Pope, 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.

ENG 252 Major American Writers 3.
Credit is not allowed for both ENG 252 and ENG 265 or ENG 266.
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.

ENG 260 Introduction to Literary Study 3.
Prerequisite: ENG 101.
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.

ENG 261 English Literature I 3.
Credit is not allowed for both ENG 261 and ENG 251.
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.

ENG 262 English Literature II 3.
Credit is not allowed for both ENG 262 and ENG 251.
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, Woolstencraft, Wordsworth, Keats, Shelley, Bronte, Carlyle, Tennyson, Browning, Yeats, Woolf, Joyce and Eliot. Credit will not be given for both ENG 262 and ENG 251.

ENG 263 American Literature I 3.
Credit is not allowed for ENG 265 and ENG 252.
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.

ENG 264 American Literature II 3.
Credit is not allowed for both ENG 266 and ENG 252.
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.

ENG 265 American Literature I 3.
Credit is not allowed for ENG 265 and ENG 252.
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.

ENG 266 American Literature II 3.
Credit is not allowed for both ENG 266 and ENG 252.
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.

ENG 267 LGBTQI Literature in the U.S. 3.
A 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.

ENG 268 Introduction to Creative Nonfiction 3.
Prerequisite: ENG 101.
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.

ENG 269 Introduction to Film 3.
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.

ENG 270 Introduction to American Folklore 3.
Principal types of folklore; field work in collecting and assimilating material from various cultural traditions. Emphasis on American folklore and its origins.

ENG 271 Explorations in Creative Writing 3.
Prerequisite: ENG 101.
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.

ENG 272 Fiction Writing 3.
Prerequisite: ENG 101.
Experience in writing short prose fiction. Class critiquing of student work and instruction in techniques of fiction.

ENG 273 Poetry Writing 3.
Prerequisite: ENG 101.
Experience in writing poetry. Class critiquing of student work and instruction in techniques of poetry.
ENG 292 Writing About Film 3.
Prerequisite: ENG 101.
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 films reviews of various lengths.

ENG 298 Special Projects in English 1-3.
Faculty-guided independent study, or courses on special topics determined by departmental interest or need.

ENG 305 Women and Literature 3.
Prerequisite: Sophomore standing and above.
Nineteenth- and twentieth-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: ENG 214.
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, and tables.

ENG 316 Principles of News and Article Writing 3.
Prerequisites: ENG 101 and ENG 214.

ENG 317 Designing Web Communication 3.
Prerequisite: ENG 214, or ENG 216, or ENG 314.
A course in the layout, design, and composition of web-based communication. Students will learn to analyze audiences and their uses of information in order to plan, compose, and critically evaluate web-based communication. Students will acquire skill with HTML coding, screen design, and multimedia authoring and will apply those skills to the composition of a variety of web texts (i.e. websites). Course work will require students to become proficient with commercially available HTML and photoeditors.

ENG 321 Survey of Rhetorical Theory 3.
Prerequisite: Sophomore standing and above.
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.

ENG 322 Writing in the Rhetorical Tradition 3.
Prerequisite: ENG 101.
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.

ENG 324 Modern English Syntax 3.
Prerequisite: ENG 101.
Study of Modern English at the sentence level. Analysis of grammatical structure. Consideration of language variation in English.

ENG 325 Spoken and Written Traditions of American English Dialects 3.
Prerequisite: ENG 101.
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.

ENG 326 History of the English Language 3.
Prerequisite: ENG 101.
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.

ENG 327 Language and Gender 3.
Prerequisite: ENG 101.
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).

ENG 328 Language and Writing 3.
Prerequisite: ENG 101.
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 to evaluate grammar textbooks and compositions. Intended for English Education majors. Credit will not be awarded for both ENG 328 and ENG 324.

ENG 330 Screenwriting 3.
Prerequisite: 6 credit hours from courses in writing for media, creative writing, or Film Studies.
Writing for films, story planning, character development, communicating information, building scenes, relationships between script and cinematic dimensions, working with studios and editors.

ENG 331 Communication for Engineering and Technology 3.
Prerequisite: Junior standing. Credit is not allowed for both ENG 331 and ENG 332 or ENG 333.
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.

ENG 332 Communication for Business and Management 3.
Prerequisite: Junior standing. Credit is not allowed for both ENG 332 and ENG 331 or ENG 333.
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.
ENG 333 Communication for Science and Research 3. 
Prerequisite: Junior standing. Credit is not allowed for both ENG 333 and ENG 331 or ENG 332.
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.

ENG 349 African Literature in English 3. 
Prerequisite: Sophomore standing and above.
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.

ENG 350 Professional Internships 3. 
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.

ENG 359 Topics in Film Studies 3. 
Critical approaches to focused film topics involving film genres, directorial styles, or trends within a national cinema. Topics will vary from semester to semester.

ENG 362 The British Novel of the 18th Century 3. 
Prerequisite: Sophomore standing and above.
Emphasizes major novelists such as Defoe, Richardson, Fielding, Sterne, and Austen.

ENG 363 The British Novel of the 19th Century 3. 
Prerequisite: Sophomore standing and above.
Emphasizes major novelists such as Dickens, Trollope, the Brontes, Eliot, and Hardy.

ENG 364 History of Film to 1940 3. 
Prerequisite: Sophomore standing and above.
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.

ENG 368 American Poetry to 1900 3. 
Prerequisite: Sophomore standing and above.
American poetry written in English from the colonial period to 1900. Development of styles and themes in relation to historical context. Emphasis on poets such as Bradstreet, Taylor, Wheatley, Poe, Sigourney, Emerson, Longfellow, Whitman, Dickinson, and Robinson.

ENG 369 The American Novel of the 19th Century 3. 
Prerequisite: Sophomore standing and above.
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.

ENG 370 Early Twentieth-Century Fiction 3. 
Prerequisite: Sophomore standing and above.
Study of narrative fiction written during the first half of the twentieth century. Typical subjects: James, Conrad, Stein, Hemingway, Woolf, Faulkner, Hurston, Wright, Beckett.

ENG 371 Late Twentieth-Century Fiction 3. 
Prerequisite: Sophomore standing and above.

ENG 372 Early Twentieth-Century Poetry 3. 
Prerequisite: Sophomore standing and above.
Study of poetry written in English during the first half of the twentieth century. Typical subjects: Hardy, Robinson, Yeats, Eliot, Pound, H.D., Williams, Hughes, Moore, Stevens.

ENG 373 Late Twentieth-Century Poetry 3. 
Prerequisite: Sophomore standing and above.

ENG 374 History of Film From 1940 3. 
Prerequisite: Sophomore standing and above.
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.

ENG 375 African American Cinema 3. 
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.

ENG 376 Science Fiction 3. 
Prerequisite: Sophomore standing and above.
Representative works of science fiction. Emphasis on works written in the twentieth century, with some attention to the history and development of the genre.

ENG 377 Fantasy 3. 
Prerequisite: Sophomore standing and above.
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.

ENG 378 Women & Film 3. 
This course will introduce students to the rich international history of women’s participation in the motion picture industry. Course includes readings, screenings, discussions, and a final examination.

ENG 380 Modern Drama 3. 
Prerequisite: Sophomore standing and above.
Major plays and playwrights from Ibsen to Pinter, including at least some of the following: Strindberg, Chekhov, Shaw, O'Neill, Hellman, Pirandello, Brecht, Williams, Miller, Albee.
ENG 381 Creative Nonfiction Writing Workshop 3.
Prerequisite: ENG 215, 287, 288, or 289.
A workshop in creative nonfiction (literary or magazine journalism) for the student with demonstrated understanding of the basic techniques of creative writing and journalism.

ENG 382 Film and Literature 3.
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.

ENG 384 Introduction to Film Theory 3.
Prerequisite: ENG 282.
Survey of critical approaches to film art. Application of theoretical paradigms—formalist, realist, psychoanalytic, feministic, poststructuralist—to individual films, genres, national cinemas and directors.

ENG 385 Biblical Backgrounds of English Literature 3.
Prerequisite: Sophomore standing and above.
Influences of the Bible-principal forms, genres, and texts-on major English and American writers such as Milton, Spenser, Melville, Eliot, and Faulkner.

ENG 388 Intermediate Fiction Writing Workshop 3.
Prerequisite: ENG 288; Students must have earned a B or better in ENG 288.
An intermediate workshop in creative writing for students with demonstrated understanding of the basic techniques of writing prose fiction.

ENG 389 Intermediate Poetry Writing Workshop 3.
Prerequisite: ENG 289; Students must have earned a B or better in ENG 289.
An intermediate workshop in creative writing for students with demonstrated understanding of the basic techniques of writing poetry.

ENG 390 Classical Backgrounds of English Literature 3.
Prerequisite: Sophomore standing and above.
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.

ENG 391 Special Topics in Modern Drama 3.
Prerequisite: Sophomore standing and above.
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.

ENG 392 Major World Author 3.
Prerequisite: Sophomore standing and above.
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.

ENG 393 Studies in Literary Genre 3.
Prerequisite: Sophomore standing and above.
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.

ENG 394 Studies in World Literature 3.
Prerequisite: Sophomore standing and above.
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.

ENG 395 Studies in Rhetoric and Digital Media 3.
Prerequisite: ENG 101.
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.

ENG 396 Postmodernism 3.
Prerequisite: Sophomore standing and above.
International Modernist movement in literature, from its nineteenth-century origins to its culmination in the early twentieth century. Definitions of modernity, as embodied in a variety of genres. Placement of Modernist texts within a variety of cultures that produced them.

ENG 397 Postmodernism 3.
Prerequisite: Sophomore standing and above.
Literary expressions of Postmodernism, from its origins in the Modernist movement through its culmination in the later decades of the twentieth century. Definitions of post modernity, as embodied in a variety of genres. Placement of Postmodernist texts within a variety of cultures that have produced them.
ENG 410 Studies in Gender and Genre 3.
Prerequisite: Sophomore standing and above.
This course examines the ways in which writers have revised the literary genres to include gendered experience. It will focus on a different generic area, such as poetry, fiction, drama or autobiography, depending on its instructor.

ENG 411 Rhetorical Criticism 3.
Prerequisite: Junior standing.
Rhetorical analysis of public speeches, social movements, political campaigns, popular music, advertising, and religious communication. Neo-Aristotelian criticism, movement studies, genre criticism, dramatistic analysis, content analysis, fantasy theme analysis.

ENG 416 Advanced News and Article Writing 3.
Prerequisite: ENG 316.
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.

ENG 417 Editorial and Opinion Writing 3.
Prerequisite: ENG 214, ENG 316.
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.

ENG 420 Major American Author 3.
Prerequisite: Sophomore standing and above.
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'Connor, Morrison.

ENG 421 Computer Documentation Design 3.
Prerequisite: ENG 314, 331, 332 or ENG 333.
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.

ENG 422 Writing Theory and the Writing Process 3.
Prerequisite: ENG 101.
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.

ENG 425 Analysis of Scientific and Technical Writing 3.
Prerequisite: Junior standing.
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 scientific or technological setting.

ENG 426 Analyzing Style 3.
Prerequisite: ENG 101.
Development of a greater understanding of and facility with style in written discourse. Theories of style, stylistic features; methods of analysis, imitation.

ENG 430 Advanced Screenwriting 3.
Prerequisite: ENG 330.
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.

ENG 439 17th-Century English Literature 3.
Prerequisite: Sophomore standing and above.
Works of major nondramatic literary figures in England during the period 1600-1700, such as Donne, Jonson, Herbert, Marvell, Bacon, and Browne.

ENG 448 African-American Literature 3.
Prerequisite: Junior standing.
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.

ENG 449 16th-Century English Literature 3.
Prerequisite: Sophomore standing and above.
Nondramatic prose and poetry of the sixteenth century, with consideration of literary types and movements. Emphasis on major authors, including Sidney and Spenser.

ENG 451 Chaucer 3.
Prerequisite: Sophomore standing and above.
Introduction to the study of Chaucer through an intensive reading of The Canterbury Tales.

ENG 452 Medieval British Literature 3.
Prerequisite: Sophomore standing and above.
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.

ENG 453 The Romantic Period 3.
Prerequisite: Sophomore standing and above.
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.

ENG 455 Literacy in the U.S. 3.
Prerequisite: ENG 101; Junior or senior standing.
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. Service-learning component links this academic study to required tutoring (2 hours per week) of children and adults in local community service agencies in addition to attending class. Students will need to provide their own transportation.

ENG 459 Seminar in Film Studies 3.
Prerequisite: ENG 101; Junior or senior standing.
Advanced critical approaches to focused film topics involving film genres, directories styles, or trends within a national cinema. This seminar-style course will include screenings, readings, regular discussions, and a substantive final research paper. Topics will vary from semester to semester. Junior or senior standing or permission of instructor required.
ENG 460 Major British Author 3.
Prerequisite: Sophomore standing and above.
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.

ENG 462 18th-Century English Literature 3.
Prerequisite: Sophomore standing and above.
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.

ENG 463 The Victorian Period 3.
Prerequisite: Sophomore standing and above.
Significant British poets, writers of prose non-fiction, and novelists studied in the social, economic, scientific, intellectual, and theological contexts of the Victorian era.

ENG 464 British Literature, 1900-1945 3.
Prerequisite: Sophomore standing and above.
Variety of writings by British authors between the death of Queen Victoria and the end of World War II. Typical subjects: Hardy, Conrad, Shaw, Yeats, Forster, Joyce, Lawrence, Eliot, Woolf, Beckett.

ENG 465 British Literature, Since 1945 3.
Prerequisite: Sophomore standing and above.
Study of a variety of writings by British authors since World War II. Typical subjects: Beckett, O'Brien, Orwell, Lessing, Murdoch, Rhys, Auden, Larkin, Osborne, Rushdie.

ENG 467 American Colonial Literature 3.
Prerequisite: Sophomore standing and above.
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.

ENG 468 American Romantics 3.
Prerequisite: Sophomore standing and above.
Major American writers from 1825 to 1865. Relationship between literary developments and social change. Emphasis on such writers as Emerson, Hawthorne, Cooper, Poe, Melville, Douglass, Stowe, Thoreau, and Whitman.

ENG 469 American Realism and Naturalism 3.
Prerequisite: Sophomore standing and above.
Major American writers from 1865 to 1914, with emphasis on novelists such as Twain, James, Howells, Chopin, and Dreiser.

ENG 470 American Literature, 1914-1945 3.
Prerequisite: Sophomore standing and above.

ENG 471 American Literature, Since 1945 3.
Prerequisite: Sophomore standing and above.
Study of a variety of writings by U.S. authors since World War II. Typical subjects: Ellison, Lowell, Williams, Welty, Bellow, Baldwin, O'Connor, Barthelme, Albee, Mailer, Ashbery, Morrison, McDermott, DeLillo.

ENG 475 Literature, the Arts, and Mass Culture 3.
A review of the debate regarding art and mass culture, with attention to recent developments in cultural theory and practice.

ENG 476 Southern Literature 3.
Prerequisite: Sophomore standing and above.
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.

ENG 480 Modern Drama 3.

ENG 486 Shakespeare, The Earlier Plays 3.
Prerequisite: Sophomore standing and above.
Shakespeare's major works before 1600 with emphasis on his development as a playwright.

ENG 487 Shakespeare, The Later Plays 3.
Prerequisite: Sophomore standing and above.
Shakespeare's major works after 1600 with emphasis on his tragedies and the late romances.

ENG 488 Advanced Fiction Writing Workshop 3.
Prerequisite: ENG 388.
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.

ENG 489 Advanced Poetry Writing Workshop 3.
Prerequisite: ENG 389.
An advanced workshop in creative writing for students with demonstrated understanding and accomplishment in the techniques of writing poetry. This course is restricted to juniors and seniors. Departmental approval required.

ENG 490 Studies in Medieval Literature 3.
Prerequisite: Sophomore standing and above.
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.

ENG 491 Honors in English 3.
Requisite: English Majors Only.
Intensive course or independent study project designed as one portion of the Honors Program in English. Subject varies.

ENG 492 Special Topics in Film Styles and Genres 3.
Critical approaches to focused film topics involving film genres, directorial styles, or trends within a national cinema. Topics will vary from semester to semester.

ENG 493 Special Topics in Folklore 3.
Topics and genres in folklore, such as Folktale and Legend, Folklore and Religion, African-American Folktale. Topics will vary from semester to semester.

ENG 494 Special Topics in Linguistics 3.
Prerequisite: ENG 101.
(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.
ENG 496 Seminar in Literary Criticism 3.
Prerequisite: 9 hours of literature at the 300 level or above.
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.

ENG 497 Senior Seminar in World Literature 3.
Prerequisite: Junior standing or Senior standing.
Rotating topics in world literature, including treatment of materials from more than one culture and including consideration of the subject's theoretical or methodological framework. Readings in English (original languages encouraged but not required).

ENG 498 Special Topics in English 1-6.
Prerequisite: Six hours in ENG above the 100 level.
Directed individual study or experimental course offerings in language or literature. Individual study arranged through consultation with faculty member and Director of Undergraduate Studies.

ENG 499 Special Topics in Creative Writing 3.
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.
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.

ENG 506 Verbal Data Analysis 3.
Prerequisite: ENG 513 or ENG 527 or COM 541 or COM 542.
Research strategies for understanding how spoken and written language shapes activities (e.g., design, instruction, counseling, gaming interactions, e-commerce, etc.). Tracking patterns of use 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.

ENG 507 Writing for Health and Environmental Sciences 3.
Prerequisite: Graduate standing, Doctoral student, Master's student.
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.

ENG 508 Usability Studies for Technical Communication 3.
Prerequisite: ENG 517.
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.

ENG 509 Old English Literature 3.
Study of Old English language with selections from important poems including Beowulf. Examination of the poetry in the light of various modern critical approaches.

ENG 510 Middle English Literature 3.
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.

ENG 511 Theory and Research In Composition 3.
Prerequisite: ENG 517.
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.

ENG 512 Theory and Research In Professional Writing 3.
Corequisite: ENG 666.
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.

ENG 513 Empirical Research In Composition 3.
Prerequisite: ENG 511.
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.

ENG 514 History Of Rhetoric 3.
Prerequisite: Graduate Standing or the equivalent of COM/ENG 321 or COM/ENG 411.
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.

ENG 515 Rhetoric Of Science and Technology 3.
Prerequisite: ENG 514.
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.

ENG 516 Rhetorical Criticism: Theory and Practice 3.
Prerequisite: Graduate Standing or the equivalent of COM/ENG 321 or COM/ENG 411.
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.

ENG 517 Advanced Technical Writing, Editing and Document Design 3.
Prerequisite: ENG 314.
Advanced study of document design, technical editing and usability. For students planning careers as technical communicators.

ENG 518 Publication Management for Technical Communicators 3.
Prerequisite: ENG 517.
Advanced study of publication and team management issues such as staffing, scheduling, cost-reduction and subcontracting. For students planning careers as technical communicators.

ENG 519 Online Information Design and Evaluation 3.
Prerequisite: ENG 517.
Concepts and practices related to multimedia information design, information architectures, human-computer interaction, and genre for complex websites.
ENG 520 Science Writing for the Media 3.
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.

ENG 521 Modern English Usage 3.
Prerequisite: ENG 524.
Analysis of what "usage" means, a look at the shaping of attitudes about English in the twentieth century and the service of language during that period to form social groups. Attention to the transmission of these attitudes and to the role of the schools in that transmission.

ENG 522 Writing in Nonacademic Settings 3.
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 in nonacademic settings and completion of a project that connects academic and nonacademic components. Graduate Standing in an English Department graduate program required. Modest liability insurance fee required. Students must provide their own transportation to the practicum site.

ENG 523 Language Variation Research Seminar 3.
Prerequisite: ENG 525.
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.

ENG 524 Introduction to Linguistics 3.
Prerequisite: Graduate standing or 12 hrs. in ENG.
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.

ENG 525 Variety In Language 3.
Prerequisite: Graduate standing or 12 hrs. in ENG.
Language variation description, theory, method and application; focus on regional, social, ethnic and gender varieties; sociolinguistic analysis, basic discourse analysis.

ENG 526 History Of the English Language 3.
A survey of the growth and development of the language from its Indo-European beginnings to the present.

ENG 527 Discourse Analysis 3.
Prerequisite: Graduate standing.
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.

ENG 528 Sociophonetics 3.
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.

ENG 529 16th-Century Non-Dramatic English Literature 3.
Prerequisite: ENG 524.
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.

ENG 530 17th-Century English Literature 3.
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 textual assignments. Content and focus varies according to instructor's emphasis, but writers covered usually include Donne, Herbert, Crashaw, Marvell and Browne.

ENG 531 American Colonial Literature 3.
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.

ENG 532 Narrative Analysis 3.
Prerequisite: Graduate standing.
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.

ENG 533 Bilingualism and Language Contact 3.
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.

ENG 534 Quantitative Analysis om Sociolinguistics 3.
Prerequisite: ENG 523.
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.

ENG 535 Sociolinguistic Methods 3.
This course introduces students to the fundamental methodology of sociolinguistics. Students will learn about interviewing techniques, IRB regulations, and both quantitative and qualitative data analysis techniques.

ENG 539 Seminar In World Literature 3.
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).
ENG 540 History Of Literary Criticism 3.
Prerequisite: Graduate standing or PBS status.
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.

ENG 541 Literary and Cultural Theory 3.
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.

ENG 548 African-American Literature 3.
Prerequisite: Grad. standing.
Advanced study of critical theories of African-American literature, the contexts of cultural criticism and 20th-century novels of African-American writers within these frames.

ENG 549 Modern African Literature 3.
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.

ENG 550 English Romantic Period 3.
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.

ENG 551 Chaucer 3.
Prerequisite: ENG 451, Graduate standing.
Intensive study of the works of Chaucer in the light of medieval literary traditions, medieval history and a variety of medieval and modern critical approaches.

ENG 554 Contemporary Rhetorical Theory 3.
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.

ENG 555 American Romantic Period 3.
The literary culture of the United States from 1820s through 1860s, setting 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.

ENG 558 Studies In Shakespeare 3.
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.

ENG 559 Seminar in Film Studies 3.
Advanced critical approaches to focused film topics involving film genres, directories styles, or trends within a national cinema. This seminar-style course will include screenings, readings, regular discussions, and a substantive final research paper. Topics will vary from semester to semester. Junior or senior standing or permission of instructor required.

ENG 560 Victorian Poetry and Critical Prose 3.
The literature of Victorian England: 1837-1901; the major poets and essayists, movements and questions in their historical contexts, religious, political and aesthetic.

ENG 561 Milton 3.
An intensive reading of Milton with attention to background materials in history and culture of seventeenth-century England.

ENG 562 18TH-Century English Literature 3.
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.

ENG 563 18TH-Century English Novel 3.
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.

ENG 564 Victorian Novel 3.
Study of Victorian literature of United States from 1860s to early 1900s with emphasis on fiction by such realists and naturalists as Twain, Howells, Chesnutt, James, Crane, Whitman, Dreiser and Norris. Inclusion of prose of writers such as Adams and DuBois possible.

ENG 565 American Realism and Naturalism 3.
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, Whitman, Dreiser and Norris. Inclusion of prose of writers such as Adams and DuBois possible.

ENG 566 American Realism and Naturalism 3.
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, Whitman, Dreiser and Norris. Inclusion of prose of writers such as Adams and DuBois possible.

ENG 567 20TH-Century British Drama 3.
Survey of modern British drama from its beginnings at turn of the century to present.

ENG 570 20TH-Century British Prose 3.
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.

ENG 571 20TH-Century British Poetry 3.
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.

ENG 572 Modern British Drama 3.
Survey of modern British drama from its beginnings at turn of the century to present.

ENG 573 Modern American Drama 3.
A survey of modern American drama centering on major figures.

ENG 575 Southern Writers 3.
Introduction to literary culture of “the South,” tracing the roots of the twentieth-century “Southern Renaissance” in such ante-bellum 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.

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.
ENG 577 20th-Century American Prose 3.
An examination of representative American writers of novel and short fiction.

ENG 578 English Drama To 1642 3.
Prerequisite: ENG 261 and upper division or Graduate standing.
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.

ENG 579 Restoration and 18th-Century Drama 3.
Representative British plays of the period 1660-1780 studied in cultural, social and ethical contexts. Usually includes works by Etheredge, Wycherley, Behn, Dryden, Otway, Vanburgh, Farquhar, Congreve, Lillo, Gay, Goldsmith and Sheridan.

ENG 580 Literary Postmodernism 3.
Prerequisite: Graduate standing.
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.

R: Graduate Students Only.
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.

ENG 582 Studies in Literature 3.
Prerequisite: Graduate standing.
Variation in content. Selected problems and issues in literature.

ENG 583 Studies In Composition and Rhetoric 3.
Prerequisite: Graduate standing.
Variation in content. Selected problems and issues in composition and rhetoric.

ENG 584 Studies In Linguistics 3.
Prerequisite: Graduate standing.
Variation in content. Selected problems and issues in linguistics.

ENG 585 Studies In Film 3.
Prerequisite: Graduate standing.
Variation in content. Selected problems and issues in film.

ENG 586 Studies In Theory 3.
Prerequisite: Graduate standing.
Variation in content. Selected problems and issues in theory.

ENG 587 Interdisciplinary Studies in English 3.
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.

ENG 588 Fiction Writing Workshop 3.
Prerequisite: ENG 488 or ENG 489.
Advanced work in techniques of writing fiction for students with substantial experience in writing. Workshop sessions with students commenting on each other’s work.

ENG 589 Poetry Writing Workshop 3.
Prerequisite: ENG 488 or ENG 489.
Advanced work in techniques of writing poetry for students with substantial experience in writing. Workshop sessions with students commenting on each other’s work.

ENG 590 Studies In Creative Writing 3.
Prerequisite: ENG 588 or 589.
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.

ENG 591 Studies in National Cinemas 3.
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.

ENG 592 Special Topics in Film Styles and Genres 3.
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 ENG 592.

ENG 610 Special Topics English 1-3.

ENG 624 Teaching College Composition 3.
Prerequisite: ENG 511 and mentored assistantship in ENG 101.
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.

ENG 626 Advanced Writing for Empirical Research 3.
Prerequisite: Graduate standing.
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.

ENG 636 Directed Readings 1-6.
Prerequisite: Graduate standing.
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.

ENG 669 Bibliography and Methodology 1-3.
Intensive study of the bibliography and methodology of literary research. Required of all graduate students in English.

ENG 675 Projects in Technical Communication 3.
Prerequisite: ENG 518.
Capstone course for M.S. in Technical Communication. Students engage in major semester-long individual project under direction of instructor.

ENG 676 Master's Project in English 3.
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.
ENG 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

ENG 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

ENG 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

ENG 690 Master's Examination 1-3.
Prerequisite: Master's student.
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.

ENG 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

ENG 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.

ENG 698 Master's Thesis Preparation 1-9.
Prerequisite: Master's student.
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.

ENG 722 Linguistics and Literacy 3.
Prerequisite: ENG 525.
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.

ENG 723 Advanced Language Variation Research Seminar 3.
This course is designed for PhD students who have basic knowledge of sociolinguistic variation. It looks in detail at the fundamental theories, methods, and conclusions that have shaped the study of sociolinguistic variation during the past 50 years, and it provides solid familiarity with theory and quantitative methods. Students will carry out quantitative research on linguistic variation.

ENG 727 Discourse Analysis 3.
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.

ENG 729 Language Variation and Social Theory 3.
Prerequisite: ENG 523.
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.

ENG 730 Ethnolinguistic Variation 3.
Prerequisite: ENG 525.
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.

ENG 731 Applied Sociolinguistics 3.
Prerequisite: ENG 525.
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.

ENG 798 Special Topics in English Studies 3.
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.

ENG 810 Directed Readings in English Studies 1-6.
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.

ENG 896 Summer Dissertation 1.

ENT - Entomology Courses

ENT 110 General Entomology 3.
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.
ENT 121 Pesticides and Their Utilization 3.
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.

ENT 132 Urban Entomology 3.
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.

ENT 163 Ornamental & Turf Insects 3.
Practical course in the biology, recognition, and management of common insect and related arthropod pests that attack ornamentals and turf. WALDVOGEL.

ENT 190 Current Topics in Pest Management 1.
Discussions of current topics of pest management. Topics selected by the students and instructors to include different phases of pest management. Discussions led by leaders in the various facets of the industry.

ENT 201 Insects and People 3.
Introduction to the fascinating world of insects and how they interact with people. Survey of insect history, diversity, structure and function, and behavior. Examples of harmful and beneficial insects in a variety of human activities concluding with some profound impacts insects have had on history, society and culture.

ENT 203 An Introduction to the Honey Bee and Beekeeping 3.
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 social system of one of the animal world's most complex and highly organized non-human societies.

ENT 207 Insects and Human Disease 3.
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 pathogens 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.

ENT 212 Basic Entomology 1.
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.

ENT 305 Introduction to Forensic Entomology 3.
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.

ENT 401 Honey Bee Biology and Management 3.
Prerequisite: (ENT 201, ENT 203, ENT 425, BIO 105 or PB 200). 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.

ENT 402 Forest Entomology 3.
Prerequisite: Junior standing.
Fundamentals of morphology, classification, biology, ecology and control of insects attacking trees, with emphasis on silvicultural practices.

ENT 425 General Entomology 3.
Prerequisite: BIO 181 or BIO 140 or BIO 350.
Explores the science of entomology by focusing on the basic principles of systematics, morphology, physiology, development, behavior, ecology, and control of insects. Field trips provide opportunities to collect insects and study their adaptations to a wide variety of natural environments.

ENT 450 Challenges in Plant Resource Protection 3.
Prerequisite: CS 414 or ENT 425 or PP 315.
This course provides applied training to students in the scientific and regulatory aspects of plant protection using real-world studies, scenarios, and addressing important contemporary issues for safeguarding American agriculture. Students will gain hands-on problem solving abilities regarding the diagnosis, containment, and mitigation of introduced plant pests and pathogens.

ENT 460 Fundamentals of (Pest) Risk Analysis 1.
This course provides students with a historical perspective as well as real-time exposure to working professionals involved in the development of risk analysis documents for plant protection. The course uses real world scenarios and addresses contemporary issues facing scientists and regulators tasked with safeguarding American agriculture. Students will gain hands-on problem solving abilities regarding the identification and mitigation of plant pathogens, insects, and noxious weeds that can be introduced into the USA through international trade in agricultural commodities.

ENT 470 Advanced Turfgrass Pest Management 2.
Prerequisite: C- or better in CS 200.
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.
ENT 492 External Learning Experience 1-6.
Prerequisite: Sophomore standing.
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.

ENT 493 Special Problems in Entomology 1-6.
Prerequisite: Sophomore standing.
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.

ENT 495 Special Topics in Entomology 1-3.
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

ENT 501 Advanced Beekeeping 3.
Prerequisite: ENT 203.
A hands-on course in honey bee management with some emphasis on bee pollination of selected crops based on an understanding of bee biology, bee behavior, bee pathology and bee botany. Credit not allowed for both ENT 401 and ENT 501.

ENT 502 Insect Diversity 4.
Prerequisite: ENT 425.
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.

ENT 503 Insect Morphology and Physiology 3.
Prerequisite: (CH 221 or CH 225) and (CH 223 or CH 227) and ENT 425.
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.

ENT 504 Professional Development for Entomologists 2.
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.

ENT 506 Principles of Genetic Pest Management 3.
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.

ENT 509 Biology of Aquatic Insects 3.
Prerequisite: ENT 425.
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.

ENT 520 Insect Behavior 3.
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.

ENT 525 Entomology for Educators 3.
Prerequisite: General Biology.
Insects and other arthropods used as paradigms for teaching basic principles of Biology and Ecology. Project-oriented format covering topics embracing the learning cycle, scientific method, critical thinking skills, and hand-on laboratory activities.

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.

ENT 527 Insect Neurogenomics 3.
Prerequisite: GN 413/513 or similar coursework (with permission of instructor).
Sensory processing systems in the insect brain (visual, olfactory, gustatory, and mechanosensory), learning and memory and circadian rhythm. Each process will be considered at the behavioral, anatomical, neural, and genetic level. Examples will be drawn from multiple insect species, using recent studies. Techniques: quantitative real-time PCR, microarrays, mapping quantitative trait loci, Drosophila transgenics, RNAi, imaging neuronal activity, etc. For Graduate students with background in molecular biology techniques.

Prerequisite: ENT 425.
The principles underlying modern methods for protecting food, clothing, shelter and health from insect attack.

ENT 560 Techniques in Molecular Ecology and Evolution 3.
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.

ENT 582 Medical and Veterinary Entomology 3.
Prerequisite: ENT 425 or Graduate standing.
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.

ENT 591 Special Topics In Entomology 3.
Prerequisite: Graduate standing.
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.
ENT 601 Seminar 1.
Prerequisite: Graduate standing in ENT or closely allied fields.
Discussion of entomological topics selected and assigned by seminar chair.

ENT 604 Insect Natural History and Field Ecology 1.
Prerequisite: Graduate standing in Entomology.
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.

ENT 620 Special Problems 1-3.
Original research on special problems in entomology not related to a thesis problem. Provides experience and training in research. Credits Arranged.

ENT 641 Agricultural Entomology Practicum 3.
Prerequisite: Economic entomology (ENT 762 recommended).
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 second summer session.

ENT 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

ENT 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

ENT 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

ENT 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

ENT 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

ENT 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

ENT 720 Insect Pathology 3.
Prerequisite: ENT 425 and MB 351.
A treatment of the noninfectious and infectious diseases of insects, the etiological agents and infectious processes involved, immunological responses and applications.

ENT 726 Biological Control of Insects and Weeds 3.
Prerequisite: ENT 425.
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.

ENT 731 Insect Ecology 3.
Prerequisite: ENT 425 and BO (ZO) 760.
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.

ENT 762 Insect Pest Management in Agricultural Crops 3.
Prerequisite: ENT 425.
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.

ENT 765 Advanced Forest Entomology 3.
Prerequisite: ENT 402 or ENT 502.
Coverage of the important insect pests of forest and shade trees including regeneration pests, defoliating insects, inner-bark borers, wood borers, sucking insects, and bud, twig and root feeding insects. Detailed examination of concepts in forest pest management and population dynamics.

ENT 791 Special Topics in Entomology 1-3.
Prerequisite: Graduate standing.
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 modelling, extension entomology, computer methods and urban, forest and stored product pests.

ENT 801 Seminar 1.
Prerequisite: Graduate standing in ENT or closely allied fields.
Discussion of entomological topics selected and assigned by seminar chair.
ENT 804 Insect Natural History and Field Ecology 1.
Prerequisite: Graduate standing in Entomology.
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.

ENT 820 Special Problems 1-3.
Original research on special problems in entomology not related to a thesis problem. Provides experience and training in research.

ENT 841 Agricultural Entomology Practicum 3.
Prerequisite: Economic entomology (ENT 762 recommended).
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 second summer session.

ENT 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

ENT 890 Doctoral Preliminary Exam 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

ENT 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
For students who have completed all credit hour requirements, full-time enrollment for the master's degree and are writing and defending their theses.

EOE 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

EOE 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

EOE 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

EOE 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.

ES - Environmental Science Courses

ES 100 Introduction to Environmental Sciences 3.
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.

ES 200 Climate Change and Sustainability 3.
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 responsible for developing and presenting seminars.

ES 295 Special Topics in Environmental Science 1-4.
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.

ES 300 Energy and Environment 3.
Prerequisite: CH 101 or PY 212 or PY 208.
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.
ET - Environmental Technology Courses

ET 105 Introduction to Environmental Regulations 1
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.

ET 120 Introduction to Renewable Energy Technologies and Assessments 3
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.

ET 201 Environmental Technology Laboratory I 1
Use of field and laboratory instrumentation for monitoring water quality and quantity. 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.

ET 202 Environmental Technology Laboratory II 1
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.

ET 203 Pollution Prevention 1
Prerequisite: ES 100.
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.

ET 220 Solar Photovoltaics Assessment 3
Prerequisite: ET 120.
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.

ET 240 Wind and Hydroelectric Energy Assessment 3
This course introduces concepts, designs, tools, techniques, and material requirements for systems that convert wind and water into usable energy. Topics include the analysis, measurement, and estimation of potential energy of wind and water systems. Upon completion, students should be able to demonstrate an understanding of the technologies associated with converting wind and water into a viable energy source.

ET 252 Introduction to Spatial Technologies 3
Introduction to types of spatial information technologies and their uses in environmental assessments. Topics include: map reading, geographic positioning systems, geographic information systems, and remote sensing. This course will provide a basic overview of these technologies through lectures, and will afford an exposure to their uses through a series of structured laboratory exercises.
Prerequisite: ET 120.
Overview of the historical and current role of bioenergy and biomass potential, technologies and systems, resource supplies, current market developments, and barriers to use in the USA. Students will learn biomass classifications and develop skills to assess landscapes for woody and non-woody biomass stocks, yields and energy values. Skills for techniques to measure woody biomass for managed forest plantations and natural forest stands and select herbaceous bioenergy crops will be developed. Emphasize North Carolina sites and spatial data to develop conceptual framework and assessment skills. Targeted for science and non-science students.

ET 262 Renewable Energy Adoption: Barriers and Incentives 3.
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.

ET 293 Independent Study in Environmental Technology & Management 1-6.
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 Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

ET 294 Independent Study in Environmental Technology & Management 1-6.
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 Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

ET 295 Special Topics in Environmental Technology & Management 1-6.
Special Topics in Environmental Technology & Management at the 200 Level for offering courses on an experimental basis.

ET 301 Environmental Technology Laboratory III 1.
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 the class receive Occupational Safety and Health Administration (OSHA) 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) certification. Required field trips may extend beyond lab time.

ET 302 Environmental Technology Laboratory IV 1.
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.

ET 303 Laboratory Safety Systems and Management 1.
Theory and practice of regulation, management, and auditing of laboratory safety. Laboratory field trips may extend beyond class time.

ET 310 Environmental Monitoring and Analysis 3.
Prerequisites: CH 101 or 100; BIO 181; ET students only.
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.

ET 320 Fundamentals of Air Pollution 3.
Prerequisite: (MA 121, MA 131, or MA 141) and (PY 131 or PY 201 or PY 205 or PY 211).
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.

ET 330 Environmental Technology Practicum 3.
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.

ET 401 Environmental Technology Laboratory V 1.
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.

ET 410 Toxic Substances and Society 3.
Prerequisite: Junior standing.
Interdisciplinary evaluation of past, present and future effects of toxic substances in the environment. Addresses various dimensions of toxic substances; special emphasis on ways to minimize adverse effects in contemporary and future societies.

ET 455 Adaptive Management and Governance 3.
Junior standing or above.
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 resource 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.

ET 460 Practice of Environmental Technology 3.
Prerequisites: ET 310 or SSC 442; and ET Senior Only.
Preparation and presentation of comprehensive environmental assessments and analyses. Critical roles of quality control and assurance. The ISO 14000 environmental management standard of the American National Standards Institute (ANSI). Preparation for certification as an environmental auditor by ANSI and registration as an Environmental Professional by the National Register of Environmental Professionals. Optional training and exams for Environmental Auditors Registration Association and American National Standards Institute/ Register Accreditation Board Written Examination available.
ET 470 Environmental Forensics 3.  
Prerequisite: ET 310 or SSC 442.  
Use of site assessment methodologies and state of the art technologies from analytical chemistry, molecular biology, biogeochemistry, and GIS to solve environmental cases of "Who done it?" with regards to soil/sediment, water, and air contamination. Two field trips which may extend beyond class time are required.

ET 484 Practice of Renewable Energy Assessments 1.  
P: ET 220 and (ET 240 or ET 255 or ET 262); R: Renewable energy assessment minors only.  
Renewable Energy Assessment principles, practices, and technologies. Lectures and field practicum concerning renewable energy potential on a variety of types of land across North Carolina. This course is for enrollment by students who are minoring in renewable energy assessments only.

ET 490 Senior Seminar in Environmental Technology 1.  
Prerequisite: ET Senior Only.  
Weekly departmental and university seminars and group discussions to enrich and broaden student perspectives on the practice and development of environmental technology. Oral and written reporting of seminars topics.

ET 493 Independent Study in Environmental Technology & Management 1-6.  
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 Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

ET 494 Independent Study in Environmental Technology & Management 1-6.  
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 Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

ET 495 Special Topics in Environmental Technology & Management 1-6.  
Special Topics in Environmental Technology & Management at the 400 level for offering courses on an experimental basis.

FIM - Financial Mathematics Courses

Prerequisites: (MA 421 or ST 421), MA 341, and MA 405.  
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.

FIM 549 Financial Risk Analysis 3.  
Prerequisites: MA 405 and (MA 421 or ST 421) and (MA/ST 412 or MA/ST 413).  
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.

FIM 590 Special Topics in FIM 1-3.  
Special Topics in FIM.

FIM 601 Seminar in Financial Mathematics 1-3.  
Seminar in Financial Mathematics.

FIM 610 Special Topics in Financial Mathematics 1-3.  
Special Topics in Financial Mathematics.

FIM 620 Special Problems in FIM 1-3.  
Special Problems in FIM.

FIM 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.  
Non-Thesis Masters Continuous Registration - Half Time Registration.

FIM 689 Non-Thesis Masters Continuous Registration - Full Time Registration 3.  
Non-Thesis Masters Continuous Registration - Full Time Registration.

FIM 693 Master's Supervised Research 1-3.  
Master's Supervised Research.

FL - Foreign Languages Courses

FL 216 Art and Society in France 3.  
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.

FL 219 Studies in Great Works of Non-Western Literature 3.  
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.

FL 220 Studies in Great Works of Western Literature 3.  
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, Danta, 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.

FL 221 Literature of the Western World I 3.  
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.
FL 222 Literature of the Western World II 3.
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, Tolstoy.

FL 223 Contemporary World Literature I 3.
Prerequisite: ENG 112.
Twentieth-century literature of some of the following cultures: Russian, Eastern European, Western European, Latin American, Canadian, Australian.

FL 224 Contemporary World Literature II 3.
Prerequisite: ENG 112.
Twentieth-century literature of some of the following cultures: Asian, Arabian, African, Caribbean, Native-American.

FL 246 Literature of the Holocaust 3.
Fictional and nonfictional versions of the Holocaust, focusing on themes of survival, justice, theology, and the limits of human endurance.

FL 295 Special Topics in Foreign Languages and/or Literatures 1-6.
A special projects course on topics to be determined as needed in the departmental program.

FL 298 Independent Study in Foreign Language or Literature 1-6.
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.

FL 392 Major World Author 3.
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.

FL 393 Studies in Literary Genre 3.
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.

FL 394 Studies in World Literature 3.
Prerequisite: ENG 111 and 112 or 113.
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.

FL 395 Study Abroad Programs 1-3.
Specific category of courses involving language and/or culture taught in foreign countries through the Department Study Abroad Program.

FL 406 Modernism 3.
International Modernist movement in literature, from its nineteenth-century origins to its culmination in the early twentieth century. Definitions of modernity, as embodied in a variety of genres. Placement of Modernist texts within a variety of cultures that produced them.

FL 407 Postmodernism 3.
Literary expressions of Postmodernism, from its origins in the Modernist movement through its culmination in the later decades of the twentieth century. Definitions of post modernity, as embodied in a variety of genres. Placement of Postmodernist texts within a variety of cultures that have produced them.

FL 424 Linguistics for ESL Professionals 3.
Prerequisite: Admission to ESL teacher licensure candidacy, Corequisite: NC teaching license in any area.
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 English speech and writing patterns of non-native speakers. Examination of the ways children, adolescents, and adults learn a second language.

FL 425 Methods and Materials in Teaching English as a Second Language 3.
Prerequisite: Admission to Teacher Education Candidacy or admission to ESL Licensure Program.
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.

FL 439 Perspectives on English as a New Language 3.
Prerequisite: Admission to ESL Teacher Licensure, Corequisite: NC teaching license in any area.
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).

FL 440 Internship in Teaching English as a Second Language 3.
Prerequisite: Admission to ESL Licensure Program, Corequisite: Teacher Licensure in any primary area.
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.

FL 495 Special Topics in Foreign Languages and Literatures 1-6.
A concentrated study of a special period, author or genre to be determined as needed in the departmental program.

FL 497 Senior Seminar in World Literature 3.
Prerequisite: Junior standing or Senior standing.
Rotating topics in world literature, including treatment of materials from more than one culture and including consideration of the subject's theoretical or methodological framework. Readings in English (original languages encouraged but not required).

FL 498 Independent Study in Foreign Language or Literature 1-6.
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.
FL 505 Issues and Trends in Foreign Language Education: Theory & Practice 3.
Prerequisite: Graduate standing.
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.

FL 506 Instructional Technology in Foreign Language Education: Addressing the National 3.
Prerequisite: Graduate standing.
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.

FL 507 College Teaching of Foreign Languages 3.
Prerequisite: Graduate status.
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 observation of practicing instructors and micro-teaching in college-level Spanish or French classes. Credit not given for both FL 507 and either FL/ECI 505 or FL/ECI 506.
Course taught in English. Required for new FLL Teaching Assistants.

FL 508 Second Language Acquisition Research: Interlanguage Development 3.
Prerequisite: Graduate Standing or Permission of the Instructor.
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.

FL 539 Seminar In World Literature 3.
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).

FL 540 History Of Literary Criticism 3.
Prerequisite: Graduate standing or PBS status.

FL 541 Literary and Cultural Theory 3.
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.

FLA - Foreign Languages and Literatures - Arabic Courses

FLA 101 Beginning Arabic 101 3.
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.

FLA 102 Beginning Arabic 102 3.
Prerequisite: FLA 101 or 111.
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. Credit will be allowed for either FLA 102 or FLA 112, but not for both.

FLA 103 Beginning Arabic 103 Conversation 1.
Corequisite: FLA 101.
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.

FLA 104 Beginning Arabic 102 Conversation 1.
Prerequisite: FLA 103; Corequisite: FLA 102.
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.

FLA 201 Intermediate Arabic I 3.
Prerequisite: FLA 102 or FLA 112.
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 acquisition of vocabulary and grammatical tools necessary to undertake more in-depth readings and discussions of news articles from the Arab media. Authentic materials from the Arab media will be used in addition to text-related video and audio materials.
FLA 202 Intermediate Arabic II 3.
Prerequisite: FLA 201.
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 acquisition of vocabulary and grammatical tools necessary to undertake more in-depth readings and discussions of news articles from the Arab media. Authentic materials from the Arab media will be used in addition to text-related video and audiomaterials.

FLA 203 Intermediate Arabic Conversation I 1.
Prerequisite: FLA 102.
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 various social situations.

FLA 204 Intermediate Arabic Conversation II 1.
Prerequisite: FLA 201.
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 various social situations.

FLA 301 Advanced Intermediate Arabic I 3.
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 tools necessary to understand and produce all the basic structures of Modern Standard Arabic. Arabic film and media will be used in class. The student will also be introduced to selected short stories from modern Arabic literature.

FLA 302 Intermediate Arabic II Conversation 3.
Prerequisite: FLA 202.
Continuation of basic skills. Greater emphasis on reading, writing and Chinese cultural traditions. Students are encouraged to use their speaking skills in a variety of typical social situations. Special attention is given to naturalness of speech.

FLA 303 Intermediate Arabic III Conversation 3.
Prerequisite: FLA 203.
Continuation of basic skills. Greater emphasis on reading, writing and Chinese cultural traditions. Students are encouraged to use their speaking skills in a variety of typical social situations. Special attention is given to naturalness of speech.

FLA 304 Intermediate Arabic IV Conversation 3.
Prerequisite: FLA 302.
Continuation of basic skills. Greater emphasis on reading, writing and Chinese cultural traditions. Students are encouraged to use their speaking skills in a variety of typical social situations. Special attention is given to naturalness of speech.

FLA 330 Media Arabic 3.
Prerequisite: FLA 202.
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.

FLC - Foreign Language - Chinese Courses

FLC 101 Elementary Chinese I 3.
Corequisite: FLC 103.

FLC 102 Elementary Chinese II 3.
Corequisite: FLC 104.
Continuation of basic skills. Emphasis on speaking and listening with some reading, writing and Chinese culture.

FLC 103 Elementary Chinese I Conversation 1.
Corequisite: FLC 101.
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.

FLC 104 Elementary Chinese II Conversation 1.
Prerequisite: FLC 101 and FLC 103; Corequisite: FLC 102.
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.

FLC 201 Intermediate Chinese I 3.
Corequisite: FLC 203.
Continuation of basic skills. Greater emphasis on reading, writing and Chinese cultural traditions.

FLC 202 Intermediate Chinese II 3.
Corequisite: FLC 204.
Continuation of basic skills. Focus on reading, writing, Chinese cultural traditions and patterns of behavior.

Prerequisite: FLC 102 and FLC 104; Corequisite: FLC 201.
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.

FLC 204 Intermediate Chinese II Conversation 1.
Prerequisite: FLC 201 and FLC 203; Corequisite: FLC 202.
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.

FLC 201 Intermediate Chinese I Conversation 1.
Prerequisite: FLC 102 and FLC 104; Corequisite: FLC 201.
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.

FLC 202 Intermediate Chinese II 3.
Corequisite: FLC 204.
Continuation of basic skills. Focus on reading, writing, Chinese cultural traditions and patterns of behavior.

FLC 302 Intermediate Chinese IV 3.
Prerequisite: FLC 301.
Continued practice in speaking and understanding Chinese with greater emphasis on reading and writing. Continued study of cultural and literary texts.

FLC 351 Modern Chinese Popular Culture 3.
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.

FLC 401 Advanced Chinese: Readings in Literature and Social Sciences 3.
Prerequisite: FLC 302.
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.
FLE - Foreign Language - English Courses

FLE 100 Introduction to Academic Writing 4.
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.

FLE 101 Academic Writing and Research 4.
Prerequisite: Grade of C- or better in FLE 100 or placement via ESL testing guidelines.
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.

FLE 201 Oral Communication in English for International Students 3.
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.

FLE 400 American English Pronunciation for International Students 3.

FLE 401 Advanced Oral Communication in English for International Students 3.
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.

FLE 402 Advanced Written Communication in English for International Students 3.
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.

FLF - Foreign Language - French Courses

FLF 101 Elementary French 1 3.
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.

FLF 102 Elementary French II 3.
Prerequisite: FLF 101.
Continuation of FLF 101 with intensive practice in spoken French. Readings in French culture and civilization.

FLF 110 Accelerated Elementary French 3.
Prerequisite: Placement into this course determined by The Department of Foreign Languages and Literatures Placement Test: http://sasw.chass.ncsu.edu/fl/place.htm.
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.

FLF 201 Intermediate French I 3.
Prerequisite: FLF 102 or FLF 110.
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 201.
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.

FLF 212 French: Language, Culture, and Technology 3.
Prerequisite: FLF 102 or FLF 110.
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.

FLF 301 Survey of French Literature from the Middle Ages through the Enlightenment 3.
Prerequisite: An advanced language skills course (FLF 308, 310, 315) or FLF 202 with permission of instructor.
Reading and discussion of representative works with attention to literary analysis as well as to historical and cultural background.

FLF 302 Survey of French Literature from Romanticism to the Contemporary Period 3.
Prerequisite: An advanced language skills course (FLF 308, 310, 315) or FLF 202 with Consent of Instructor.
Reading and discussion of representative works with attention to literary analysis as well as to historical and cultural background.

FLF 306 French Business Communication 3.
Prerequisite: FLF 202.
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.

FLF 307 Business French 3.
Prerequisite: FLF 202.
Business French vocabulary and concepts with emphasis on cultural differences and their importance in the new global village business world.
FLF 308 Advanced Conversation: Contemporary French Cultures 3.
Prerequisite: FLF 202.
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.

FLF 309 French Phonetics and Pronunciation 3.
Prerequisite: FLF 202.
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.

FLF 310 Advanced Written Communication 3.
Prerequisite: FLF 202.
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.

FLF 315 French Civilization and Culture 3.
Prerequisite: FLF 202.
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.

FLF 318 The Heritage of French Cinema 3.
Prerequisite: 3 hrs. in French at 300 level.
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 Coup, and Diva.

FLF 321 French Cultures and contexts 3.
Prerequisite: FLF 202.
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.

FLF 398 Independent Study in French 1-3.
Individualized study in French language, culture, or literature. Topic, mode of study, and credit hours to be determined in consultation with faculty member supervising work. Course may be taken a maximum of two 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.

FLF 401 French Graduate Reading 3.
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.

FLF 411 Approaches to French Translation 3.
Prerequisite: at least two French (FLF) 300 level courses.
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.

FLF 414 Studies in French Prose 3.
Prerequisite: 3 hrs in French at 300 level with 3 hrs in literature.
Major developments in the French essay, letter, novel and other prose forms from the Renaissance to 1900. Readings from such authors as Montaigne, Sevigne, Lafayette, Rousseau, Sand, Balzac, Stendhal, Flaubert.

FLF 425 Literature, Cinema and Culture of the Francophone World 3.
Prerequisite: Graduate standing.
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.

FLF 492 Seminar in French Studies 3.
Prerequisite: Junior standing and 6 hrs in French literature.
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.

FLF 502 Variety in Language: French 3.
Prerequisite: Graduate standing.

FLF 503 Issues in the Acquisition of L1 and L2 French 3.
Explores French first language (L1) and second language (L2) acquisition while addressing the theoretical and practical issues. Topics include: learner language, developmental sequences, cognitive processes, learner strategies, learner internal and external factors, and implications of acquisition research for pedagogical practice. Relevant to current and prospective teachers of L2 French.

FLF 511 Approaches to French Translation 3.
Prerequisite: Graduate standing.
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.

FLF 515 Art and Society in France 3.
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.

FLF 521 French Cultures and Contexts 3.
Prerequisite: Graduate status required for FLF 521.
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.
FLG 525 Literature, Cinema and Culture of the Francophone World 3.
Prerequisite: Graduate standing.
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.

FLG 592 Seminar in French Studies 3.
Prerequisite: At least one 400-level French class; Graduate standing.
Seminar on literary, linguistic, or cultural topic in French studies. Research paper and oral presentation required. Conducted entirely in French. Rotating topics. Credit not allowed for both 492 and 592.

FLG 595 Special Topics in French 3.
Prerequisite: Graduate standing.
In depth exploration of specialized topics in French literature, culture or language. Also used to test and develop new courses. Course taught in French.

FLF 630 Independent Study in French 1-3.
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.

FLF 675 Special Project in French 3.
Prerequisite: Student must be in final semester of his or her program.
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.

FLF 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master’s student.
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.

FLF 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master’s student.
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.

FLG - Foreign Language - German Courses

FLG 101 Elementary German I 3.
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.

FLG 102 Elementary German II 3.
Prerequisite: FLG 101.
Second 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.

FLG 201 Intermediate German I 3.
Prerequisite: FLG 102.
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.

FLG 202 Intermediate German II 3.
Prerequisite: FLG 201.
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.

FLG 212 German Language, Culture, Science, and Technology 3.
Prerequisite: FLG 201.
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.

FLG 301 Advanced German 3.
Prerequisite: FLG 202 or FLG 212 or a score of 688 on the NC State placement test.
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.

FLG 302 German Oral and Written Expression 3.
Prerequisite: FLG 202 or FLG 212 or a score of 688 on the NC State placement test.
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.

FLG 307 Business German 3.
Prerequisite: FLG 202 or FLG 212.
Business German vocabulary and terminology. Readings and discussions on current business topics. Special consideration to intercultural communication relative to international business operations.

FLG 311 Introduction to German Translation 3.
Prerequisite: FLG 202 or FLG 212.
Introduction to theory, methods, and techniques in translation applied to materials of various fields and professions. Emphasis on written translation.

FLG 315 Germanic Civilization and Culture 3.
Prerequisite: FLG 202 or FLG 212.
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.
FLG 318 New German Cinema 3.
Prerequisite: FLG 202 or FLG 212.
Survey of the major contributions to the "New German Cinema" (1970's to 1990's). Attention to film as an artistic medium and to the cinematic representation of German history and culture. Reading, discussion, and viewing of films including films by Schloendorff (Die Blechtrommel), Fassbinder (Die Ehe der Maria Braun), von Trotta (Rosa Luxemburg), Herzog (Stroszek), and Wenders (Der Himmel ueben Berlin).

FLG 320 Introduction to German Literature 3.
Prerequisite: FLG 202 or FLG 212.
An introduction to reading and analyzing German, Austrian, and Swiss literary texts in their cultural and historical contexts. Discussion of various genres (short story, novel, drama, poetry) formal aspects, literary periods, and a variety of critical approaches. Lectures and much discussion. Oral and written assignments, exam.

FLG 323 Twentieth Century German Literature 3.
Prerequisite: FLG 202 or FLG 212.
Twentieth century literature from German-speaking countries. Readings of Mann, Kafka, Rilke, Hesse, Durrenmatt, Frisch, Grass, and a variety of poets.

FLG 325 German Lyric Poetry 3.
Prerequisite: FLG 202 or FLG 212.
A historical and interpretative study of the German lyric from the fifteenth into the twentieth century with special attention to the poet's choice of theme, the ways in which that theme is treated, and the relevance of the poem to the human experience.

FLG 390 German Studies Topics 3.
Prerequisite: FLG 202 or FLG 212.
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.

FLG 398 Independent Study in German 1-6.
Prerequisite: FLG 202 or FLG 212.
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.

FLG 401 German Graduate Reading 3.
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.

FLG 407 Business German II 3.
Prerequisite: FLG 307.
Second course in the two-course series on Business German. Topics cover project planning, international marketing, trade fair presentation, financial issues, work place issues, logistics, including all forms of oral and written communication in these areas. Brief lectures, much discussion, oral presentations, written assignments, exam. Course can be used as preparation for certification in the internationally recognized "Zertifikat Deutsch fur den Beruf" (certificate "German for Professionals"). Certification is voluntary, for a fee, and separate from the course.

FLG 420 Current Issues in German-Language Media 3.
Prerequisite: Two courses at the FLG 300 level.
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 scope, and major political, economic, social and cultural issues in the German-speaking countries. Discussion, oral presentations, written assignments.

FLG 430 Cultural Artifacts in the German-Speaking Countries 3.
Prerequisite: One FLG 300-level course and one from this list: FLG 315, 316, 318, 320, 323, 325, 390.
Focus on major cultural achievements in Germany, Austria and Switzerland, including literature, film, art, and music. Topics will vary. Examples are: "Kafka and Modernism", "German/Austrian/Swiss Literature and Film-Adaptations", "German-LanguageOpera", "German Art and Society in the 20th Century", or "The Faust Theme in Literature, Art, and Music". This course is repeatable so long as a different topic is covered each time.

FLG 440 Green Germany: Nature and Environment in German Speaking Cultures 3.
Prerequisite: 3 Hours of 300-Level German.
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.

FLG 492 Senior Seminar in German Studies 3.
Prerequisite: Two 300-level FLG courses on literature or culture or film. Capstone seminar in German literature or culture. Student presentations and either a substantial essay or a series of essays. Topics vary each semester.

FLG 499 Internship in Germany, Austria, or German-Speaking Switzerland 1-6.
Prerequisite: Two courses at the FLG 300 level.
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.

FLH - Foreign Language - Hebrew Courses

FLI - Foreign Language - Italian Courses

FLI 101 Elementary Italian I 3.
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.
FLJ 102 Elementary Japanese II 3.
Prerequisite: FLJ 101.
Continuation of FLJ 101 with emphasis on acquisition of oral skills through class practice and use of audio aids. Readings in Italian culture, civilization and literature.

FLJ 201 Intermediate Italian I 3.
Prerequisite: FLI 102.
Third of four consecutive courses to develop skills of speaking, listening, reading and writing. Readings and discussion of Italian culture, civilization and literature.

FLJ 202 Intermediate Italian II 3.
Prerequisite: FLI 201.
Last of four sequential language courses. Increased emphasis on reading and writing. Readings in the literature, culture, and civilization of Italy.

FLI 308 Italian Reading and Conversation 3.
Prerequisite: FLI 202.
Advanced readings and intensive conversational practice in Italian for students beyond the intermediate level.

FLI 318 Italian Society Through Cinema 3.
Prerequisite: FLI 202.
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.

FLJ - Foreign Language - Japanese Courses
FLJ 101 Elementary Japanese I 3.
Corequisite: FLJ 103.
Introduction to standard, formal Japanese. Emphasis on speaking and listening skills. Exposure to Japanese culture, reading, and writing.

FLJ 102 Elementary Japanese II 3.
Prerequisite: FLJ 101, Corequisite: FLJ 104.
Continuation of basic skills. Emphasis on speaking and listening skills; inclusion of Japanese cultural factors in communication. Some reading and writing.

FLJ 103 Elementary Japanese I Conversation 1.
Corequisite: FLJ 101.
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.

FLJ 104 Elementary Japanese II Conversation 1.
Prerequisite: FLJ 101, Corequisite: FLJ 102.
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.

FLJ 201 Intermediate Japanese I 3.
Prerequisite: FLJ 102 or FLJ 105, Corequisite: FLJ 203.
Continuation of basic skills. Greater emphasis on reading and writing. More exposure to Japanese cultural traditions.

Prerequisite: FLJ 201, Corequisite: FLJ 204.
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 102, Corequisite: FLJ 201, FLJ 202 or FLJ 301.
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.

FLJ 204 Intermediate Japanese II Conversation 1.

FLJ 301 Intermediate Japanese III 3.
Prerequisite: FLJ 202.
Continued study of Japanese language. Primary emphasis on spoken Japanese, but attention also given to reading, writing and culture.

FLJ 302 Intermediate Japanese IV 3.
Prerequisite: FLJ 301.
Continued training in the foundations of Japanese language. Primary emphasis on spoken Japanese, with increased attention to reading and writing.

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.

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.

FLJ 351 Contemporary Culture in Japan 3.
Prerequisite: FLJ 101.
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.
FLJ 401 Advanced Japanese I 3.
Prerequisite: FLJ 302.
Continued training in the foundations of Japanese language, with emphasis on complex verb forms. Increased attention to reading and writing.

FLJ 402 Advanced Japanese II 3.
Prerequisite: FLJ 401.
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.

FLM - Film Studies Courses

FLM 378 Women & Film 3.
This course will introduce students to the rich international history of women's participation in the motion picture industry. Course includes readings, screenings, discussions, and a final examination.

FLM 450 Professional Internship in Film Studies 3.
Prerequisite: completed 9 hours of Film Studies coursework.
150 hours of professional work over the course of a semester. Students may undertake any work relevant to the field of Film Studies, but they are required to complete at least one professional project indicating that they have developed a specific skill in film programming, exhibition, production, research, or promotion. A paper is due at the end of the semester, outlining the significance of the professional experience in relation to some aspect of film history, theory, criticism, distribution, or production. Students must provide their own transportation. Restricted to FLM majors. FLM 450 may only be taken once for credit towards the major requirements.

FLM 459 Seminar in Film Studies 3.
Prerequisite: ENG 282, ENG 384 and Junior or Senior standing.
Advanced critical approaches to focused film topics involving film genres, directories styles, or trends within a national cinema. This seminar-style course will include screenings, readings, regular discussions, and a substantive final research paper. Topics will vary from semester to semester. Junior or senior standing or permission of instructor required.

FLN - Foreign Language - Hindi Courses

FLN 101 Elementary Hindi-Urdu I 3.
Corequisite: FLN 103.
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.

FLN 102 Elementary Hindi-Urdu II 3.
Prerequisite: FLN 101, Corequisite: FLN 104.
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.

FLN 103 Elementary Hindi-Urdu I Conversation 1.
Corequisite: FLN 101.
Required conversational practice for FLN 101. Special attention to individual pronunciation and intonation. Introduction of formal and informal speech. Use of audiovisual materials.

FLN 104 Elementary Hindi-Urdu II Conversation 1.
Prerequisite: FLN 101, Corequisite: FLN 102.
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.

FLN 201 Intermediate Hindi-Urdu I 3.
Prerequisite: FLN 102, Corequisite: FLN 203.
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.

FLN 202 Intermediate Hindi-Urdu II 3.
Prerequisite: FLN 201, Corequisite: FLN 204.
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.

FLN 203 Intermediate Hindi-Urdu I Conversation 1.
Prerequisite: FLN 102, Corequisite: FLN 201.
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.

FLN 204 Intermediate Hindi-Urdu II Conversation 1.
Prerequisite: FLN 201, Corequisite: FLN 202.
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.

FLN 301 Twentieth Century Hindi & Urdu Fiction 3.
Prerequisite: FLN 202.
Introduces advanced Hindi-Urdu students to the prose fiction of major Hindi and Urdu literary figures including Munshi Premchand, Saadat Hasa Manto and others. Texts will be provided in both Hindi and Urdu scripts and/or English translation as available.

FLN 302 Modern Hindi & Urdu Poetry 3.
Prerequisite: FLN 301.
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.

FLN 401 Hindi Literature and South Asian Cultural Contexts 3.
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.

FLP - Foreign Language - Portuguese Courses

FLP 101 Elementary Portuguese I 3.
Introduction to the fundamentals of Brazilian Portuguese: pronunciation, comprehension, and spoken syntax and grammar.

FLP 102 Elementary Portuguese II 3.
Prerequisite: FLP 101.
Continuation of the essentials of Brazilian Portuguese. Further stress on pronunciation and comprehension and introduction of reading and writing skills.
FLP 201 Intermediate Portuguese I 3.
*Prerequisite: FLP 102 or placement in course.*
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.

FLP 401 Brazilian Portuguese for Spanish Speakers 3.
*Prerequisite: Native/Heritage Spanish Speaker or FLS 202 or Equivalent and Instructor's Approval.*
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->Portuguese->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.

FLR - Foreign Language - Russian Courses

FLR 101 Elementary Russian I 3.
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.

FLR 102 Elementary Russian II 3.
*Prerequisite: FLR 101.*
Emphasis on acquisition of basic oral skills, with complementary reading and writing exercises and attention to Russian cultural heritage.

FLR 201 Intermediate Russian I 3.
*Prerequisite: FLR 102.*
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.

FLR 202 Intermediate Russian II 3.
*Prerequisite: FLR 201.*
Advanced aspects of Russian syntax through study of text. Continued attention to conversational practice and vocabulary building.

A study of selected plays, short stories and novels of the great Russian writers of the nineteenth century: Pushkin, Lermontov, Gogol, Goncharov, Turgenev, Dostoevsky, Saltykov-Shchedrin, Leskov, Tolstoy and Chekhov. Examinations of peculiarly Russian as well as the universal aspects of this literature. All readings, lectures and discussions in English.

FLR 304 Russian Literature in Translation: The Twentieth Century 3.
A study of selected poems, plays, short stories and novels by major Russian writers of the twentieth century, such as Chekhov, Gorky, Blok, Mayakovsky, Esenin, Zamyatin, Olesha, Bulgakov, Babel, Pilnyak, Pasternak, Solzhenitsyn, Evtushenko, and Voznesensky. All readings, lectures and discussions in English.

FLR 318 Russian Cinema and Society 3.
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.

FLS - Foreign Language - Spanish Courses

FLS 101 Elementary Spanish I 3.
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.

FLS 102 Elementary Spanish II 3.
*Prerequisite: FLS 101.*
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.

FLS 105 Intensive Elementary Spanish 6.
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.

FLS 110 Accelerated Elementary Spanish 3.
*Prerequisite: A score of 167 or better on the Spanish placement exam is required for matriculation in this course.*
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.

FLS 201 Intermediate Spanish I 3.
*Prerequisite: FLS 102, 105 or 110.*
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.

FLS 202 Intermediate Spanish II 3.
*Prerequisite: FLS 201.*
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.
FLS 210 Accelerated Intermediate Spanish 3.
Prerequisite: A score of 25-30 on the Spanish placement exam is required for matriculation in this course.
Content of FLS 102 and FLS 201 at an accelerated pace, for students placed into the course based on results of the Spanish placement test, or those with significant knowledge/experience with another Romance language. Substantial amount of work outside of class. Development of a balanced foundation in listening, speaking, reading, and writing Spanish, and understanding Hispanic cultures.

FLS 212 Spanish: Language, Technology, Culture 3.
Prerequisite: FLS 102, FLS 110, or FLS 105.
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 requirement.

FLS 295 Intermediate Special Topics in Spanish 3.
Prerequisite: FLS 201.
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.

FLS 331 Spanish Oral and Written Expression I 3.
Prerequisite: FLS 202.
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.

FLS 332 Spanish Oral and Written Expression II 3.
Prerequisite: FLS 202.
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.

FLS 333 The Sounds of Spanish 3.
Prerequisite: FLS 202.
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.

FLS 335 Spanish for Native and Heritage Speakers 3.
Native or heritage speaker of Spanish with Advanced or Superior proficiency on the ACTFL Oral Proficiency Scale.
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 on the Teaching of Foreign Languages proficiency scale.

FLS 366 Spanish for Business 3.
Prerequisite: FLS 331.
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.

FLS 377 Spanish for Tourism in the Hispanic World 3.
Prerequisite: FLS 202.
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.

FLS 380 Introduction to Hispanic Literatures and Cultures 3.
Prerequisite: FLS 331, Corequisite: FLS 332.
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.

FLS 381 Literature and Culture of Spain I 3.
Prerequisite: FLS 332; Corequisite: 340.
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.

FLS 382 Literature and Culture of Spain II 3.
Prerequisite: FLS 332; Corequisite: 340.
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.

FLS 383 Literature and Culture of Spain III 3.
Prerequisite: FLS 332, Corequisite: FLS 332.
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.

FLS 384 Literature and Culture of Latin America I 3.
Prerequisite: FLS 332, Corequisite: FLS 340.
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.
FLS 352 Literature and Culture of Latin America II 3.
Prerequisite: FLS 332; Corequisite: 340.
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.

FLS 353 Literature and Culture of Latin America III 3.
Prerequisite: FLS 332; Corequisite: 340.
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.

FLS 360 Hispanic Cinema 3.
Prerequisite: FLS 331 and Corequisite FLS 332.
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.

FLS 395 Special Topics in Spanish 3.
Prerequisite: FLS 202.
Special Topics in language and cultures of the Spanish speaking world for students at the 300 level. Includes courses taught in Spanish study abroad programs. Course may be taken up to three times.

FLS 399 Intensive Spanish Oral Proficiency Workshop 1.
Prerequisite: 3 Hours of 300-level Spanish.
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 tasks to support in class activities. Designed to help Spanish majors to achieve the intermediate high oral proficiency level required for graduation. This is a 5-week course. Departmental permission is required.

FLS 400 Methods and Techniques in Spanish Translation and Interpretation 3.
Prerequisite: 12 credits of 300 level Spanish.
Study and practical application of theory, methods and techniques of translation based on materials relevant to various fields and professions.

FLS 401 Spanish Graduate Reading 3.
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.

FLS 402 Introduction to Spanish Linguistics 3.
Prerequisite: 12 credits of 300 level Spanish.
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.

FLS 405 Spanish-English Comparative Grammar 3.
Prerequisite: 12 credits of 300 level Spanish.
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.

FLS 411 Topics in the Culture of Spain 3.
Prerequisite: 12 credits of 300-level Spanish.
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.

FLS 412 Topics in the Culture of Latin America and the Caribbean 3.
Prerequisite: 12 credits of 300-level Spanish.
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.

FLS 413 Spain and the Americas in Transatlantic Perspective 3.
Prerequisite: 12 credits of 300-level Spanish.
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.

FLS 492 Seminar in Hispanic Studies 3.
Prerequisite: 12 credits of 300 level Spanish.
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.

FLS 495 Advanced Special Topics in Spanish 3.
Prerequisite: 12 credits of 300-level Spanish.
Advanced special topics in language and cultures of the Spanish speaking world for students at the 400 level. Includes courses taught in Spanish study abroad programs. Course may be taken up to three times.

FLS 502 Linguistic Structure of Spanish 3.
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.

FLS 503 Spanish Applied Linguistics 3.
Prerequisite: FLS 502 (Linguistic Structure of Spanish).
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.
FLS 504 Spanish Language Change and Variation 3.
Prerequisite: FLS 502 (Linguistic Structure of Spanish).
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.

FLS 509 Spanish Phonetics and Phonology 3.
Prerequisite: FLS 502 (Linguistic Structure of Spanish).
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.

FLS 510 Spanish Dialectology 3.
Prerequisite: FLS 502 Linguistic Structure of Spanish or permission of instructor.
Overview of geographic linguistic variation in the Spanish-speaking world. Data from phonetics/phonology and morpho-syntax will form the basis of study. Topics include the development of dialect differences, dialects and languages of the Iberian peninsula, and Spanish usage in Latin America. Spanish as a world language in Africa and Asia, as well as indigenous influences on Spanish, are also covered.

FLS 511 Spanish Sociolinguistics 3.
Prerequisite: FLS 502 (Linguistic Structure of Spanish).
Overview of synchronic linguistic variation in the Spanish-speaking world. The social stratification of language in Spanish speaking communities according to social class, gender, and age will be explored. The contribution of these factors to language change among Spanish speakers in the Americas and Spain will also be explored.

FLS 515 History of Spanish Language 3.
Prerequisite: FLS 502 or equivalent; or permission of instructor.
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.

FLS 525 Poetry and Politics in Latin America 3.
Prerequisite: FLS 492: Admission into the M.A. Program in Spanish.
This course examines the poetry of Octavio Paz, Cesar Vallejo, and Pablo Neruda from the 1930s to the 1950s and covers the aesthetic and political debates regarding realism, surrealism and socialist realism in Europe and Latin America. The focus is on the relationship between literary form and politics. Course is offered in Spanish.

FLS 526 Cultures, discourses and practices in early modern Spain 3.
Overview of early modern Spanish short fiction, theatre, and the reflection of these genres in the everyday practices and cultural discourse of Imperial Spain. Taught in Spanish. Graduate status or permission of instructor.

FLS 528 Don Quixote 3.
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.

FLS 530 The Cultural Production of Spanish Democracy 3.
Prerequisite: Graduate standing.
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.

FLS 553 The Latin American Avant-Garde 3.
Prerequisite: FLS 502 or equivalent; or permission of instructor.
Overview of early modern Spanish short fiction, theatre, and the reflection of these texts, it also provides, through the reading of various theoretical articles, a basic introduction to narrative theory (Genette, Booth, Bal, Brooks, etc.). Graduate standing required.

FLS 592 Graduate Seminar in Hispanic Studies 3.
Prerequisite: Graduate standing in Hispanic Studies; M.A. students in Hispanic Studies.
A concentrated study of genres, periods or other special topics in Hispanic Studies to be determined as needed in the departmental program. Rotating topics on literature and/or culture; may be taken more than once for credit.

FLS 595 Special Topics in Spanish 3.
Prerequisite: Graduate standing.
In depth exploration of specialized topics in Spanish literature, culture or language. Also used to test and develop new courses. Course taught in Spanish.

FLS 600 Independent Study in Spanish 1-3.
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.

FLS 675 Special Project in Spanish 3.
Prerequisite: Student must be in final semester of his or her program.
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.

FLS 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.
FLS 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

FLS 790 Special Topic in Hispanic Studies 3.
In depth exploration of specialized topics in Spanish literature, culture or language. Also used to test and develop new courses. May be taken more than once for credit. Graduate Standing.

FLS 792 Seminar in Hispanic Studies 3.
A concentrated study of genres, periods or other special topics in Hispanic Studies to be determined as needed in the departmental program. Rotating topics on literature and/or culture; may be taken more than once for credit. Graduate Standing.

FLS 793 Studies in Golden Age Literature and Culture 3.
Explores how sixteenth-and-seventeenth century Spanish literature and historiography reflect on the emergence of Spain as a politically unified nation. Focus on foundation discourses, the voice of excluded minorities, and the historical events that threatened this unity. Topics include: nation and narration, culture authority, state propaganda, Moriscos, women, the advent capitalism, and rebellion of the Moors of Granada. May be repeated for credit. (Maximum of 6 hours.) Graduate Standing.

Examines the commonalities and distinctions of the quest for independence, modernity and democracy in Latin America and Spain in the 19th century. May be repeated for credit. (Maximum of 6 hours.) Graduate Standing.

A cultural studies-oriented inquiry into selected topics pertinent to contemporary (20th & 21st centuries) Peninsular Spanish literature and culture. Literary and/or cinematic texts are studies in their socio-historical context and in relation to issues of class, gender, ethnicity, and political ideology. Course requires graduate standing. May be repeated for credit. (Maximum of 6 hours.) Graduate Standing.

FLS 797 Studies in Colonial Latin American Literature and Culture 3.
Exploration of the role of literature, material artifacts and public display that reinforce culture heritage and national identity from the colonial period through 19th century Latin America. May be repeated for credit. (Maximum of 6 hours.) Graduate Standing.

Analysis of the major literature, films, and/or literary movements in their historical context in Latin America in the Twentieth and Twent-First Centuries. May be repeated for credit. (Maximum of 6 hours.) Graduate Standing.

FLS 799 Seminar in Literature and Culture of One Latin American Country 3.
Analysis of the most representative literature and culture in one Latin American country in a given historical period. May be repeated for credit. (Maximum of 6 hours.) Graduate Standing.

FM - Feed Mill Courses

FM 425 Feed Manufacturing Technology 3.
Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225.
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.

FM 460 Feed Mill Operations and Leadership 2.
Prerequisite: PO(ANS) 425.
Principles and current practices of modern feed mill operations. Topics include managing employees, team building, safety, budgets, regulations, and key performance indicators.

FM 480 Feed Quality Assurance & Formulation 3.
Prerequisite: PO(ANS) 425.
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.

FM 490 Feed Science Seminar 1.
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.

FM 494 Feed Mill Learning Experience 1.
Prerequisite: PO(ANS) 425.
Hands-on laboratory teaching students how to safely operate feed mill equipment and manufacture feed using a computer system.

FM 525 Advanced Feed Science and Technology 3.
Prerequisite: PO/ANS/NTR 415 or ANS 230 or related feed industry experience.
Feed mill management, equipment, maintenance, operation, safety, and regulations pertaining to feed manufacturing. Feed ingredient purchasing, inventory, storage, quality evaluation, and computerized feed formulation. Advanced NTR525 topics include more detailed aspects of feed science and technology, feed mill design and process flow, operations management, feed quality assurance, regulations, and computer applications. The Distance Education section will have independent study assignments in place of lab experience. Credit will not be given for both PO/ANS 425 and NTR 525.

FM 580 Feed and Ingredient Quality Assurance 3.
Prerequisite: NTR(FM) 525.
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.

FM 594 Advanced Feed Mill Practicum 1.
Prerequisite: NTR(FM) 525.
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.
FM 790 Advanced Feed Formulation 3.
Prerequisite: NTR(FM) 525.
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.

FOR - Forestry Courses

FOR 150 Professional Development I: Critical Thinking in Natural Resources 1.
Techniques of critical thinking applied to a broad range of natural resource and forestry issues.

FOR 172 Forest System Mapping and Mensuration I 2.
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 characteristics; introduction to forest sampling. Application of spreadsheets and word processing to analyze and summarize resource characteristics. Field trip required.

FOR 202 Anatomy and Properties of Renewable Materials 3.
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.

FOR 204 Silviculture 2.
Prerequisite: Summer camp eligibility.
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.

FOR 220 Urban and Community Forestry 3.
Introduction to the interdisciplinary study of urban forestry and greenspaces. Study of urban forest history, distribution and ownership patterns, urban ecology and ecosystems, benefits and uses of urban forests, vegetation establishment and maintenance, urban planning and policy, community interactions, urban forestry implementation.

FOR 221 Conservation of Natural Resources 3.
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.

FOR 248 Forest History, Technology and Society 3.
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.

FOR 250 Professional Development II: Communications in Natural Resources 1.
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.

FOR 252 Introduction to Forest Science 3.
Not open to Forest Management Majors (15FOMND, 15FORMTBS, 15FGM).
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.

FOR 260 Forest Ecology 3.
Introduction to forest ecosystems, their structure, and the processes that regulate them including: radiation, temperature, water, and biogeochemistry; productivity; plant populations; structure and function of forest communities; succession; wind and fire; and human influences.

FOR 261 Forest Communities 2.
Prerequisite: FOR 339 or PB 220 or PB 403.
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.

FOR 264 Forest Wildlife 1.
Prerequisite: Summer camp eligibility.
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 representative species presented.

FOR 265 Fire Management 1.
Prerequisite: Summer camp eligibility.
Effects of wildfire and prescribed fire on forest ecosystem components and processes; fire behavior and the ecosystem and meteorologic 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.

FOR 273 Forest System Mapping and Mensuration II 3.
Prerequisite: FOR 172.
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 Mill Forest.

FOR 291 Independent Study in Forestry 1-6.
Detailed investigation of forestry topics of interest to undergraduates under faculty direction on a tutorial basis. Credit and content determined by faculty member in consultation with Undergraduate Program Director or Department Head. 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.
FOR 293 Independent Study in Forest Management 1-6.
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-Standard Courses" be completed by the student and faculty member prior to registration by the department.

FOR 294 Independent Study in Forest Management 1-6.
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-Standard Courses" be completed by the student and faculty member prior to registration by the department.

FOR 295 Special Topics in Forestry 1-6.
Study of forestry topics not covered in existing courses at the introductory level. Development of a new course on a trial basis.

FOR 303 Silvics and Forest Tree Physiology 3.
P: (CH 101 or 103) and [(CH 201 and 202) or (CH 203 and 204) or PY 205 or PY 211].
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.

FOR 304 Theory of Silviculture 4.
Prerequisite: FOR 260.
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.

FOR 318 Forest Pathology 3.
Prerequisite: PB 200.
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.

FOR 319 Forest Economics 3.
Prerequisite: ARE 201 or EC 205 or EC 201.
Economic approaches for evaluating the production and costs of forest management, timber harvesting activities, and nontimber 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.

FOR 330 North Carolina Forests 3.
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-sit relationships, forestry practices, non-conventional management objectives. Two required Saturday field trips.

FOR 334 Operations Research Applications in Natural Resources 1.
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, non-linear and integer programming concepts. The emphasis is on problem formulation and solution using computer programs. Half semester course.

FOR 339 Dendrology 4.
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.

Prerequisite: Junior standing.
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.

FOR 353 Air Photo Interpretation and Photogrammetry 3.
Prerequisite: MA 114 or MA 121 or MA 131 or MA 141.
Theory, principles, and techniques of utilizing air photos for inventory and management of renewable resources, photogrammetric and engineering applications, hydrologic and terrain analysis, and land use/cover mapping. Introduction to remote sensing and use of color infrared, thermal, Skylab, and Landsat imagery in resource mapping.

FOR 374 Forest Measurement, Modeling, and Inventory 3.
Prerequisite: FOR 273.
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.

FOR 402 Forest Entomology 3.
Prerequisite: Junior standing.
Fundamentals of morphology, classification, biology, ecology and control of insects attacking trees, with emphasis on silvicultural practices.

FOR 404 Forest Wildlife Management 3.
Prerequisite: Junior standing.
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.

FOR 405 Forest Management 4.
Prerequisite: FOR 304, FOR 319, FOR 374.
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.

FOR 406 Forest Inventory, Analysis and Planning 4.
Prerequisite: FOR 405, FOR 460.
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.
FOR 411 Forest Tree Genetics and Biology 3.
Prerequisite: Junior standing.
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.

FOR 414 World Forestry 3.
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.

FOR 415 World Forestry Study Tour 1.
Corequisite: FOR 414.
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 an off-week field trip to Mexico and/or Central America.

FOR 420 Watershed and Wetlands Hydrology 4.
Prerequisite: SSC 200, BIO 360.
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 processes. Two weekend field trips are required. Credit will not be given for both FOR(NR)420 and FOR(NR)520.

FOR 422 Consulting Forestry 3.
Prerequisite: Senior standing in Forest Management.
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.

FOR 434 Forest Operations and Analysis 3.
Junior standing or above.
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.

FOR 450 Professional Development IV: Leadership 1.
Prerequisite: Junior standing.
Concepts and applications of leadership principles with emphasis on leadership challenges and opportunities for professionals in natural resources management. Assessment and development of leadership skills.

FOR 491 Special Topics in Forestry and Related Natural Resources 1-4.
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.

FOR 493 Independent Study in Forest Management 1-6.
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" be completed by the student and faculty member prior to registration by the department.

FOR 494 Independent Study in Forest Management 1-6.
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" be completed by the student and faculty member prior to registration by the department.

FOR 501 Dendrology 3.
Prerequisite: PB 200.
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.

FOR 502 Forest Measurements 1.
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.

FOR 503 Tree Physiology 1.
Prerequisite: Graduate standing.
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.

FOR 504 Forest Management 4.
Fundamental principles and analytical techniques necessary in 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. Credit not allowed for both FOR 505 and FOR 405.

FOR 507 Silviculture Mini Course 1.
One-third semester mini-course. A condensed version of silviculture. Ecological processed 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.

FOR 509 Forest Resource Policy 1.
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.
FOR 510 Introduction to GPS 1.
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.

FOR 513 Silviculture for Intensively Managed Plantations 3.
Prerequisite: FOR 507.
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 environmentally sustainable.

FOR 519 Forest Economics 3.
Prerequisite: Basic course in economics.
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.

FOR 520 Watershed and Wetlands Hydrology 4.
Prerequisite: SSC 200, BIO 360.
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. Field study of watersheds and hydrologic measurements. Two weekend field trips required. Credit for both FOR(NR) 420 and FOR(NR) 520 is not allowed.

FOR 522 Consulting Forestry 3.
Prerequisite: Graduate standing.
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. To receive graduate credit, a student must write a term paper on a topic mutually agreed upon with the instructor. Credit for both FOR 422 and FOR 522 is not allowed.

FOR 531 Wildland Fire Science 3.
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.

FOR 534 Forest Operations and Analysis 3.
Management science and operational techniques in forestry. Road layout, construction, and machine systems: harvesting machine optimization and selection. Harvesting, production and forest planning. Linear programming, queuing, decision and inventory theory, and other techniques for solving problems typically encountered in forest operations management. Credit not allowed for both FOR 534 and FOR 434.

FOR 540 Advanced Dendrology 3.
Prerequisite: BO 403 or FOR 339.
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.

FOR 561 Forest Communities of the Southeastern Coastal Plain 1.
Prerequisite: FOR 212, FOR 501.
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.

FOR 562 Forest Communities of the Southern Appalachians 1.
Prerequisite: FOR 212, FOR 501.
Species composition, distribution, site requirements, and succession of principal forest communities of southern Appalachians. Identification of important member plant species. Overnight field trips to typical examples.

FOR 575 Advanced Terrestrial Ecosystem Ecology 3.
Views organisms and physical environment as integrated system. Outlines processes governing assimilation and cycling of energy, carbons, 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.

FOR 583 Tropical Forestry 3.
Prerequisite: Senior standing.
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.

FOR 595 Special Topics 1-6.
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.

FOR 601 Graduate Seminar 1.
Prerequisite: FOR 420, ST 512.
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.

FOR 603 Research Methods in Forestry and Environmental Resources 1.
Prerequisite: Graduate standing.
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.
FOR 610 Special Topics In Forestry 1-3.
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.

FOR 680 Field Practicum in Tropical Forestry 2.
Principles of tropical forest protection and management through case studies. Participants will travel to a tropical region outside the United States for two weeks of intensive field studies. Topics: balancing economic growth with environmental protection, industrial forestry, protection forestry, projects and organizations, policy issues.

FOR 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

FOR 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

FOR 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

FOR 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

FOR 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

FOR 713 Advanced Topics In Silviculture 3.
Prerequisite: FOR 304.
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.

FOR 725 Forest Genetics 3.
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.

FOR 726 Advanced Topics In Quantitative Genetics and Breeding 3.
Prerequisite: ST 511, Corequisite: ST 512.
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.

FOR 727 Tree Improvement Research Techniques 3.
Prerequisite: FOR 411 or GN 411.
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.

FOR 728 Quantitative Forest Genetics Methods 3.
Prerequisite: GN 703, ST 701.
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.

FOR 734 Advanced Forest Management Planning 3.
Prerequisite: FOR 405 or FOR 434 or OR 501, Corequisite: FOR 772.
History, principles, structures and use of modern forest management planning and decision-making techniques. Emphasis on optimization procedures and public forest management.

FOR 750 Ecological Restoration 3.
Prerequisite: BO 360, SSC 200, Corequisite: BO 565.

FOR 753 Environmental Remote Sensing 3.
Prerequisite: FOR 353.
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.
FOR 784 The Practice Of Environmental Impact Assessment 1-4.
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.

FOR 795 Advanced Special Topics in Forestry 1-3.
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.

FOR 801 Seminar 1.
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.

FOR 803 Research Methods in Forestry and Environmental Resources 1.
Prerequisite: Grad. standing.
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.

FOR 810 Special Topics in Forestry 1-3.
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.

FOR 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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 890 Doctoral Preliminary Exam 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

FOR 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

FPC - Fiber and Polymer Science Courses


FPC 720 Yarn Production/Properties: Advanced Topics 3.
Prerequisite: TT 520 or TE 501.
Lectures and seminar discussion of recent development in yarn manufacturing. Group research into topical areas of yarn production and properties.

FPC 792 Special Topics in Fiber Science 1-12.

FPC 801 Seminar 1-99.

FPC 830 Independent Study 1-3.

FPC 876 Special Project in Fiber and Polymer Sciences 1-12.

FPC 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

FPC 890 Doctoral Preliminary Exam 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

FPC 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

FS - Food Science Courses

FS 201 Introduction to Food Science 3.
Science and practice of providing a wholesome, nutritious, economical and readily available supply of basic and processed foodstuffs. Chemical nature of foods, nutritional requirements, health-related dietary considerations, microorganisms, foodborne illnesses, preservation and processing, food additives, food labeling, food safety and the consumer.
FS 231 Principles of Food and Bioprocess Engineering  
Prerequisite: PY 211. 
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.

FS 290 Careers in Food and Bioprocessing Sciences  
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.

FS 295 Special Topics in Food Science 1-4. 
Offerings of new or experimental courses in Food Science at the early undergraduate level.

FS 301 Introduction to Human Nutrition 3. 
Prerequisite: Sophomore standing. 
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.

FS 322 Muscle Foods and Eggs 3. 
Prerequisite: ZO 160, BIO 181 or BIO 183. 
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.

FS 324 Milk and Dairy Products 3. 
Prerequisite: BIO 181 or 183, CH 101. 
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.

FS 330 Science of Food Preparation 3. 
Prerequisite: FS 201 and CH 101. 
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.

FS 350 Introduction to HACCP 3. 
Introductory course on the Hazard Analysis and Critical Control Points System (HACCP) which is designed to decrease hazards in foods. An International HACCP Alliance approved course which covers prerequisite programs. A step by step approach for developing and implementing a HACCP plan for USDA regulated food processing plants. Offered only as a world wide web course through the Office of Instructional Telecommunications.

FS 351 Sanitation Standard Operating Procedures in Food Safety Control 3. 
This course is one of a series of six courses that are part of North Carolina State University’s Food Safety Certification program. “Sanitation Standard Operating Procedures (SSOP’s) in Food Safety Control” addresses current federal regulatory requirements for seafood, meat, and poultry processing operations. The course also addresses the international dimensions of sanitary standards in import/export of food. The course is designed to provide the student with the background necessary to develop, implement and maintain a sanitation plan based on sanitation standard operating procedures (SSOP’s).

FS 352 Introduction to Microbiological Food Safety Hazards 3. 
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.

FS 353 Good Manufacturing Practices 3. 
Food Safety sanitation in the United States is primarily regulated by FDA under their “Good Manufacturing Practices (GMP).” This course will introduce the student to the GMP and consider how and why they were developed. Students will become familiar with the issues of compliance and consider the regulations in light of international laws and current practices. The student should have some familiarity with food processing and safety.

FS 354 Food Sanitation 3. 
Prerequisite: FS/ANS/PO 350 or equivalent HACCP industry experience. 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.

FS 401 Advanced Nutrition and Metabolism 3. 
Prerequisite: (NTR 301 or NTR 415) and (CH 221 or CH 220 or CH 225). 
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.

FS 402 Chemistry of Food and Bioprocessed Materials 4. 
Prerequisite: CH 220 or 221 or 225. 
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.

FS 403 Analytical Techniques in Food & Bioprocessing Science 4. 
Prerequisite: FS 402. 
Principles, methods and techniques for quantitative physical and chemical analyses of food, nutraceutical, and pharmaceutical products. Results of analyses evaluated in terms of quality standards and governing regulations.

FS 405 Food Microbiology 3. 
Prerequisite: MB 351. 
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.
**FS 406 Food Microbiology Lab 1.**  
Prerequisite: MB 351 and Corequisite: FS 405 or FS 505.  
Laboratory experience to complement FS/MB 405. Skills in detecting and quantifying 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.

**FS 407 Risk Analysis and Hazard Analysis in Food Safety 3.**  
Prerequisite: FS/ANS/PS 350 or equivalent HACCP industry experience.  
In-depth focus on the application of the first HACCP principle, Hazard Analysis, on the identification of food safety hazards, as well as the emerging importance of risk assessment. Distance Education Only.

**FS 416 Quality Control in Food and Bioprocessing 3.**  
Prerequisite: ST 311.  
Organization and principles of quality control in the food and bioprocessing industries. Regulations and process control to maintain safety and quality. Evaluation of physical, microbiological, chemical, sensory, and stability testing for food and bioprocessed materials. Risk assessment, hazard analysis and critical control point (HACCP), process control, water quality, waste water analysis and reduction. Cleaning and sanitation and compliance inspection.

**FS 421 Food Preservation 3.**  
Prerequisite: FS 231 and FS 405.  
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.

**FS 426 Upstream Biomanufacturing Laboratory 2.**  
Prerequisite: (MB 351 and FS 231) CHE/BEC 463.  
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.

**FS 453 Food Laws and Regulations 3.**  
Prerequisite: Junior standing.  
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.

**FS 462 Postharvest Physiology 3.**  
Prerequisite: PB 421.  
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.

**FS 475 Problems and Design in Food and Bioprocessing Science 3.**  
Prerequisite: FS 231, FS 402, FS 405 or BAE(BBS) 425.  
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.

**FS 492 External Learning Experience 1-6.**  
Prerequisite: Sophomore standing.  
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 the student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

**FS 493 Special Problems in Food Science 1-6.**  
Prerequisite: Sophomore standing.  
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.

**FS 495 Special Topics in Food Science 1-3.**  
Offered as needed to present materials not normally available in regular course offerings or for offering new courses on a trial basis.

**FS 501 Advanced Nutrition and Metabolism 3.**  
Prerequisite: (NTR 301 or NTR 415 or NTR 500) and (CH 221 or CH 220 or CH 225).  
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.

**FS 502 Chemistry of Food and Bioprocessed Materials 4.**  
Prerequisite: CH 220 or 221 or 225.  
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.

**FS 505 Food Microbiology 3.**  
Prerequisite: MB 351.  
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.

**FS 506 Food Microbiology Lab 1.**  
Prerequisite: MB 351 and Corequisite: FS 405 or FS 505.  
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.
FS 520 Pre-Harvest Food Safety 3.
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.

FS 521 Food Preservation 3.
Corequisite: MB 351.
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.

FS 522 Food Packaging 3.
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.

FS 526 Upstream Biomanufacturing Laboratory 2.
Prerequisite: (MB 351 and FS 231) CHE/BEC 463.
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.

FS 530 Post-Harvest Food Safety 3.
Prerequisite: MB 351/352.
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.

FS 540 Food Safety and Public Health 3.
Prerequisite: MB 351/352.
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.

FS 550 Food Industry Study Tour 2.
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.

FS 553 Food Laws and Regulations 3.
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 for both FS 453 and FS 553 is not allowed.

FS 554 Lactation, Milk, and Nutrition 3.
Prerequisite: ANS 230 or FS/NTR 400; BCH 451 or ZO 421.
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.

FS 555 Exercise Nutrition 3.
Prerequisite: NTR 400/500.
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.

FS 557 Nutraceuticals and Functional Foods 3.
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.

FS 562 Postharvest Physiology 3.
Prerequisite: PB 321.
Pre- and post-harvest factors that affect market quality of horticultural commodities with an emphasis on technologies to preserve quality and extend storage life of crops.

FS 567 Sensory Analysis of Foods 3.
Prerequisite: Statistics 511.
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.

FS 580 Professional Development and Ethics in Food Safety 1.
Prerequisite: FSA 520 or FSA 530 or FS 540.
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 on current topical issues.

FS 591 Special Problems In Food Science 1-6.
Prerequisite: Graduate standing or Senior standing.
Analysis of scientific, engineering and economic problems of current interest in foods. Problems designed to provide training and experience in research.
FS 592 Special Research Projects in Food Science 1-3.

FS 620 Special Problems In Food Science 1-6.
Prerequisite: Graduate standing or Senior standing.
Analysis of scientific, engineering and economic problems of current interest in foods. Problems designed to provide training and experience in research.

FS 623 Special Research Problems In Food Science 1-3.
Directed research in a specialized phase of food science designed to provide experience in research methodology and philosophy.

FS 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

FS 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

FS 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

FS 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

FS 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

FS 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

FS 706 Vitamin Metabolism 2.
Prerequisite: ANS(NTR,PO) 415 and BCH 453.
Structures, chemical and physical properties, functions, deficiency symptoms, distribution, absorption, transport, metabolism, storage, excretion and toxicity of vitamins in humans and domestic animals. Nutritional significance of essential fatty acids and metabolism of prostaglandins, prostacyclins and leucotrienes.

FS 725 Fermentation Microbiology 3.
Prerequisite: BCH 451, MB 351.
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.

FS 730 Human Nutrition 3.
Prerequisite: FS 400 or NTR 415 or 419; BCH 451.
Biochemical and physiological bases of nutrition. Human nutrient requirements, assessment of nutritional status, clinical and subclinical disorders resulting from nutrient deficiencies or inadequacies.

FS 741 Thermal Processing of Foods 3.
Prerequisite: FS 231.
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.

FS 751 FoodIngredient Technology In Product Development 4.
Prerequisite: FS 402, FS 405, FS 421.
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.

FS 765 Polymer and Colloidal Properties of Foods 3.
Prerequisite: (CH 221 or CH 225) and (CH 223 or CH 227) and FS 402.
Theoretical and practical elements of applying principles from polymer and colloidal chemistry to foods. Major focus on proteins and polysaccharides in soaps, foams, emulsions and gels.

FS 780 Seminar In Food Science 1.
Preparation and presentation of scientific papers, progress reports and research and special topics of interest in foods.

FS 791 Special Problems in Food Science 1-3.
Directed research in a specialized phase of food science designed to provide experience in research methodology and philosophy. Credits Arranged.

FS 792 Special Research Projects in Food Science 1-3.
Credits Arranged.
FS 820 Special Problems In Food Science 1-6.
Prerequisite: Graduate standing or Senior standing.
Analysis of scientific, engineering and economic problems of current interest in foods. Problems designed to provide training and experience in research.

FS 823 Special Research Problems In Food Science 1-3.
Directed research in a specialized phase of food science designed to provide experience in research methodology and philosophy.

FS 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

FS 890 Doctoral Preliminary Exam 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

FS 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

FSA - Food Science Courses

FSA 520 Pre-Harvest Food Safety 3.
Prerequisite: MB 351/352.
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.

FSA 530 Post-Harvest Food Safety 3.
Prerequisite: MB 351/352.
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.

FSA 540 Food Safety and Public Health 3.
Prerequisite: MB 351/352.
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.

FSA 580 Professional Development and Ethics in Food Safety 1.
Prerequisite: FSA 520 or FSA 530 or FS 540.
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 on current topical issues.

FTD - Fashion and Textile Design Courses

FTD 104 Fashion and Textile Design First Year Studio I 4.
Co-requisite: D 100 and D 102.
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. This four credit Fall semester course 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. Additional costs may be incurred for course materials.

FTD 105 Fashion and Textile Design First Year Studio II 4.
Prerequisites: D 100, D 102, and FTD 104. Corequisites: D 101, D 103, and FTD 200.
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. This four credit spring semester course encourages first year students to think critically and in depth about concept, context, material, and design process, for textile and fashion product development. Students are guided and encouraged to act creatively through the design process as they secure a skillful level of craftsmanship in the development and making of all studio-based work. In this second semester studio, the students will further exercise their design thinking abilities, and improve their skills, methods and knowledge of design practices such as 1) design ideation, research, and documentation, 2) designing for a target consumer and product category, 3) material and medium usage through sampling and 4) project management of time and resources. Additional costs may be incurred.

FTD 200 Design Skills Workshop 3.
Prerequisite: TT 105 and Corequisite: D 105.
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: D101, D103, FTD 105, and a grade of C or better in FTD 200.
Application of industry textile design and visualization software to conception, design, development and presentation of creative textiles and textile products. Essential creative skills for textile design, such as motif and repeat development, will be introduced. Textile design solutions will be sampled using industrial technologies such as a digital printing, electronic knitting and computer-driven weaving. Color will be explored as a primary designer's tool including use in textile design, sensitivity and skills in communicating color, color perception and color theories, and color forecasting, creative projects will build skills in CAD for textiles and color. Additional costs may be incurred for course materials/equipment. FTD Majors only.
FTD 215 Fashion Design 1 3.
Prerequisite: Grade of C or better in FTD 200 and Corequisite: FTD 201. Studio course which introduces students to the basic rules and principles of flat pattern-making for apparel products. Advanced applications will be demonstrated through workshops utilizing concept-driven problems and follow-up critiques. Concurrent practices with computer-aided design will be presented where applicable. FTD majors only.

FTD 216 Fashion Workroom Practices 3.
Prerequisite: (Grade of C or better in FTD 200) or (Grade of C or better in FTM 219).
Studio course introducing the basic concepts and practices for the creation of final garments and extending through quality analysis of the final product. Incorporates workroom techniques for production of a variety of sewn product applications using various fabrics. FTD majors only. Additional costs may be incurred for course materials/equipment.

FTD 218 Fashion Illustration 3.
Prerequisite: ADN 281.
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.

FTD 319 Fashion Design 2 3.
Prerequisite: Grade of C or better in FTD 215, FTD 216, and FTM 317.
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 and FTM majors only.

FTD 321 Fashion Design by Draping 3.
Prerequisite: (C or better in FTD 215 and FTD 216) or (C or better in FTM 219 and FTM 315).
Exploration of three-dimensional methods of apparel design using textile substrates. Design and execution of draped garment structures will be explored in a studio setting. Additional costs may be incurred for course materials/equipment. FTD and FTM majors only.

FTD 373 Yarn Design Studio 3.
Prerequisite: TT 221 and a grade of C or better in FTD 201.
Design of yarns and sample production, including the creation of novelty yarns, fancy yarns, and innovative effects in spun and plied fibers. Exploration of color, luster, twist, and slub variations in yarns to address both functional and aesthetic challenges. Studio experiences in creating innovative yarns appropriate for use in different fabric formation technologies. Additional costs may be incurred for course materials/equipment. FTD majors only.

FTD 374 Surface Design and Texture 3.
Prerequisite: TT 105 and a grade of C or better in FTD 200 and FTD 201.
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.

FTD 375 Woven Textile Design Studio I 3.
Prerequisite: Grade of C or better in both TT252 and FTD 373.
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.

FTD 376 Knitted Textile Design Studio I 3.
Prerequisite: Grade of C or better in both TT252 and FTD 373.
Design and sample production of hand and machine knitted textiles. Exploration of basic structures, terms and definitions, including knitting notation and terminology. Development of creative knitted 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 materials/equipment. FTD majors only.

FTD 420 Fashion Design 3 3.
Prerequisite: Grade of C or better in FTD 319 and FTD 321.
Studio course exploring sources of inspiration requiring students to translate and develop source material into creative garments. Integrates knowledge across the curriculum and works with a firm, contest, or current theme to develop a fashion design statement. Additional costs may be incurred for course materials/equipment. FTD majors: Fashion Design concentration only.

FTD 475 Woven Textile Design Studio II 3.
Prerequisite: Grade of C or better in FTD 375.
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.

FTD 476 Knitted Textile Design Studio II 3.
Prerequisite: Grade of C or better in FTD 376.
Further development of knit design beyond basic design concepts and knit structures to product application. Development of creative knitted 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 materials/equipment. FTD majors only.
FTD 479 Senior Textile Design Studio 6.
Prerequisite: FTD 374, FTD 475, FTD 476.
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.

FTM - Fashion and Textile Management Courses

FTM 217 The Textile Industry 3.
Prerequisite: TT 105.
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 integrated Textile Complex. One Saturday attendance during the semester is required.

FTM 219 Fashion Product Analysis 3.
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.

FTM 220 Principles of Retailing and Supply Chain Management in Textiles 3.
Prerequisite: FTM 217.
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.

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 areatextile 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.

FTM 282 Introduction to Textile Brand Management and Marketing 3.
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.

Prerequisite: Junior standing.
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 to develop innovative textile products. Write a business plan to take the textile product to market. Multidisciplinary and experiential learning environment is cultivated through in-class activities and online collaboration.

FTM 315 Fashion Product Design 3.
Prerequisite: FTM 217 and FTM 219.
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.

FTM 317 Computer-Aided-Design for Apparel 3.
Prerequisite: FTM 215 or Corequisite: FTM 315.
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.

FTM 318 Fashion Development Processes 3.
Prerequisite: FTM 317.
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; and quality evaluations.

FTM 320 Retail Merchandising in Fashion and Textiles 3.
Prerequisite: FTM 220.
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.

FTM 352 Dress, Style, Change 3.
Interdisciplinary course focusing on historical and cultural principles of style as related to dress and fashion. Examination of fashion and stylistic trends in cycles of dress.

FTM 380 Management and Control of Textile and Apparel Systems 3.
Prerequisite: FTM 217; Corequisite: TT 221.
Management approaches, practices and basic economic considerations in the development, production and distribution of industrial and consumer textile and apparel products.
Prerequisite: FTM 282 and (EC 201 or ARE 201).
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 of major strategic tools used for brand management and marketing activities by firms across the integrated textile complex. Students will be assigned practical application projects that require utilization of academic knowledge with industry application.

FTM 384 Visual Merchandising Principles and Management 3. 
Prerequisite: Junior standing or higher, FTM 217, Corequisite: FTM 382. 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.

FTM 385 Fashion and the Consumer 3. 
Prerequisite: FTM 217, FTM 282. 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.

FTM 387 Textile Brand Communications & Promotions 3. 
Prerequisite: FTM 382. 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 (IBMC) and how these strategies and tactics are used within the textile complex advance brand positioning. Knowledge of IBMC will be demonstrated via case studies, examination and textile industry-related application projects. FTM Majors Only.

FTM 400 Major Fashion Designers 3. 
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 major historical and current fashion designers that have had an international influence on US fashion merchandise. An additional focus of the course will be on the career path of major fashion designers. A study of haute couture and pret-a-porter will be conducted to provide insight into special management issues.

FTM 415 Fashion Product Development 3. 
Prerequisite: FTM 318. 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.

FTM 416 The Fashion Industry 3. 
Prerequisite: Senior standing. 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.

FTM 420 Retail Buying in Fashion and Textiles 3. 
Prerequisite: FTM 320. Overview and analysis of the components of buying and selling products at the 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.

FTM 431 Quality Management and Control In Textile Manufacturing 3. 
Prerequisite: TT 221, TT 252, TT 331, and ST 361 or BUS 350. Principles of quality and process management and control in textile/apparel manufacturing with emphasis in quality management systems, quality costs, statistical control chart procedures, process capability, acceptance sampling, and optimal process and product design and improvement methods.

FTM 460 Textile Market Research 3. 
Prerequisites: FTM 382 and (ST 311, ST/BUS 350, ST 361, or ST 370). 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).

Prerequisite: TT/FTM 380 and ACC 210 and [(MA 131 and MA 132) or MA 141] and (ST 311 or ST 361 or BUS 350 or ST 370). 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.

FTM 481 Product Costing in the Textile and Apparel Industry 3. 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.
FTM 482 Advanced Textile Brand Management and Marketing 3.
Prerequisite: FTM 382.
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 of 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.

FTM 483 Global Trade & Sourcing 3.
Prerequisite: FTM 282 or EC 201 or ARE 201 or EC 205.
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.

FTM 484 Strategic Planning and Decision Making in the Textile and Fashion Industries 3.
Prerequisite: BUS 320 or FTM/TT 380, and TT 221 or equivalent.
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.

FTM 485 Textile Computer Integrated Enterprise 3.
Prerequisite: TT/FTM 380.
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.

FTM 486 Supply Chain Management in the Textile Industry 3.
Prerequisite: TT/FTM 380.
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.

FTM 487 Textile and Apparel Labor Management 3.
Prerequisite: Senior standing.
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.

FTM 490 Development Projects in Textile and Apparel Management 1-3.
Prerequisite: Junior standing and 2.75 GPA.
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.

FTM 491 Special Topics in Textile and Apparel Management 1-4.
Prerequisite: Senior standing.
Special topics related to textile and apparel management.

FTM 494 International Industrial Internship in Textile Management 3.
Prerequisite: At least FL 202 for internships in non-English speaking countries, Minimum GPA 2.5, Junior standing.
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.

FTM 497 Senior Fashion Collection Studio 6.
Prerequisite: FTM 318.
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.

FTM 499 Textile Senior Project 4.
Prerequisite: Senior standing.
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 be presented formally at the end of the semester. Course should be taken in the last semester of the Senior year. It cannot be substituted by other project courses.

FW - Fisheries Wildlife Sciences Courses

FW 221 Conservation of Natural Resources 3.
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 underline 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.

FW 293 Independent Study in Fisheries, Wildlife, and Conservation Biology 1-6.
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.

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.
FW 314 Coastal Ecology and Management 1.
**Prerequisite: BIO 181.**
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 charges for room and board. Students must provide their own transportation to CMAST.

FW 333 Conservation Biology in Practice 3.
**Prerequisite: FW 221 or PB 360 or BIO 360 or FOR 260.**
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.

FW 353 Wildlife Management 3.
*R: Sophomore Standing.*
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.

FW 373 Vertebrate Natural History 3.
**Prerequisite:** BIO 360 or PB 360.
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.

FW 403 Urban Wildlife Management 3.
**Prerequisite:** Junior standing.
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.

FW 404 Forest Wildlife Management 3.
**Prerequisite:** Junior standing.
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.

FW 405 Tropical Wildlife Ecology in Nicaragua 3.
This 9-week course provides an overview of tropical wildlife ecology and management, sustainable land use, and the Nicaraguan 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 in Nicaragua, but emphasis will be on the use of mist nets in long-term bird monitoring program in a shade-grown coffee plantation. Expenses associated with this course are the responsibility of the student. Requires instructor approval.

FW 411 Human Dimensions of Wildlife and Fisheries 3.
**Juniors and Seniors Only.**
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.

FW 415 Professional Development in Fisheries, Wildlife, and Conservation Biology 1.
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.

FW 430 Fisheries and Wildlife Administration 3.
**Prerequisite:** PS 201, PS 202; FW/BIO 420, FW/BIO 353. Describes and compares the administrative structures and programs of federal and state fish and wildlife agencies and develops an understanding of the basis on which these agencies function. Evaluates the interrelationships that fisheries-wildlife professionals, special interest groups, public agencies and legislative bodies play in resource management programs.

FW 444 Mammalogy 3.
**Prerequisite:** PB 360 or BIO 360 or FOR 260.
The biology of mammals: evolution, functional morphology, reproduction, behavior, ecology, population biology, classification and identification. One or more weekend field trip planned. One independent field research project is required.
Prerequisite: One 200-level or higher course in BIO, ES, ET, FOR, FW, NR, PB, PRT, or ZO.
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: FW 353 and ST 311.
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: Junior standing and above.
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: One 200-level or higher course in ES, ET FOR, FW, NR, PB, PRT, or ZO.
This course provides an international perspective on desert ecology, the African savannah 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.

FW 492 External Learning Experience 1-6.
Prerequisite: Sophomore standing.
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.

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.

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.

FW 495 Special Topics in Fisheries and Wildlife Science 1-3.
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

FW 511 Human Dimensions of Wildlife and Fisheries 3.
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.

FW 515 Fish Physiology 3.
Prerequisite: GN 411, ZO 420, 421, 441.
The biology of fishes: physiology, anatomy, endocrinology, behavior and genetics. Designed especially for graduate students in fisheries. Several trips to research laboratories taken.

FW 553 Principles Of Wildlife Science 3.
Prerequisite: BO 360 or ZO 260.
The principles of wildlife management and their application studied in the laboratory and in the field.

Prerequisite: One course in wildlife management or zoology or biology or natural resources or forestry or botany, Graduate standing.
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 and FW 560.

This course provides an international perspective on desert ecology, the African savannah 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.

FW 586 Aquaculture 3.
Prerequisite: BO 360 or ZO 260 or Graduate standing or Senior standing.
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.
FW 587 Aquaculture Laboratory 1.
Prerequisite: BO 360 or ZO 260 or Graduate standing or Senior standing.
Corequisite: ZO 586.
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.)

FW 595 Special Topics in Fisheries and Wildlife Sciences 1-6.
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.

FW 602 Seminar In Wildlife Management 1.
Current topics and issues in wildlife biology and management. Students select and research topics, give seminars and lead group discussions.

FW 610 Special Topics in Fisheries and Wildlife Sciences 1-6.
Special topics in various aspects of fisheries and wildlife science are developed under the direction of a graduate faculty member. Also used to develop new courses.

FW 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

FW 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

FW 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

FW 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

FW 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

FW 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

FW 720 Epidemiology of Wildlife Diseases 3.
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 Quantitative Fisheries Management 3.
Current methods for assessment and management of exploited fish populations, including sampling methods, data analysis and modeling. A required research paper or project.

FW 730 Ethics in Fisheries and Wildlife Sciences 2.
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.

FW 801 Issues in Fisheries and Wildlife Sciences Doctoral Seminar 2.
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.

FW 802 Seminar in Fisheries and Wildlife 1.
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.

FW 810 Special Topics in Fisheries and Wildlife 1-3.
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.

FW 885 Doctoral Supervised Teaching 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 of the assignment. For doctoral students in Fisheries and Wildlife Sciences.

FW 890 Doctoral Preliminary Exam 1-9.
For students who are preparing for and taking written and/or oral preliminary exams.

Instruction in research and research under the mentorship of a member of the Graduate Faculty. For doctoral students in Fisheries and Wildlife Sciences.
Dissertation Research. For doctoral students in Fisheries and Wildlife Sciences.

Summer Dissertation Research. For doctoral students in Fisheries and Wildlife Sciences.

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.

FYD - Family Life and Youth Development Courses

FYD 500 Supervised Professional Experience in Family Life & Youth Development 3.
In preparation for professional positions in family life & youth development, students will work with a faculty member or organizations to design a Masters capstone study project that aligns with their professional goals. Faculty supervision required.

FYD 501 Theories in Child & Youth Development 3.
This course will critically compare and evaluate the primary developmental theories and their usefulness in predicting behavior, cognition, and social-emotional growth. The course is designed to prepare practitioners for educational service deliver to examine how theories guide practice in child and youth development.

FYD 502 Theories in Family Sciences 3.
This course will critically compare and evaluate the major human development theories and their application to family life and youth development and examine the usefulness of theory in describing, explaining, predicting, or changing behavior.

FYD 523 Family Relationships Over the Life Course 3.
Prerequisite: Graduate standing.
Applications of theories and research about interpersonal relationships and family dynamics to issues facing families over the life course, emphasizing the interplay of social, developmental and health factors in affecting change, continuity and well-being.

FYD 524 Gerontology in Family Life Education 3.
Prerequisite: Graduate standing.
The course will examine the social context of aging, the lived experience of aging as reported by older persons, and the interaction of individuals and families with social institutions and community systems of care, including the "aging network".

FYD 531 Effective Management of Family Resources 3.
Prerequisite: Graduate student status or any PBS student.
Family resource management theory is used to examine personal financial management concepts. Family systems and stress theories will be employed to emphasize the interconnections between families, communities, resources through topics such as personal management (decision-making, time & organizational management, stress management); human and social capital (education, skill building, health, employability, relationships); physical capital (transportation, real estate, and housing); financial management (credit and debt, budgeting, retirement issues, bankruptcy).

FYD 532 Program Development & Evaluation in Youth & Family Settings 3.
This course examines the application of classic and contemporary theories and models of leadership to the work of community-based organizations. Students will examine leadership from diverse perspectives; then analyze the strengths and weaknesses of leadership theories and models when applied to organizational development of community-based systems.

FYD 533 Complex Family Issues 3.
Prerequisite: Graduate Standing or Permission of Instructor.
This course will examine educational intervention strategies for family issues that pose particular difficulty for Family Life and Parenting Educators. Topics include: addictions/substance abuse; child abuse and neglect; domestic abuse; illness, death and dying; divorce/mediation; step-families & single parenting; gang memberships, suicidal ideation, sexuality/teen pregnancy; and rape and other acts of violence. The course will include a discussion of evidence-based prevention and treatment options for referring clients, and a debate of the role of educators in this process.

FYD 535 Family Health & Well-being 3.
This course will examine health and well-being issues of special concern to families, especially healthy lifestyle choices. Areas of focus will include food safety and nutrition, physical activity and well-being and healthy environments. Woven throughout the course will be the family's role in creating supportive situations related to health and well-being as well as the impact of public and social policies. Students must have completed a Bachelor's of Science.

FYD 540 Environmental Influences on the Family 3.
Prerequisite: Graduate standing.
The course will include an examination of social, economic, and behavioral housing theory, historical and current housing policy and its relationship to the housing, neighborhoods and community development and an investigation of diverse populations and their housing/neighborhood concerns.

Theoretical and empirical literature in lifespan, family life, and parent education will be explored along with implications for issues affecting families including content, delivery, and evaluation of parent education programs. Offered either face-to-face or in person via Distance Education.

FYD 544 Family Communication and Coaching 3.
This course examines communication in families and integrates the coach approach to communication including identifying individual and family issues; appreciating differences; discovering purpose; practicing forgiveness; resolving conflict; conducting successful critical conversations; mending relationships; effective communication; direct and indirect communication; the art of saying no; the power of words; powerful questions; work/life balance; identifying values; stress management.

FYD 545 Family Communication and Coaching 3.
This course examines communication in families and integrates the coach approach to communication including identifying individual and family issues; appreciating differences; discovering purpose; practicing forgiveness; resolving conflict; conducting successful critical conversations; mending relationships; effective communication; direct and indirect communication; the art of saying no; the power of words; powerful questions; work/life balance; identifying values; stress management.

FYD 550 Family and Youth Professionals as Leaders 3.
This course examines the application of classic and contemporary theories and models of leadership to the work of community-based organizations. Students will examine leadership from diverse perspectives; then analyze the strengths and weaknesses of leadership theories and models when applied to organizational development of community-based systems.
F禹553 Applied Concepts in Child and Youth Development 3.
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 Youth theories & practice.

F禹554 Collaborations & Partnerships in Family & Youth Settings 3.
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.

F禹556 Organizational Systems in Youth and Family Settings 3.
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.

F禹557 Volunteerism in Youth and Family Settings 3.
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 volunteerism; and future trends in volunteerism. Restricted to graduate and post-baccalaureate students only.

In-depth examination of current and emerging issues and trends impacting volunteer involvement in community-based youth and family organizations to prepare current and future youth and family professionals to manage volunteers in local program delivery; examining contemporary research related to trends and issues, and evaluating historical and current social phenomena so as to understand their impact upon volunteer involvement and consider future challenges for volunteer administrators. Restricted to graduate and post-baccalaureate students only.

F禹559 Administration and Supervision of Youth and Family Programs 3.
Fundamental concepts and theories of administration and management as applied to family life and youth development organizational contexts with emphasis given to organizing and managing human resources and including business operations, planning, decision-making, organizing, staffing, communicating, motivating, leading, and controlling.

F禹558 Contemporary Issues in Community Youth Development 3.
Students will explore social, cultural, political, and/or organizational underpinnings of youth issues as focused in (1) issues facing community-based youth serving organizations themselves (e.g., mission, structure, funding, staffing, impact and accountability, and politics, etc); and (2) issues facing the youth audiences served by the organizations (e.g., healthy lifestyles/obesity/substance abuse, sexuality, youth-against-youth violence, career exploration and workforce development, civic engagement, academic success and school drop-out, etc.).

F禹590 Special Topics Family Life and Youth Development 1-6.
Special Topics Family Life and Youth Development.

F禹630 Independent Study in Family Life & Youth Development 1-3.
Students engaged in independently designed study guided by specific objectives constructed under the supervision of a faculty member.

F禹695 Thesis Research 3-6.
Thesis Research.

GC - Graphic Communications Courses

GC 120 Foundations of Graphics 3.
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.

GC 250 Architectural Graphic Communications 3.
Prerequisite: GC 120 or TDE 220.
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.

GC 320 3D Spatial Relations 3.
Prerequisite: GC 101 or GC 120 or GC/IE 210.
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.

GC 330 Basic Technical Animation 3.
Prerequisite: GC 120 or TDE 220.
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, photo-realism, and raytracing.

GC 340 Concepts of Website Development 3.
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.

GC 350 Applied CAD/D and Geometric Controls 3.
Prerequisite: GC 120.

GC 420 Visual Thinking 3. Prerequisite: Engineering or technical student. Develop visual thinking skills through a series of exercises using various visual media. Integrates and stresses 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.


GC 496 Special Topics in Graphic Communications 1-4. Topical study in areas of current interest and need to students and/or needs of curricula served by Graphic Communications.

GC 498 Independent Study in Graphic Communications 1-4. Prerequisite: GC 120 or TDE 220. Independent study in areas of current interests 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-Standard Courses" be completed by the student and faculty member prior to registration by the department.

GD - Graphic Design Courses

GD 201 Design, Context, and Experience 6. Prerequisite: D 101, D 103, and D 103. Co-requisite: GD 210, GD 217. 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.

GD 202 Designing for Settings, People, and Use 6. Prerequisite: GD 201, GD 210, GD 217; Corequisite: GD 310, GD 317. 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.

GD 203 History of Graphic Design 3. 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.

GD 210 Image and Technology 3. Prerequisite: D 101, D 103, and D 105. Introduction to representation and visualization strategies particular to the applied communication contexts of graphic design, including mapping, diagramming, and photography. Discussion of the role of various technologies in the construction of meaning. Digital camera and appropriate student-owned technology and software required. Graphic Design majors only, except with Department Head permission.

GD 217 Typography and Technology 3. Prerequisite: D 101, D 103, and D 105. 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.

GD 292 Special Topics in Graphic Design 1-3. Topics of current interest in Graphic Design. Normally used to develop new courses.


GD 303 Graphic Design Theory and Practice 3. 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.

GD 310 Visualization, Representation, and Display 3. Prerequisite: GD 210. 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.

GD 317 Typographic Language, Writing, and Reading 3. Prerequisite: GD 217. 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.

GD 400 Advanced Graphic Design Studio 6. Prerequisites: GD 301 and GD 203 and GD 303. Topical and interdisciplinary studios addressing advanced visual communication problems. Graphic Design Majors only, except with Department Head permission.

GD 401 Capstone Graphic Design Studio 6. Prerequisite: GD 400. Capstone experience focused on the transition from school to work. Individual capstone project, collaborative work, and professional practice discussions. Graphic Design majors only, Seniors.

GD 410 Online and Mobile Interaction Design Systems 3. Prerequisite: GD 310. 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.
GD 417 Information and Publishing Design Systems 3.  
Prerequisite: GD 317.
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: Junior standing in the major and Study Abroad Office approval.
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.

GD 492 Special Topics in Graphic Design 1-3.  
Prerequisite: Jr standing in Graphic Design major.
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.

GD 494 Internship in Graphic Design 3.  
Prerequisite: Junior standing in Graphic Design and 3.0 GPA or better.
Supervised field experience in graphic design offices and organizations.

GD 495 Independent Study in Graphic Design 1-3.  
Prerequisite: Junior standing in Graphic Design and 3.0 GPA or better.
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 the student and faculty member prior to registration by the department.

GD 501 Graduate Graphic Design Studio 9.  
Corequisite: GD 571.
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.

GD 502 Graduate Graphic Design Studio II 9.  
Prerequisite: GD 501, Corequisite: GD 572.
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.

GD 503 Graduate Graphic Design Studio III 9.  
Prerequisite: GD 573, Corequisite: GD 671.
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 relationships among audiences.

GD 510 Imaging for Graphic Design IV 3.  
Prerequisite: GD 410, Design Majors.
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.

GD 517 Type IV 3.  
Prerequisite: GD 417, Design Majors.
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.

GD 571 Design As Cognitive Artifact 3.  
Prerequisite: GD 501.
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.

GD 572 Design as Cultural Artifact 3.  
Prerequisite: GD 571.
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.

GD 573 New Information Environments 3.  
Prerequisite: GD 503.
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.

GD 580 Special Topics In Graphic Design History 3.  
Prerequisite: GD 242.
Topics of current interest in interpretation, criticism, methodology and research, relating to graphic design history. Further specialized study in the history of printing, typography, communication, image-making and information systems. Investigation of how we study artifacts, production and producers.

GD 581 Graphic Design Final Project Research 3.  
Prerequisite: GD 502.
A seminar course to assist students in preparing foundation for final project to be conducted in GD 688 Final Project Studio.

GD 588 Final Project Studio In Graphic Design 6.  
Prerequisite: GD 581.
Final project for graduate students supervised by members of their graduate advisory committees.

GD 592 Special Topics In Graphic Design 1-3.  
Prerequisite: Graduate standing.
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.
GEO - Geography Courses

GEO 200 Principles of Geography 3.
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.

GEO 220 Cultural Geography 3.
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.

GES - Genetic Engineering and Society Courses

GES 506 Principles of Genetic Pest Management 3.
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.

GES 508 Emerging Technologies and Society 3.
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.

GES 591 Special Topics in Genetic Engineering and Society 1-4.
Special topics and experimental course offerings in Genetic Engineering and Society.

GIS - Geographic Information Systems Courses

GIS 295 Special Topics in Geospatial Information Science 1-4.
Special Topics in Geospatial Information Science at the 200 level for offering courses on an experimental basis.

GIS 410 Introduction to Geographic Information Systems 3.
Overview of the operations and functions of computerized spatial display and map analysis processes (Geographic Information Systems), production of effective computer-generated maps and spatial displays, concepts for spatial modeling. Extensive independent learning and computer experiences including on-line virtual laboratory sessions. Credit will not be given for both GIS 410 and GIS 510.

GIS 505 Introduction to Geovisualization Technologies 2.
This course provides an overview of emerging methods and tools for the visual exploration, analysis, synthesis, and presentation of data that contains geographic information. Specific methods include the collection and representation of three-dimensional, remotely sensed, and gigapixel imagery. An introduction to the display of digital imagery and visualizations through interactive GIS and immersive virtual environment technology is also covered. This hands-on course provides an opportunity to interact with current technologies within the Center for Earth Observation's Digital Imagery Visualization Laboratory.

GIS 510 Introduction to Geographic Information Science 3.
An overview of operations and functions of geographic information systems (GIS). Students develop expertise in spatial reasoning, problem definition, and skilled application of GIS software through lectures, readings, and extensive hands on experiences. All course materials are delivered through the Internet. Credit will not be given for both GIS 510 and GIS 410.

GIS 512 Introduction to Environmental Remote Sensing 3.
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.
GI5 515 Computer Cartography 2.
Prerequisite: NR/PRT 462 or GI5 510.
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 project maps in both print and web media.

GI5 520 Advanced Geospatial Analytics 3.
Prerequisite: GI5 510 or PA 541 or SSC 440.
Focus is on advanced geospatial analysis and technologies. Students enhance geoprocessing skills and understanding of the analysis capabilities of geospatial technology, learn to integrate and analyze spatial data in various formats, and explore methods for displaying geographic data analysis results in decision support and modeling systems. All course materials are delivered through the Internet and student activity can be accomplished with student owned computers.

GI5 521 Surface Water Hydrology with GIS 3.
Prerequisite: GI5 510 or PA 541 or SSC 440.
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.

GI5 530 Principles of Geospatial Information Science 3.
Prerequisite: GI5 510 or PA 541 or SSC 440.
This course is a study of theoretical underpinnings of geospatial information science including spatial data concepts, analysis, and modeling. Topics include projections, georeferencing, spatial representations, generalization, conflation, spatial topologies, and an introduction to remote sensing and image processing.

GI5 540 Geospatial Programming Fundamentals 3.
Prerequisite: GI5 510 or PA 541 or SSC 440.
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.

GI5 550 Geospatial Data Structures and Web Services 3.
Prerequisite: GI5 540.
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.

GI5 582 Geospatial Modeling and Analysis 3.
The course explains digital representation and analysis of geospatial phenomena and provides foundations in methods and algorithms used in GIS analysis and modeling. Special focus is on terrain modeling, geomorphometry, watershed analysis and introductory GIS-based modeling of landscape process (water, sediment). This course includes analysis from lidar data, 3D visualization, and principles of open source GIS. Introductory level knowledge of GIS or surveying/ geomatics principles is required.

GI5 590 Geospatial Information Science Master's Project 3.
Prerequisite: GI5 550.
This is the culminating course for The Master of Geospatial Information Science and Technology degree. Students develop a professional portfolio highlighting the understanding and skills they have developed throughout the degree program. Featured in the portfolio will be a complex geospatial analysis project containing interoperable spatial and non-spatial data, web services, and customized user interfaces and work flows.

GI5 595 Special Topics in Geospatial Information Science 1-6.
Special Topics in Geospatial Information Science.

GI6 01 Seminar in Geospatial Information Science 1.
Seminar in Geospatial Information Science.

GI6 10 Special Topics in Geospatial Information Science 1-6.
Special Topics in Geospatial Information Science.

GI6 30 Independent Study 1-6.
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.

GK - Global Knowledge Courses

GK 295 Global Knowledge Special Topics 1-3.
Special topics course offering for the general education Global Knowledge category.

GN - Genetics Courses

GN 301 Genetics in Human Affairs 3.
Appreciation and understanding of genetics in everyday life. Genetic perspective on normal human development, birth defects, birth control, cancer, organ transplants, intelligence, mental illness, and radiation and chemical exposure and issues raised by applications of recently developed genetic techniques such as in vitro fertilization, genetic engineering and prenatal monitoring.

GN 311 Principles of Genetics 4.
Prerequisite: BIO 183 or ZO 160.
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.

GN 312 Elementary Genetics Laboratory 1.
Corequisite: GN 311.
Genetic experiments and demonstrations using a variety of bacterial, plant and animal organisms. Mendelian inheritance, linkage analysis, population genetics, cyto genetics, biochemical genetics, DNA isolation, electrophoresis, and Southern blotting.

GN 421 Molecular Genetics 3.
Prerequisite: C- or better in GN 311.
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.
GN 423 Population, Quantitative and Evolutionary Genetics 3.
Prerequisite: GN 311 and (MA 131 or MA 141).
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.

GN 425 Advanced Genetics Laboratory 2.
Prerequisite: GN 312; Corequisite: GN 421.
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.

GN 427 Introductory Bioinformatics 3.
Prerequisite: GN 311 and (MA 131 or MA 141) with grades of C- or better.
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.

GN 434 Genes and Development 3.
Prerequisite: C- or better in GN 421.
Genes and genetic pathways that control development in animals; overview of early, pivotal experiments in embryology and genetics; use of molecular biology, genomics and bioinformatics to study genes and development; concentration on four model systems; presentation and discussion of major issues in developmental biology.

GN 441 Human and Biomedical Genetics 3.
Prerequisite: C- or better in GN 421.
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.

GN 451 Genome Science 3.
Prerequisite: C- or better in GN 423.
Complementation of modern genomics approaches with classical and molecular genetics; goals of major genome projects in animals, plants, humans, and microorganisms; genomic science opportunities at NCSU and in the Research Triangle; presentation and discussion of current literature; and preparation for careers in genomics-related fields.

GN 461 Advanced Bioinformatics 3.
Prerequisite: GN 427 and ST 311 with grades of C- or better.
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.

GN 490 Genetics Colloquium 1.
Prerequisite: GN 421.
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.

GN 492 External Learning Experience 1-6.
Prerequisite: Sophomore standing.
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.

GN 493 Special Problems in Genetics 1-6.
Prerequisite: GN 311 and (MA 131 or MA 141).
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

GN 513 Advanced Genetics 3.
Prerequisite: GN 311.
Biological macromolecules and their interactions. Chromatin and chromosome structure. Bacteria, viruses, plants, animals and fungi as genetic systems. Transcription, RNA processing, genetic code, translation, DNA replication and cell cycle. RFLP mapping. DNA and forensics. Genetic transformation and cloning of plants and animals. Recombinant DNA methodology. Credit for both GN 413 and GN 513 is not allowed.

GN 521 Molecular Genetics 3.
Prerequisite: GN 311.
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.

GN 527 Insect Neurogenomics 3.
Sensory processing systems in the insect brain (visual, olfactory, gustatory, and mechanosensory), learning and memory and circadian rhythm. Each process will be considered at the behavioral, anatomical, neural, and genetic level. Examples will be drawn from multiple insect species, using recent studies. Techniques: quantitative real-time PCR, microarrays, mapping quantitative trait loci, Drosophila transgenics, RNAI, imaging neuronal activity, etc. For Graduate students with background in molecular biology techniques.
GN 541 Human and Biomedical Genetics 3.
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.

GN 685 Master’s Supervised Teaching 1-3.
**Prerequisite:** Master’s student.
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.

GN 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
**Prerequisite:** Master’s student.
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.

GN 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
**Prerequisite:** Master’s student.
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.

GN 690 Master’s Examination 1-6.
**Prerequisite:** Master’s student.
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.

GN 693 Master’s Supervised Research 1-9.
**Prerequisite:** Master’s Student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

GN 695 Master’s Thesis Research 1-9.
**Prerequisite:** Master’s Student.
Thesis Research.

GN 696 Summer Thesis Research 1.
**Prerequisite:** Master’s student.
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.

GN 699 Master’s Thesis Preparation 1-9.
**Prerequisite:** Master’s Student.
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.

GN 701 Molecular Genetics 3.
**Prerequisite:** GN 311.
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.

GN 702 Cellular and Developmental Genetics 3.
**Prerequisite:** GN 701.
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.

GN 703 Population and Quantitative Genetics 3.
**Prerequisite:** GN 311 and ST 512.

GN 708 Genetics of Animal Improvement 3.
**Prerequisite:** GN 311, ST 512.
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.

GN 713 Quantitative Genetics and Breeding 3.
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.

GN 720 Molecular Biology In Plant Breeding 3.
**Prerequisite:** CS(GN,HS) 741, GN 701.
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.

GN 721 Genetic Data Analysis 3.
**Prerequisite:** ST 430 and GN 311.

GN 725 Forest Genetics 3.
**Prerequisite:** GN 311.
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.

GN 730 Fungal Genetics and Physiology 3.
**Prerequisite:** BCH 451, BO 775, GN 311 or PP 501.
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.
GN 735 Functional Genomics 3.
Prerequisite: GN 701.
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.

GN 740 Evolutionary Genetics 3.
Prerequisite: GN 703.
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.

GN 745 Quantitative Genetics In Plant Breeding 1.
Prerequisite: CS(GN, HS) 741, ST 512, course in quantitative genetics recommended.
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.

GN 746 Breeding Methods 2.
Prerequisite: CS (GN, HS) 741, ST 512.
Theory and principles of plant breeding methodology including population improvement, selection procedures, genotypic evaluation, cultivar development and breeding strategies.

GN 750 Developmental Genetics 3.
Prerequisite: GN 701, GN 702.
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.

GN 755 Population Genetics 3.
Prerequisite: GN 703.
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.

GN 756 Computational Molecular Evolution 3.
Prerequisite: GN 311 and ST 511.

GN 757 Statistics for Molecular Quantitative Genetics 3.
Prerequisite: ST 512 and GN 703 or ST 721.
Genetic mapping data. Linkage map reconstruction, quantitative genetical models. Statistical methods and computer programs for mapping quantitative trait loci and estimating genetic architecture of quantitative traits.

GN 758 Microbial Genetics & Genomics 3.
Prerequisite: BCH 451 or GN 311.
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.

GN 761 Advanced Molecular Biology Of the Cell 3.
Prerequisite: BCH 703 and 705.
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.
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.

GN 801 Seminar 1.
Prerequisite: Graduate standing.
Informal group discussion of prepared topics assigned by instructor.

GN 809 Colloquium in Genetics 2.
Prerequisite: Graduate standing.
Informal group discussion of prepared topics assigned by instructor.

GN 810 Special Topics in Genetics 1-4.
Critical study of selected areas and special topics of current interest in genetics and related fields.

GN 820 Special Problems 1-3.
Prerequisite: Advanced Graduate standing.
Special topics designed for additional experience and research training.

GN 850 Professionalism and Ethics 1.
Prerequisite: Graduate standing.
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.

GN 860 Plant Breeding Laboratory 1.
Prerequisite: CS(GN,HS)741.
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.

GN 861 Plant Breeding Laboratory 1.
Prerequisite: CS(GN,HS)741.
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.

GN 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.
GN 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation Research.

GN 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

GPH - Global Public Health Courses

GPH 201 Fundamentals of Global Public Health 3.
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.

Prerequisite: C- or better in BIO 212 or BIO 250.
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.

GRK - Foreign Language - Greek Courses

GRK 101 Elementary Greek I 3.
Introduction to Classical Greek. Greek alphabet, basic grammar and syntax. Readings based on Greek mythology, philosophy, and literature.

GRK 102 Elementary Greek II 3.
Prerequisite: GRK 101.
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.

GRK 201 Intermediate Greek I 3.
Prerequisite: GRK 102.
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.

GRK 202 Intermediate Greek II 3.
Prerequisite: GRK 201.

GRK 399 Directed Readings in Greek 3.
Prerequisite: GRK 202.
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.

GS - Genomic Sciences Courses

GTI - NC Global Training Initiative Courses

GTI 401 US Culture and Education Colloquium 3.
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 discussions, research, 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.

HA - History of Art Courses

HA 201 History of Art From Ancient Greece Through the Renaissance 3.
Art from Ancient Greece and Rome through Italian Renaissance. Major art forms of painting, sculpture, and architecture.

HA 202 History of Art From the Renaissance Through the 20th Century 3.
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 trottage.

HA 203 History of American Art 3.
A history of American Art (painting, sculpture and architecture) from the Colonial Period through the 20th century.

HA 240 Introduction to Visual Culture 3.
Prerequisite: Sophomore standing.
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.

HA 298 Special Topics in Art History 3.
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.

HA 395 History of Art: Study Abroad 3.
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.)
HA 401 19th Century European Art from Revolution to Post-Impressionism 3.
Prerequisite: HA 201 or HA 202.
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.

HA 404 Italian Renaissance Art and Material Culture 3.
Prerequisite: 3 hrs. of HA.
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.

HA 410 History of the Art of Photography 3.
Prerequisite: 3 Hours of History of Art, Film, History, or Literature.
History of and the interaction between art and photography from the invention of photography to the present.

HA 498 Independent Study in History of Art 1-6.
Prerequisite: 3 hours History of Art.
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 registration by the department.

HESA - HESA - Health Exercise Aquatics Courses

HESA 214 Beginning Swimming 1.
Swimming strokes and deep water skills for the non-swimmer to survive in the water.

HESA 215 Advanced Beginning Swimming 1.
Prerequisite: HESA 214 or equivalent skill.
Continuation of Basic Strokes acquired in Beginning Swimming, additional new strokes, and survival skills.

HESA 217 Survival Swimming 1.
Prerequisite: HESA 214 or equivalent skill.
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 drownpoofing, 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.

HESA 221 Intermediate Swimming 1.
Prerequisite: HESA 214 or equivalent skill.
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.

HESA 223 Lifeguard Training 2.
Prerequisite: PE 221 or equivalent skill.
This course is designed to provide entry-level lifeguard participants with the knowledge and skills prevent, recognize and respond to emergencies and to provide care for injuries and sudden illnesses until Emergency Medical Services (EMS) personnel arrive and take over. Optional fee assessed for certification.

HESA 224 Water Safety Instructor 1.
Prerequisite: PE 221 or equivalent skill.
Designed to provide students with the skills and knowledge necessary to qualify for an American Red Cross Water Safety Instructor’s certification. Optional fee assessed for certification.

HESA 226 Skin and Scuba Diving I 2.
Prerequisite: PE 221 or equivalent skill.
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 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).

HESA 227 Skin & Scuba Diving II 2.
Prerequisite: HESA 226 or equivalent skills.
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).

HESA 228 Springboard Diving 1.
Prerequisite: HESA 215 or equivalent skills.
Development of fundamental one-meter springboard diving.

HESA 229 Scuba Leadership 2.
Prerequisite: HESA 227 or equivalent skill.
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).

HESA 231 Scientific Diving 3.
Prerequisite: HESA 227 or equivalent skill.
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).

HEDS - Health Exercise Studies Dance Courses

HSED 233 Clogging 1.
This beginning-level dance class covers the fundamentals of traditional and precision clogging. Emphasis is placed on basic foot skills, combinations, freestyle techniques, and Appalachian Mountain Figures. Clogging shoes are required for class.
HESD 234 Country Dance 1.
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.

HESD 240 Social Dance 1.
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.

HESD 241 Social Dance II 1.
Prerequisite: HESD 240 or equivalent skills.
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 currently offered in the beginning level class. Dances taught will differ from semester to semester.

HESD 263 Tap Dance 1.
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.

HESD 264 Ballet 1.
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.

HESD 273 Jazz Dance 1.
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.

HESD 274 Modern Dance I 1.
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.

HESD 275 Modern Dance II 1.
Prerequisite: HESD/DAN 274 (or permission of instructor).
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.

HESE - Health Exercise Studies Emergency Medicine Courses

HESE 300 Emergency Medical Technician 4.
Corequisite: HESE 351.
This course leads to eligibility for optional certification as an emergency medical technician basic with the state of North Carolina and the National Registry of Emergency Medical Technicians. Topics include: roles and responsibilities; medical/legal considerations; respiratory/ cardiac emergencies; CPR and airway adjuncts; bleeding and shock; trauma management; medical emergencies and their management; environmental emergencies; emergency childbirth; pediatrics; geriatrics; exposure to hazardous situations; introduction to hazardous materials; psychological emergencies; patient packaging and triage; stabilization and transport of the sick and injured; communications and report writing. Two Saturday classes are required. Certification requires additional time, fees and internship liability insurance.

HESE 301 Advanced Emergency Medical Technician 4.
Prerequisite: HESE/BIO 300 and HESE 351; Coreq: HESE 352.
This hybrid course leads to eligibility for optional certification as an advanced emergency medical technician (AEMT) with the North Carolina Office of EMS and/or the National Registry of Emergency Medical Technicians. Topics include advanced concepts in airway management, pharmacology, cardiac electrophysiology, vascular access, fluid and electrolyte disturbances, and an approach to differential-based assessment and management of acutely ill or injured patients. Certification will require additional time, fees, and internship liability insurance. Refer to online scheduled classes for current charge. Students will be responsible for own transportation to clinic.

HESE 304 Psychosocial Aspects of Aging in Emergency Care 2.
This course will focus on both the physiologic and psychosocial needs of the aging patient related to the provision of emergency care.

HESE 351 EMS Clinical I 1.
C: HESE/BIO 300.
Clinical Practicum I is the initial field internship offered as a co-requisite with HESE 300: Emergency Medical Technical (EMT). Students will complete 48 hours of field internship with a local EMS agency with an emphasis on basic life support skills. Certification requires additional time, liability insurance, and fees. Refer to online scheduled classes for current charges. Students responsible for providing own transportation to clinical rotations.

HESE 352 EMS Clinical II 3.
P: HESE/BIO 300 and HESE 351; C: HESE/BIO 301.
Clinical Practicum II is the clinical and field internship essential as a co-requisite to HESE/BIO 301: Advanced Emergency Medical Technician (AEMT). Students will complete 84 hours of field internship with a local EMS agency and 48 hours with a local emergency department with an emphasis on skills competency at the AEMT level. Certification will require additional time, fees, and internship liability insurance. Refer to online scheduled classes for current charges. Students responsible for providing own transportation to clinical.

HESE 363 Advanced Patient Assessment 3.
Prerequisite: HESE/BIO 301, HESE 352, BIO 183, and BIO 212.
This course will provide students with advanced patient assessment techniques for the history and physical exam to produce differential diagnoses through clinical reasoning. This course can only be taken for a letter grade.
HESE 377 Pharmacology 3.
Prerequisite: HESE/BIO 301, HESE 352, BIO 183, and (BIO 212 or BIO 421).
This course will integrate the principles of pharmacology and medications to formulate a treatment plan intended to mitigate emergencies and improve overall patient health. This course can only be taken for a letter grade.

HESE 391 Emergency Pediatric Care 1.
Prerequisite: HESE/BIO 301, HESE 352, BIO 183, and (BIO 212 or BIO 421).
This course integrates assessment and management principles of emergency care for the neonatal and pediatric populations. Additional fees are required for certification. This course can only be taken for a letter grade.

HESE 428 Cardiology 3.
Prerequisite: HESE/BIO 301, HESE 352, BIO 183, and BIO 212.
This course will allow students to utilize anatomical, physiological, and pathophysiological principles in the assessment and management of cardiovascular disorders. This class can only be taken for a letter grade.

HESE 451 EMS Clinical III 3.
Prerequisite: HESE 352.
This course will allow students to complete 48 hours of clinical fieldwork with a local EMS agency and 156 hours with a local emergency department with an emphasis on skills competency at the paramedic level. Additional fees required. Students responsible for providing own transportation. Internship liability insurance required. Certification will require additional time and fees.

HESE 452 EMS Clinical IV 4.
Prerequisite: HESE 451; Co-requisite: HESE 461 and HESE 480.
This course will allow students to complete 252 hours of field internship with a local EMS agency. An emphasis on skills competency at the paramedic level. Additional fees required. Students responsible for providing own transportation. Internship liability insurance required. Certification will require additional time and fees.

HESE 461 Advanced ECG 2.
Prerequisite: HESE/BIO 301, HESE 352, BIO 183, and BIO 212.
This course will allow students apply principles in the interpretation and management of 4 and 12-lead cardiac rhythms for comprehensive patient care.

HESE 470 Medical Emergencies 3.
Prerequisite: HESE/BIO 301, HESE 352, BIO 183, and BIO 212.
This course will integrate the principles of epidemiology and pathophysiology to formulate a field impression and implement a comprehensive plan for a patient with a medical complaint. This course can only be taken for a letter grade.

HESE 480 Trauma Emergencies 3.
Prerequisite: HESE/BIO 301, HESE 352, BIO 183, and BIO 212.
This course will integrate the principles of epidemiology and pathophysiology to formulate a field impression and implement a comprehensive plan for a patient with a traumatic complaint. This course can only be taken for a letter grade.

HESF - Health Exercise Studies Fitness Courses

HESF 100 Cross Training 2.
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.

HESF 101 Fitness and Wellness 1.
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.

HESF 102 Fitness Walking 1.
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.

HESF 103 Water Aerobics 1.
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.

HESF 104 Swim Conditioning 1.
Prerequisite: PE 215 or equivalent skill.
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.

HESF 105 Aerobics and Body Conditioning 1.
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.
HESF 106 Triathlon 1.
Prerequisite: PE 221 or equivalent skill.
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.

HESF 107 Run Conditioning 1.
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.

HESF 108 Water Step Aerobics 1.
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 or out of the water.

HESF 109 Step Aerobics 1.
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.

HESF 110 Adapted Physical Education 1.
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.

HESF 111 Indoor Group Cycling 1.
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.

HESF 230 Pilates/Core Training 1.
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.

HESF 237 Weight Training 1.
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.

HESF 279 Yoga I 1.
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.

HESF 280 Yoga II 1.
This course will build upon material introduced in Yoga I by emphasizing the physical practice of yoga at an intermediate level. Coursework will require a deeper level of understanding of a variety of yoga poses, as well as mastery of the fitness skills required to perform these poses and maintain a safe yoga practice. Breathing techniques and the philosophy of Hatha Yoga will also be addressed.

HESF 282 Advanced Aerobics and Leadership 1.
This is an introductory course in which students will be provided content knowledge and practical experience in teaching and evaluating group exercise classes. A variety of group exercise forms will be covered in addition to the use of resistance equipment. Basic fitness and training principles will be discussed as applicable to advanced aerobics and leadership. The course content is equivalent to the ACE Group Fitness Instructor certification. Certification is not part of the course and would require separate testing pursued by the student.

HESM - Health and Exercise Studies Minor Courses
HESM 201 Coaching Baseball/Softball 2.
Theories, techniques, and strategies of coaching baseball/softball.

HESM 202 Coaching Basketball 2.
Theories, techniques, and strategies of coaching basketball.

HESM 203 Coaching Football 2.
Theories, techniques, and strategies of coaching football.

HESM 204 Coaching Golf 2.
Theories, techniques, and strategies of coaching golf.

HESM 205 Coaching Soccer 2.
Theories, techniques, and strategies of coaching soccer.

HESM 206 Coaching Swimming and Diving 2.
Theories, techniques and strategies of coaching swimming and diving.

HESM 207 Coaching Tennis 2.
Theories, techniques, and strategies of coaching tennis.
HESM 208 Coaching Track & Field/Cross-Country 2.
Theories, techniques, and strategies of coaching track and field and cross-country.

HESM 209 Coaching Volleyball 2.
Theories, techniques, and strategies of coaching volleyball.

HESM 211 Strength Training and Conditioning 2.
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.

HESM 212 Alcohol, Drugs and Tobacco 2.
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.

HESM 213 Human Sexuality 2.
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 Introduction to Adventure Education 3.
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.

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.

HESM 216 Backcountry Instruction Methodology 2.
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.

HESM 275 Behavior Change in Wellness 2.
R: Wood Wellness Village Stude.
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.

HESM 280 Responding to Emergencies 2.
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 281 Emergency Medical Responder 3.
This course introduces the knowledge and skills necessary to respond appropriately in an emergency at the Emergency Medical Responder provider level. Topics include: introduction to the EMS system, roles and responsibilities, medical/legal considerations, respiratory emergencies and ventilation devices, cardiac emergencies and cardio pulmonary resuscitation (CPR), automated external defibrillation (AED), patient assessment, medical emergencies, trauma management, special patients, and emergency medical service (EMS) operations. This course does not satisfy the Physical Education GEP requirement.

HESM 284 Women's Health Issues 2.
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 current critical topics in women's health will also take place. Minor courses.

HESM 285 Personal Health 2.
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.

HESM 286 Nutrition, Exercise and Weight Control 2.
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.

HESM 287 Stress Management 2.
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.

HESM 300 Practicum in Health 1.
Prerequisite: HESM 285, HESM 375, HESM 377, and 6 hours of electives from the Health Minor.
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. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge.

HESM 301 Coaching Practicum 1.
Prerequisite: Requires departmental consent, First Aid, and CPR Certification or Equivalent.
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 in the practicum. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge.
HESM 302 Practicum Experience in Outdoor Programs 1.
Prerequisite: HESM 214, HESM 215, HESM 216, HESM 280 or equivalent.

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 Physical Education 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. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge.

HESM 303 Sports Science Practicum 1.
Prerequisite: Completed coursework in Sports Science Minor.

A 30-hour practical sports science specialist experience in a fitness specific setting within the triangle area. Course does not constitute credit toward the physical education requirement. Students are required to purchase internship liability insurance to participate in the practicum. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge.

HESM 314 Methods of Group Exercise Instruction 2.
Prerequisite: Any 100-level PE course.

A core course in teaching methods and concepts of multi-training and condition in group exercise, equipment and current rends; participation in selected activities designed to promote fitness; planning programs for physical fitness for educational institutions and social agencies. Course does not constitute credit toward meeting Physical Education GER requirement.

HESM 320 Movement Improvisation 1.

Conceptually guided, spontaneous movement generation and invention reached through individual and group experiences.

HESM 328 Dance Composition II 2.
P: DAN 272.

This course builds on skills and concepts learned in Dance Composition I. Various approaches to choreography will be discussed and explored. A student-choreographed group work will be created and performed. A small fee may be required for dance concert attendance.

HESM 335 Prevention of Sexual Assault and Violence 3.

Historical and cultural perspective on rape, sexual assault, and relationship violence will be presented. The course prepares students to deliver a standard outreach program that includes statistics, definitions, risk reduction techniques, medical, legal, psychological, community and campus resources.

HESM 375 Health Planning and Programming 2.
Prerequisite: HESM 285 Personal Health.

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.

HESM 377 Methods of Health Promotion 2.

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.

HESM 381 Athletic Training 3.
Prerequisite: HESM 280 or HESM 281 or CPR/First aid Certification. Incidence, causes, prevention and treatment of sports-related injuries. Conditioning for sports, injury recognition and evaluation, taping techniques, first aid care, treatment and reconditioning.

HESM 476 Motor Learning and Sport Performance 3.

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.

HESM 477 Coaching Concepts 3.

Practical and theoretical concepts essential to the preparation of coaches. This course does not constitute credit toward meeting Physical Education requirements.

HESM 478 Exercise Physiology and Sports Science 3.

Basic principles of human anatomy, physiology, and biomechanics and their relationship to athletic coaching.

HESM 479 Sport Management 3.

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.
Prerequisite: HESM 478.

Fundamentals and scientific principles necessary to plan, design, implement, and evaluate individual exercise programs.

HESO - Health Exercise Studies Outdoor Courses

HESO 253 Orienteering 1.

Navigating on foot from defined point to defined point, with use of map and compass in the shortest possible time.

HESO 255 Basic Canoeing 1.
Prerequisite: Basic swimming ability required.

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.

HESO 257 Backpacking 1.
Prerequisite: Must pass basic fitness test.

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.

HESO 258 Basic Rock Climbing 1.

Instruction and direct experience for the beginning rock climber. Emphasis on safe rope systems for belaying and basic movement on rock.
HESO 259 Intermediate Rock Climbing 1.  
Prerequisite: HESO 258.  
Development of intermediate rock climbing skills and practices including: climbing safety, belaying techniques, anchor systems, partner and 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.

HESO 262 Introduction to Whitewater Canoeing 1.  
Prerequisite: HESO 255, Intermediate swimming ability required.  
Instruction and directed 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.

HESO 263 Whitewater Kayaking 1.  
Prerequisite: Intermediate swimming ability.  
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.

HESO 276 Whitewater Rafting 1.  
Prerequisite: Intermediate swimming ability required.  
Whitewater rafting skills and practices emphasizing safe river travel, minimal impact river camping techniques, and trip planning. Participate in one required weekend fieldtrip. Additional charge assessed for the fieldtrip. Refer to the online schedule of classes for the current charge.

HESO 277 Mountain Biking 1.  
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.

HESO 278 Fly-Fishing 1.  
Prerequisite: Basic swimming ability.  
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.

HESO 281 Introduction to Challenge Course Programming 1.  
Prerequisite: HESO 258 or equivalent skills.  
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).

HESO 283 Mountaineering 1.  
Prerequisite: HESO 258, HESO 257.  
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.

HESO 284 Sea Kayaking 1.  
Prerequisite: Intermediate swimming ability.  
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.

HESR - Health Exercise Studies Racquet Courses

HESR 242 Badminton 1.  
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.

HESR 248 Squash 1.  
This is an introductory squash course in which students will develop the basic skills necessary to play the game of squash. Skills that will be covered include the serve, forehand and backhand drives, volleys, lob and boast shots. Fundamental strategies and rules will be covered for singles, cutthroat, and doubles play. Basic fitness and training principles will be discussed as applicable to the sport of squash. Approved protective eyewear must be provided by the student.

HESR 249 Tennis I 1.  
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.

HESR 250 Tennis II 1.  
Prerequisite: HESR 249.  
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.
HESS 256 Racquetball 1.
This is a beginning racquetball course in which the students will develop the basic skills to play the game of racquetball. Technical skills include forehand and backhand groundstrokes, ceiling balls, serves and proper footwork. Students will also learn the fundamental rules, basic strategies, and court positioning for singles, cutthroat and doubles play. Basic fitness and training principles will be discussed as applicable to the sport of racquetball. Approved protective eyewear must be provided by the student.

HESS - Health Exercise Studies Specialty Courses

HESS 219 Gymnastics 1.
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.

HESS 235 Beginning Karate 1.
Introduction to traditional Japanese karate: kihon (basic punching, striking, blocking, and kicking techniques); kata (formal drills); yaku/soku kumite (pre-arranged sparring); and demonstration of ji-yu-kumite (controlled free sparring). Karate uniform required.

HESS 239 Self Defense 1.
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.

HESS 243 Bowling 1.
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.

HESS 244 Fencing 1.
This course will provide students with the fundamentals of modern foil fencing. Emphasis will be placed on safety, footwork, blade work, etiquette, refereeing, judging, rules, techniques and strategy. Offensive and defensive techniques will be practiced in partner drills and during an in-class tournament. Basic rules in and techniques of epee and saber will be presented.

HESS 245 Golf 1.
This course will provide golf instruction at an introductory level. Coursework will introduce full swing fundamentals, chipping, pitching and putting fundamentals, rules, and etiquette on the golf course, and history of the game. Students will develop and appreciation for the game of golf through practice, play, and time of the golf course. There is a required fee for class meetings at the Lonnie Poole Golf Course Range. Check the online scheduling for current charge. The student must provide their own transportation to the golf course.

HESS 246 Handball 1.
This course will provide handball instruction at the beginning level in which students will develop the basic skills necessary to play the game of handball. Technical skills include serves, overhead, sidearm, and underhand strokes, ceiling shot, lob, three-wall shot, kill shots and passing shots. Instruction will include an emphasis on the fundamental strategies and rules used in singles, doubles, and cutthroat play. Basic fitness and training principles will be discussed as applicable to the game of handball. Students are required to purchase handball gloves and protective eyewear.

HESS 251 Target Archery 1.
Shooting fundamentals, safety, selection, and care of equipment.

HESS 252 Skiing/Snowboarding 1.
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 are responsible for providing their own transportation. 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.

HESS 254 Beginning Equitation 1.
This course is designed to apply knowledge of the fundamentals of health-related fitness toward developing, maintaining and sustaining active and healthy lifestyle through equestrian sports. Basic techniques, theories and performance in equitation including skills at the walk, trot and over ground poles will be taught. Care of the horse, grooming, tacking, and safety around horses will be addressed. Students will travel off campus once a week. Refer to the online schedule of classes for the current charge. Students must provide their own transportation and paddock boots. Students must meet the weight guidelines of the North American Horseman’s Association.

HESS 260 Intermediate Equitation 1.
Prerequisite: Beginning Equitation. This course is designed to apply knowledge of the fundamentals of health related fitness toward developing, maintaining, and sustaining active and healthy lifestyle through equestrian sports. Intermediate techniques, theories and performance in equitation including skill at walk, trot, canter over ground poles and small cross bars will be taught. Care of the horse, tack and safety around horses will be assessed. Students will travel off campus once a week. Students must meet the weight restriction of the North American Horseman’s Association. Refer to the online schedule of classes for the current fee. Students must provide their own transportation to the stable, paddock boots, and riding pants.

This course is for student athletes on a team sponsored by the NCSU Department of Athletics or currently enrolled ROTC students. Coursework will require a high level of skill acquisition and mastery of the fitness skills required to perform training techniques and safe sport practice. The rules and terminology of each activity will also be addressed. Course not repeatable.

HESS 295 Special Topics in Physical Education 1-3.
Examination of selected topics in health, fitness, outdoor leadership, physical education, and sport.
Hi 205 Western Civilization Since 1400 3.
A survey of Western Civilization from the Renaissance to the present.

Hi 207 Ancient Mediterranean World 3.
The ancient cultures of the Middle East, Greece and Rome, including Mesopotamian, Egyptian, Hebrew, Phoenician, Greek and Roman societies and cultures.

Hi 208 The Middle Ages 3.
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.

Hi 209 From Renaissance to Revolution: The Origins of Modern Europe 3.
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; witchcraft; religious reforms and religious wars; commercialization; navigation; empire; slavery; the new science; and new ideas about democracy, equality, and modernity.

Hi 210 Modern Europe 1815-Present 3.
Survey of the history of European societies and political systems from 1815 to the present.

Hi 214 History and Archaeology of Ancient Latin America 3.
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.

Hi 215 Latin America to 1826 3.
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.

Hi 216 Latin America since 1826 3.
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 US.

Hi 221 British History to 1688 3.
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.

Hi 222 History of British Cultures and Societies From 1688 3.
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.

Hi 232 The World from 1200 to 1750 3.
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.
HI 233 The World Since 1750 3.
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.

HI 240 Introduction to Visual Culture 3.
Prerequisite: Sophomore standing.
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.

HI 251 Early American History 3.
Themes in early American history: colonial clash and mix of culture; generation of an American consciousness; federalism and democracy in national politics; expansion and immigration; racial and sectional division.

HI 252 Modern American History 3.
Themes in modern 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 pluralistic society.

HI 263 Asian Civilizations to 1800 3.
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.

HI 264 Modern Asia: 1800 to Present 3.
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.

HI 270 Modern Middle East 3.
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.

HI 275 Introduction to History of South and East Africa 3.
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.

HI 276 Introduction to History of West Africa 3.
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.

HI 298 Special Topics in History 1-3.
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.

HI 300 Sophomore Seminar in History 3.
Prerequisite: Sophomore standing, History Majors.
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.

HI 307 Jewish History 3.
Prerequisite: 3 hrs of History or Sophomore standing.
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.

HI 320 Religion in American History 3.
Prerequisite: 3 hrs of History or Sophomore standing.
Representative people, movements and thought in the major religions within the context of American society and culture.

HI 321 Ancient and Medieval Science 3.
Prerequisite: 3 hours of History or Sophomore standing.
Selected topics in the history of pre-modern science are studied for both their intrinsic interest and to gain perspective on the nature of modern science. Examples are taken from pre-history, Mesopotamia, Egypt, Greece, Rome, Islam, and the medieval Christian West, with the possibility of comparisons to other cultures.

HI 322 Rise of Modern Science 3.
Prerequisite: 3 hours of History or Sophomore standing.
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.

HI 324 History of Common Law and Constitution 3.
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.

HI 332 Germany and the World Wars 3.
Prerequisite:3 hrs of History or Sophomore Standing.
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.
HI 335 The World at War 3.  
Prerequisite: 3 hours of History.  
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.

HI 338 Empire, War, and Revolution in Russia 3.  
Prerequisite: 3 hours of History or Sophomore standing.  
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.

HI 341 Technology in History 3.  
Prerequisite: 3 hours of History or Sophomore standing.  
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.

HI 346 Introduction to Civil War and Reconstruction 3.  
Prerequisite: 3 hours of History or Sophomore standing.  
Survey of the causes, trajectories, and consequences of the American Civil War and the social, political, and economic struggles of Reconstruction with an emphasis on divisions by region as well as race, class, and gender.

HI 350 American Military History 3.  
Prerequisite: 3 hours of History or Sophomore standing.  
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.

HI 351 U.S. Naval History 3.  
Prerequisite: 3 hours of History or Sophomore standing.  
The role of the U.S. Navy in American history. Sea power, national defense and foreign policy. The impact of technology on naval warfare and the historical evolution of missions of the U.S. Navy.

HI 354 The Rise of the American Empire 3.  
Prerequisite: 3 hours of History or Sophomore standing.  
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.

HI 364 History of North Carolina 3.  
Prerequisite: 3 hours of History or Sophomore standing.  
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.

HI 365 The American West 3.  
Prerequisite: 3 hours of History or Sophomore standing.  
A history of the American Frontier 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.

HI 366 Native American History 3.  
Prerequisite: 3 hours of History or Sophomore standing.  
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.

HI 370 Modern Egypt 3.  
Prerequisite: 3 hours of History or Sophomore standing.  
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.

HI 371 Modern Japan, 1850 to Present 3.  
Prerequisite: 3 hours of History or Sophomore standing.  
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.

HI 372 African-American History Through the Civil War, 1619-1865 3.  
Prerequisite: 3 hours of History or Sophomore standing.  
African background and continuity of the particular role, experience and influence of African Americans in the United States through the Civil War.

HI 373 African-American History Since 1865 3.  
Prerequisite: 3 hours of History or Sophomore standing.  
The history of African-Americans from the Reconstruction era through the Civil Rights movement of the 1950s and 1960s to the present.

HI 374 Visual Culture of Modern South Asia 3.  
Prerequisite: 3 hours of History or Art Studies or Sophomore Standing.  
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 patronage and popular values through common themes and stories. Changing state formations and power relationships-- from the Mughal empire and its successor states through British imperial control and after independence-- are studied as contexts for the visual culture that emerges and changes across these time periods. Knowledge gained from HI 263 [Asian Civilizations to 1800] or HI 264 [Modern Asia] is helpful but not required.

HI 380 History of Nonprofits, Philanthropy, and Social Change 3.  
Prerequisite: 3 hours of History or Sophomore standing.  
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.
HI 381 NGO Nonprofits in a Global Context 3.
Requisite: Sophomore Standing or Above.
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.

HI 395 History: Study Abroad 1-3.
Requisite: 3 hours of History or Sophomore standing.
Topical History courses taught in NCSU Study Abroad programs.
(Current listings available in Study Abroad Office, CHASS Dean’s Office
and History Department).

HI 400 Civilization of the Ancient Near East 3.
Requisite: 3 hours of History.
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.

HI 402 Early Christianity to the Time of Eusebius 3.
Requisite: One of: REL 312, REL 317, or HI 207.
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 Christian movements; anti-heretical
writings; orthodox institutions of authority.

HI 403 Ancient Greek Civilization 3.
Requisite: 3 hours of History.
The history of the Hellenes from the Minoan civilization through
Alexander’s legacy, with readings in Herodotus and Thucydides.

HI 404 Rome to 337 A.D. 3.
Requisite: 3 hrs. of History.
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.

HI 405 History and Archaeology of the Roman Empire 3.
Requisite: 3 hrs. of History.
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 HI 505.

HI 406 From Roman Empire to Middle Ages 3.
Requisite: 3 hrs. of History.
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.

HI 407 Islamic History to 1798 3.
Requisite: 3 hrs. of History.
Credit will not be given for both HI 407 and HI 507. 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.

HI 408 Islam in the Modern World 3.
Requisite: 3 hours of History or Religious Studies.
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.

HI 409 The High Middle Ages 3.
Requisite: 3 hrs. of History.
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.

HI 410 Italian Renaissance 3.
Requisite: 3 hrs. of History.
Renaissance humanism, an educational ideal and an awareness of man
as the sole creator in the historical world, is examined in its relationship to
the Italian republics and princenes of the 14th through the 16th century.
Credit will not be given for both HI 410 and HI 510.

HI 411 Trials of Faith: Religious Reformation in Early-Modern Europe 3.
Requisite: 3 hrs. of History.
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.

HI 412 The Sexes and Society in Early-Modern Europe 3.
Requisite: 3 hrs. of History.
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.

HI 414 From Kings to Revolution: The History of Early-Modern
France 3.
Requisite: 3 hrs. of History.
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 stories 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.
HI 415 The French Revolution 3.
Prerequisite: 3 hrs. of History.
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.

HI 418 Fascist Italy and Nazi Germany 3.
Prerequisite: 3 hrs. of History.
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.

HI 419 Modern European Imperialism 3.
Prerequisite: 3 hrs. of History.
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.

HI 420 European Diplomatic History 3.
Prerequisite: 3 hours of History.
Survey of major events in European international relations, including the Congress of Vienna in 1815, the unification of Germany, World War I and II, the origins of the Cold War, European unification, and the crisis of the Soviet bloc. Credit will not be given both for HI 420 and HI 520.

HI 421 European Intellectual History: The Eighteenth Century 3.
Prerequisite: 3 hrs. of History.
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.

HI 422 European Intellectual History: The 19th Century 3.
Prerequisite: 3 hrs. of History.
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.

HI 423 Women in European Enlightenment 3.
Prerequisite: 3 hrs. of History.
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.

HI 425 Tudor and Stuart England 3.
Prerequisite: 3 hrs. of History.
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.

HI 429 20th Century Britain 3.
Prerequisite: 3 hours of History.
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.

HI 430 Modern France 3.
Prerequisite: 3 hrs. of History.
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.

HI 435 Europe Since 1945 3.
Prerequisite: 3 hrs. of History.
Survey of European politics, society, and culture from 1945 to the present day focusing equally on Eastern and Western Europe. Begins with the Cold War division of the continent and gives special attention to the years immediately following the end of the Second World War, to the revolts of 1968, to the fall of Communism in 1989-1991, and to the Wars of Yugoslav Succession, 1991-1999.

HI 437 Topics in Central and East European History 3.
Prerequisite: 3 hrs. of History.
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.

HI 440 American Environmental History 3.
Prerequisite: 3 hours of History.
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.

HI 441 Colonial and Revolutionary U.S 3.
Prerequisite: 3 hrs. of History.
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.

Prerequisite: 3 hours of History.
Analysis of state and federal constitutions developed in the United States after 1776. Theories behind a federal constitution; the Philadelphia Convention of 1787; the ratification debate; and the bill of rights. Credit will not be given for both HI 442 and HI 542.

HI 443 U.S. Constitutional History to 1883 3.
Prerequisite: 3 hrs. of History.
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.
HI 444 U.S. Constitutional History Since 1870 3.  
Prerequisite: 3 hrs. of History. 
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.

HI 445 Early American Frontier 3.  
Prerequisite: 3 hrs. of History. 
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.

HI 446 Civil War and Reconstruction 3.  
Prerequisite: 3 hrs. of History. 
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.

HI 447 History of American Women to 1900 3.  
Prerequisite: 3 hours of History. 
The historical experience of women in America from the colonial period to 1890. Women's work, education, legal and political status, religious experience, 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) 447 and HI (WGS) 547.

HI 448 American Women in the Twentieth Century 3.  
Prerequisite: 3 hrs. of History. 
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.

HI 449 U.S. Labor to 1900 3.  
Prerequisite: 3 hrs. of History. 
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.

HI 450 U.S. Labor Since 1900 3.  
Prerequisite: 3 hrs. of History. 
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.

HI 451 The Vietnam War 3.  
Prerequisite: 3 hours of History. 
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; nation building in north and south Vietnam; conflict between north and south; American intervention; and the memory of war in Vietnam. Credit for both HI 451 and HI 551 is not allowed.

HI 452 Recent America 3.  
Prerequisite: 3 hrs. of History. 
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.

HI 453 United States-Latin American Relations Since 1823 3.  
Prerequisite: 3 hrs. of History. 
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 on 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.

HI 454 History of U.S. Foreign Relations, 1900-Present 3.  
Prerequisite: 3 hrs. of History. 
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 shaped American relations with other nations. Credit for both HI 454 and HI 554 will not be allowed.

HI 455 History of the Civil Rights Movement 3.  
Prerequisite: 3 hrs. of History. 
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 HI (AFS) 455 and HI 555.

HI 456 Early American Thought 3.  
Prerequisite: 3 hours of History. 
American intellectual history to 1865. Influence of reformation, enlightenment, scientific revolution, capitalism and romanticism on social and political order. Credit will not be given for both HI 456 and HI 556.

Prerequisite: 3 hrs. of History. 
American intellectuals and their views on 20th-century topics such as politics, culture, race and gender in historical context. Credit for both HI 457 and HI 557 is not allowed.
HI 458 American Historical Biography 3.  
Prerequisite: 3 hrs. of History.  
Learn about the past through the eyes of those who made it. This course explores the multiple ways that historical biographers construct narratives of an individual life and how these relate to broader themes in American history. Credit will not be given for both HI 458 and HI 558.  

HI 459 The Early American Republic 3.  
Prerequisite: 3 hrs. of History.  
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.  

HI 461 Civilization of the Old South 3.  
Prerequisite: 3 hrs. of History.  
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.  

HI 462 Southern History since the Civil War 3.  
Prerequisite: 3 hours of History.  
Exploration of many American “Southerns” 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.  

HI 465 Oil and Crisis in the Gulf 3.  
Prerequisite: 3 hrs. of History.  
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.  

HI 466 History of the Palestinian-Israeli Conflict 3.  
Prerequisite: 3 hrs. of History.  
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.  

HI 467 Modern Mexico 3.  
Prerequisite: 3 hours of History.  
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.  

HI 469 Latin American Revolutions in the Twentieth Century 3.  
Prerequisite: 3 hrs. of History.  
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.  

HI 470 Exploring World History 3.  
Prerequisite: 3 hours of History.  
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.  

HI 471 Revolutionary China 3.  
Prerequisite: 3 hrs. of History.  
China 1900 to present. Examination of political, cultural, and socioeconomic 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.  

HI 473 Japan’s Empire in Asia, 1868-1945 3.  
Prerequisite: 3 hrs. of History.  
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.  

HI 474 Modern India 3.  
Prerequisite: 3 hours of History.  
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.  

HI 475 History of the Republic of South Africa 3.  
Prerequisite: 3 hours of History.  
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.  

HI 476 Leadership in Modern Africa 3.  
Prerequisite: 3 hours of History.  
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.  

HI 477 Women in the Middle East 3.  
Prerequisite: 3 hours of History.  
The varied forces influencing lives of women in Middle East from beginning of Islam to present.
HI 478 Islam and Christianity in Sub-Saharan Africa 3.
Prerequisite: 3 hours of History.
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.

HI 479 Africa (sub-Saharan) in the Twentieth Century 3.
Prerequisite: 3 hours of History.
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.

HI 480 Scientific Revolution: 1300-1700 3.
Prerequisite: 3 hrs. of History.
Factors behind dramatic scientific changes of the seventeenth century. Role of mathematics and experiment. Interaction of the new science with trends in philosophy, religion, alchemy, magic, medicine, and with institutional, educational, political, economic and technological factors. Credit will not be given for both HI 480 and HI 580.

HI 481 History of the Life Sciences 3.
Prerequisite: 3 hrs. of History.
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.

HI 482 Darwinism in Science and Society 3.
Prerequisite: 3 hrs. of History.
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, sociology, and relationship of sciences to ethics and religion. Credit will not be given both for HI 482 and HI 582.

HI 483 Science and Religion in European History 3.
Prerequisite: 3 hrs. of History.
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.

HI 484 Science in European Culture 3.
Prerequisite: 3 hrs. of History.
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.

HI 485 History of American Technology 3.
Prerequisite: 3 hours of History.
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.

HI 486 Science and Empire 3.
Prerequisite: 3 hours of History.
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.

HI 491 Seminar in History 3.
Prerequisite: HI 300 and 18 hours of History.
Detailed investigation of selected topics in history. Consult Department of History for specific topics.

HI 495 Honors Research in History I 2.
Prerequisite: Senior in History Honors Program.
Preparation of the honors thesis. Topics and procedures to be determined by the student and the supervising faculty member.

HI 496 Honors Research in History II 4.
Prerequisite: HI 495, Senior in History Honors Program.
Completion of the honors thesis. Topics and procedures to be determined by the student and the supervising faculty member.

HI 498 Independent Study in History 1-6.
Prerequisite: 3 hours of History.
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 completed by the student and faculty member prior to registration by the department.

HI 500 Civilizations of the Ancient Near East 3.
The civilizations of Mesopotamia and Egypt from earliest times to fall of Babylon in 539 B.C. Credit for both HI 400 and HI 500 is not allowed.

HI 504 Rome To 337 A.D. 3.
Development of ancient Rome from its origins in Italy, through its rise as an Empire embracing entire Mediterranean World and Western Europe, to Constantine, Christianity and the foundation of Constantinople. Critical examination of political achievement of a people who rose from an obscure Italian city to a world empire, with emphasis on analysis of primary courses. Credit for both HI 404 and HI 504 is not allowed.

HI 505 History and Archaeology Of the Roman Empire 3.
Analysis of Rome's unparalleled rule over the entire Mediterranean World in first four centuries A. D. through use of literary and archaeological sources. Special emphasis on imperial army and frontier security. Credit for both HI 405 and HI 505 is not allowed.

HI 506 From Roman Empire To Middle Ages 3.
Late Antiquity and the early Middle Ages. The transition from classical civilization to basis of modern civilizations: the Fall of Rome, the Germanic kingdoms, Byzantium, establishment of Christianity, birth and growth of Islam. Credit for both HI 406 and HI 506 is not allowed.

HI 507 Islamic History To 1798 3.
History of Islamic Near East to 1798. 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 for both HI(REL) 407 and HI 507 is not allowed.
HI 508 Emerging Technologies and Society 3.
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.

HI 509 The High Middle Ages 3.
Medieval culture 936-1250: 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 for both HI 409 and HI 509 is not allowed.

HI 511 Trials of Faith: Religious Reformation in Early-Modern Europe 3.
Examination of the great disruption in European civilization associated with the Protestant and Catholic Reformation. The course considers the new religious ideas and practices associated with the Reformation 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.

HI 512 The Sexes and Society in Early-Modern Europe 3.
Examination of both 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 both HI 512 and 412 is not allowed.

HI 514 From Kings to Revolution: The History of Early-Modern France 3.
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.

HI 515 Revolutionary Europe 3.
A broadly based analysis of France’s first revolutionary era. The Enlightenment and its impact, causes and character of the Revolution in France and impact of these events in France and Europe. Credit for both HI 415 and HI 515 is not allowed.

HI 518 Fascist Italy and Nazi Germany 3.
Prerequisite: 6 hours of Advanced History.
Fascism as a theoretical concept, rise of fascism in Italy and Germany, seizure of power by Mussolini and Hitler, organization of economy, churches, military, women, youth and culture under dictatorships. Students will not receive credit for both HI418 and HI 518.

HI 519 Modern European Imperialism 3.
Prerequisite: Graduate standing.
Historical background of European expression; 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 for both HI 419 and HI 519 is not allowed.

HI 520 European Diplomatic History 3.
Prerequisite: 6 hours of Advanced History.
Survey of major issues and events in European international relations, including Congress of Vienna in 1815, unification of Germany, World War I and II, origins of Cold War, European unification, and crisis of Soviet bloc. Credit for both HI 420 and HI 520 is not allowed.

HI 521 European Intellectual History: The Eighteenth Century 3.
Historical examination of some of major figures of the European Enlightenment, beginning with Locke and ending with Kant. Credit for both HI 421 and HI 521 is not allowed.

HI 522 European Intellectual History: The 19TH Century 3.
Historical examination of some of major figures of European thought during 19th century, beginning with enthusiasm of the period of the French Revolution and ending with the disillusionment of the fin de siecle. Credit for both HI 422 and HI 522 is not allowed.

HI 523 Women in European Enlightenment 3.
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.

HI 525 Tudor and Stuart England 3.
British history from the Reformation to the Civil War. Primary emphasis on certain key developments in social, political and economic life, such as development of a new concept of kingship, the growing independence of Parliament, the search for religious uniformity and changing status of aristocracy and gentry. Credit for both HI 425 and HI 525 is not allowed.

HI 530 Modern France 3.
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 for both HI 430 and HI 530 is not allowed.

HI 532 History Of Germany Since 1871 3.
Prerequisite: 6 hours of Advanced History.
German history from the unification of 1871 to the present, concentrating on problems of nationalism and political and social reform. Credit for both HI 432 and HI 532 is not allowed.

HI 533 Theory and Practice of Oral History 3.
Explores the practice of oral history. Examines historical works drawn primarily from oral sources. Teaches students to design and implement oral history projects based on independent research.

HI 534 Theory and Practice of Digital History 3.
Introduces students to the theory and practice of digital history. Students will examine theoretical scholarship on digital practices in history, exploring issues of capacity, accessibility, interactivity, and hypertextuality. Students will critique examples of digital history including digital archives, exhibits, scholarships, and teaching resources, and then apply conceptual knowledge in the creation of their own digital history projects. Graduate standing or PBS status.

HI 538 The Russian Empire To 1917 3.
History of the Russian Empire to the Revolution of 1917. Kiev Rus and the Mongol conquest; serfdom, territorial expansion and cultural insularity of Great Russian state in Moscow; Westernization, reform and great power status in 18th and 19th centuries; peoples of multinational empire; culture, educated society and revolutionary opposition; industrialization, rapid urbanization, war and revolution. Credit for both HI 438 and HI 538 is not allowed.
HI 539 History Of the Soviet Union and After 3.
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.

HI 540 American Environmental History 3.
Prerequisite: Graduate standing.
Interaction between humans and their environments in America; environmental focus on themes in American history such as colonial settlements, industrialization, progressivism, the new Deal, the 1960s. Credit will not be given for both HI 440 and HI 540.

HI 541 Colonial and Revolutionary U.S. 3.
Prerequisite: Graduate standing.
Origins of English colonies in America to the American Revolution. European background to colonization, merging of different cultures, effects of mercantile doctrine, causes of revolution. Credit for both HI 441 and HI 541 is not allowed. Credit for both HI 441 and HI 541 is not allowed.

Prerequisite: Graduate standing.
Analysis of state and federal constitutions developed in the United States after 1776. Theories behind a federal constitution; the Philadelphia Convention of 1787; the ratification debate; and the bill or rights. Credit will not be given for both HI 442 and HI 542.

HI 543 U.S. Constitutional History to 1883 3.
Prerequisite: Graduate standing.
Examines the origins and development of the United States Constitution from the Articles of Confederation to 1883. Analyzes the Federalist-Antifederalist debates; evaluates the constitution and its interaction with politics, economics, and society. Studies the powers of Congress—taxation, contracts, commerce, war, and First Amendment issues. Explores sovereignty, civil rights, and the new federalism after the Civil War. Assesses the meaning of procedural and substantive due process, and the state action theory. Appraises the transformation in American constitutionalism during Reconstruction. Students may not earn credit for both HI 443 and HI 543.

HI 544 US Constitutional History Since 1870 3.
Prerequisite: Graduate standing.
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.

HI 545 Early American Frontier 3.
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". Graduate standing or permission of instructor. Credit cannot be given for both HI 445 and HI 545.

HI 546 Topics in Civil War and Reconstruction 3.
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.

HI 547 History Of American Women To 1900 3.
Prerequisite: 6 hours of Advanced History.
Historical experience of women in America from colonial period to 1890. Women's work, education, legal and political status, religious experience and sex roles; age, class, race, sexual preference and region as significant variables in women's experience. Credit for both HI (WGS) 447 and HI (WGS) 547 is not allowed.

HI 548 American Women In the Twentieth Century 3.
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 for both HI (WGS) 448 and HI (WGS) 548 is not allowed.

HI 549 U. S. Labor To 1900 3.
Prerequisite: Graduate standing.
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 for both HI 449 and HI 549 is not allowed.

HI 550 U. S. Labor Since 1900 3.
Prerequisite: Graduate standing.
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: 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.

HI 551 The Vietnam War 3.
Prerequisite: Graduate standing.
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; nation building in north and south Vietnam; conflict between north and south; American intervention; and the memory of war in Vietnam. Credit for both HI 451 and HI 551 is not allowed.

HI 552 Recent America 3.
Examining 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 for both HI 452 and HI 552 is not allowed.
HI 553 U. S.-Latin American Relations Since 1823 3.
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 on 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.

HI 554 History Of U. S. Foreign Relations, 1900-Present 3.
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. Credit for both HI 454 and HI 554 is not allowed.

HI 555 History Of the Civil Rights Movement 3.
Prerequisite: 6 hours of Advanced History. Junior standing. The "black revolution;" stages and leaders of the movement; successes and failures in fight for desegregation, the vote and economic opportunity; impact of Civil Rights movement on the United States. Credit for both HI (AFS) 455 and HI 555 is not allowed.

HI 556 Early American Thought 3.
Prerequisite: 3 hours of History. American intellectual history to 1865. Influence of Reformation, enlightenment, scientific revolution, capitalism and romanticism on social and political order. Credit for both HI 456 and HI 556 is not allowed.

American intellectuals and their views on 20th-century topics such as politics, culture, race and gender in historical context. Credit for both HI 457 and HI 557 is not allowed.

HI 558 American Historical Biography 3.
Learn about the past through the eyes of those who made it. This course explores the multiple ways that historical biographers construct narratives of an individual life and how these relate to broader themes in American history. Credit will not be given for both HI 458 and HI 558.

HI 559 The Early American Republic 3.
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 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. Graduate standing or permission of instructor. Credit cannot be given for both HI 458 and HI 559.

HI 561 Civilization Of the Old South 3.
Distinctive features of the Old South as part of the regional development of the U. S. 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 for both HI 461 and HI 561 is not allowed.

HI 562 Southern History since the Civil War 3.
Prerequisite: 6 hours of Advanced History.
Exploration of many American southern re-visions 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.

HI 563 Topics in History and Memory 3.
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 for credit with a different topic.

HI 566 Readings in Native American History 3.
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 US federal policies; and the survival and continuity of native cultures and peoples through more than four centuries of contact, conquest, and change.

HI 569 Latin American Revolutions In the Twentieth Century 3.
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 is not allowed.

HI 571 Revolutionary China 3.
China 1900 to present. Examination of political, cultural and socio-economics revolutionary phases of China's 20th-century trans-formation from traditional empire to communism. Particular attention to post-1949 problems of nation building. Credit for both HI 471 and HI 571 is not allowed.

HI 572 The Rise of Modern Japan, 1850-Present 3.
Prerequisite: Graduate standing.
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.

HI 573 Japan's Empire in Asia, 1868-1945 3.
Prerequisite: 6 hours of advanced history.
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.

HI 575 History Of the Republic Of South Africa 3.
Prerequisite: 6 hours of Advanced History.
Evolution of Republic of South Africa's society, with emphasis on interaction of diverse peoples and cultures. Particular attention given to period since 1870. Credit for both HI 475 and HI 575 is not allowed.

HI 576 Leadership In Modern Africa 3.
Conditions under which 20th century African leaders have obtained and exercised power. Case studies of prominent leaders, both radicals, reactionaries, democrats and tyrants, such as Nkumah, Kenyatta, Nyerere, Amin, Cabral, Vorster and Senghor. Credit for both HI (AFS) 476 and HI 576 is not allowed.

HI 578 Islam and Christianity in Sub-Saharan Africa since the 19th Century 3.
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.
HI 579 African (sub-Saharan) in the Twentieth Century 3.
Prerequisite: 6 hours of Advanced History.
Developments in sub-Saharan Africa during colonial period, from end of 19th century to advent of decolonization in early 1960s. Interplay of political, social, economic and cultural factors in experiences of African peoples during this period. Students will not receive credit for both HI (AFS) 479 and HI 579.

Factors behind dramatic scientific changes of the seventeenth century. Role of mathematics and experiment. Interaction of new science with trends in philosophy, religion, alchemy, magic, medicine and with institutional educational, political, economic and technological factors. Credit for both HI 480 and HI 580 is not allowed.

HI 581 History Of Life Sciences 3.
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.

HI 582 Darwinism In Science and Society 3.
Prerequisite: 6 hours of Advanced History.
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 for both HI 482 and HI 582 is not allowed.

HI 583 Science and Religion in European History 3.
Prerequisite: 6 hours of Advanced History.
Are science and religion inherently in conflict with each other? Historical analysis of the idea of the war 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.

HI 584 Science in European Culture 3.
Prerequisite: 6 hours of Advanced History.
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 expositions. Credit will not be given for both HI 484 and HI 584.

HI 585 History of American Technology 3.
Prerequisite: Graduate standing.
Technology in American history: the ideological, social, economic, and institutional contexts of technological change from the 1760s to the present. Impacts of new technological systems. Credit for both HI 485 and HI 585 is not allowed.

HI 586 Science and Empire 3.
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.

HI 587 Cultural Resource Management 3.
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.

HI 588 Family and Community History 3.
Theory and research in family history, local history, and community studies, as well as application to public history presentation and community development. Graduate standing in history required.

HI 589 Interpretation in Historic Sites and Parks 3.
Requisite: NCSU Graduate Students (MR or DR), NDS Students Only.
Methodologies of interpreting history at historic sites and parks; training in interpretive tools linking historiography and research methodology with real places for presentation to the public; considerations of practical application. Five day trips required. Graduate standing or NDS.

HI 591 Museum Studies 3.
Organization and operation of museums as historical agencies. Role of museums in historical research and education. Graduate standing or NDS.

HI 592 Historical Writing 3.
Current theories of material culture analysis and their application to history museums. Graduate standing or NDS.

HI 593 Material Culture 3.
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.

HI 594 Cultural Heritage 3.
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.

HI 595 Introduction To Public History 3.
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.

HI 596 Material Culture and Historical Method 3.
Major steps in development of historical investigation; analysis of elements of historical research; discussion of methodology and archival materials used by contemporary scholarly historian.

HI 599 Independent Study 1-6.
Prerequisite: Graduate standing or PBS status.
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.

HI 642 Internship In Public History 3.
Supervised internship experience with a public or private historical agency or institution or local, regional or national significance. Graduate standing in History.
HI 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

HI 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

HI 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

HI 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis Research.

HI 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

HI 787 African American Public History 3.
Issues in public history practice as they relate to the collection, preservation, and interpretation of African American cultural history. Graduate standing in history required.

HI 788 Native American Public History 3.
Issues in public history practice as they relate to the collection, preservation, and interpretation of Native American history. Graduate standing in history required.

HI 791 Research Seminar in Public History 3.
Identification and development of public history research subjects, sources and their evaluation, research techniques and problems, and writing and argumentation. Graduate standing only.

HI 792 Colloquium in History 3.
Advanced historiographical readings on major topics in history. May be repeated for credit with different topic. Graduate standing in History only.

HI 885 Doctoral Supervised Teaching 1-3.
HI 889 Doctoral Dissertation Seminar 1.

HI 895 Doctoral Dissertation Research 1-3.
HI 896 Summer Dissert Res 1.
HI 899 Doctoral Dissertation Preparation 1-3.

HON - Honors Courses

HON 202 Inquiry, Discovery, and Literature 3.
Prerequisite: HON student.
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.

HON 290 Honors Special Topics - History 3.
Prerequisite: HON student.
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in History, interdisciplinary in character and often team-taught.

HON 291 Honors Special Topics - Mathematics 3.
Prerequisite: HON student.
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in mathematics, interdisciplinary in character and often team-taught.

HON 292 Honors Special Topics - Natural Sciences 3.
Prerequisite: HON student.
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in the natural sciences, interdisciplinary in character and often team-taught.

HON 293 Honors Special Topics - Literature 3.
Prerequisite: HON student.
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in history or literature, interdisciplinary in character, and often team-taught.

HON 294 Honors Special Topics - Philosophy or Religion 3.
Prerequisite: HON student.
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in philosophy, religion, or arts, interdisciplinary in character, and often team-taught.

HON 295 Honors Special Topics - Social Science 3.
Prerequisite: HON student.
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in the social sciences, interdisciplinary in character, and often team-taught.

HON 296 Honors Special Topics - Science, Technology, Society - Humanistic Perspective 3.
Prerequisite: HON student.
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in Science, Technology and Society (humanistic perspective) interdisciplinary in character and often team-taught.
HON 297 Honors Special Topics-Science, Technology, Society-Natural Sciences 3.
Prerequisite: HON student.
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in Science, Technology and Society (natural science perspective) interdisciplinary in character and often team-taught.

HON 298 Honors Research/Independent Study 1-3.
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 registration. Permission of the University Honors Program 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.

HON 299 Honors Special Topics - Visual and Performing Arts 3.
Prerequisite: HON student.
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.

HON 300 Race, Membership, and Eugenics 3.
R: University Honors Program Students; others by permission of the University Honors Program.
Theories of race are linked to eugenics, a belief and practice of improving the genetic quality of the human population. The early 20th century, the practice of 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.

HON 310 The Creative Process in Science: Realities, Comparisons, and Culture Perceptions 3.
What is creativity in the context of the sciences? How does the creative process in science differ from and how is it similar to the creative process in other fields? This interdisciplinary perspectives course helps students 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.

HON 311 Words through Space and Time 3.
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.

HON 321 Music and the Science of Sound 3.
This course investigates music using the science of sound, from the earliest experiments on vibrating strings to digital recording and MP3s, and the parallel development of music and scientific thought in western cultures. Concepts will be explained in simple mathematical and non-mathematical terms and developed in an historical perspective. Students will build instruments based upon what they have learned in the course. This course is suitable for both science and non-science students. University Honors Program student or permission of the UHP.

HON 341 Time Travel 3.
Prerequisite: HON student.
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.

HON 342 Issues in Contemporary Religion 3.
Prerequisite: HON student.
An examination of major issues in contemporary religious thought, with particular attention to how theologians have reshaped traditional theological concepts in response to 20th-21st century challenges. After considering the academic study of religion and addressing the methodological issues of the nature of religious language and the task of theology, the course will examine the impact of recent historical and cultural developments on the formulation of theological proposals and the role religion plays in shaping societal attitudes and mores.

HON 344 Kantian Ethics 3.
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.

HON 345 On the Human 3.
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.

HON 346 Ethics and Gender 3.
This course is concerned with contemporary work in ethics and gender that speaks both to the status of women and issues surrounding sexual orientation. The core readings will be Martha Nussbaum’s Sex and Social Justice, Sam Harris’ The Moral Landscape: How Science Can Determine Human Values, and an essay by Cheshire Calhoun from her book, Feminism, the Family and the Politics of the Closet. All of the major Western, secular, philosophical ethical theories and perspectives will be considered. The course will begin with some background in older ethical theories and traditions in order to better understand the contemporary literature. This class is restricted to students in the University Honors Program. Other students may enroll with permission of the UHP.
HON 347 Freedom and the Self 3.
R: University Honors Program Students; others by permission of the University Honors Program.
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.

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 interrelationship 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.

HON 353 Code Breakers: Unlocking the Mysteries of One Human Language 3.
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.

HON 391 Music and Social Life 3.
At NC State and in the Triangle people are actively engaged in music-making, dancing, devotional practices, and a multitude of other kinds of artful performance. Students in this class think about the relationship between music and other aspects of social life by doing field research to answer questions about creativity, listening, performance, and the ways music and dance shape social life, values, and ideas about difference. Students consider modes of research about music and learn techniques for doing ethnographic research. Must be a University Honors Program student or have permission of the UHP.

HON 395 Honors Cooperative Education 3.
Prerequisite: Two semester full time in University Honors Program.
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.

HON 397 Honors Extension and Engagement 1-6.
Prerequisite: One semester good standing in University Honors Program. 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.

HON 398 Honors Special Topics 1-6.
Prerequisite: HON student.
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.

HON 496 Honors Capstone Seminar 3.
Prerequisite: HON student.
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.

HON 498 Honors Research/Creative Project 1 3.
Prerequisite: One semester in good standing in University Honors Program, UHP student.
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.

HON 499 Honors Research/Creative Project 2 3.
Prerequisite: One semester in good standing in University Honors Program, UHP student.
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 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.

HS - Horticulture Science Courses

HS 101 Introduction to Ornamentals and Landscape Technology 1.
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.

HS 111 Plant ID 3.
Identification, adaptation, culture, and use of ornamental trees, shrubs, vines, ground covers and herbaceous plants.
HS 115 Plant Growth and Development 3.
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.

HS 121 Plant Propagation 3.
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.

HS 131 Fruit & Vegetable Production 3.
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.

HS 141 Greenhouse Crop Production 4.
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.

HS 144 Weeds & Diseases of Ornamentals 3.
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.

HS 151 Nursery Production 3.
Total aspects of field and container nursery stock production including site selection and development, propagation, growing procedures, harvesting, marketing, shipping and labor management practices.

HS 162 Landscape Maintenance 3.
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.

HS 171 Landscape Construction 3.
This course will provide students a fundamental and practical understanding of landscape construction techniques and equipment. AGI students only.

HS 200 Home Horticulture 3.
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.

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.

HS 202 Power of Plants: Appreciation and Use 3.
Power of Plants will focus on how plants are names and can be used in different horticultural situations and growing environments. Uniqueness, use, and plant descriptions of a wide range of horticultural plants will be considered including bonsai, topiary, espalier, and rain gardens. Not for horticultural science majors (SH, THG, THL).

HS 203 Home Plant Propagation 3.
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.

HS 204 Home Landscape Maintenance 3.
Prerequisite: HS 200 or HS 201.
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).

HS 205 Home Food Production 3.
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 educations students will be required to visit two home gardens in their area. Not for Horticultural Science Majors (SH, THG, THL).

HS 215 Agricultural Genetics 3.
Prerequisite: ZO 160 or BIO 183.
Basic principles of inheritance in plants and animals of agricultural significance. Transmission genetics and its effects on the usefulness of plants and animals. Basic principles of plant and animal improvement.

HS 242 Introduction to Small Scale Landscape Design 3.
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.

HS 250 Home Landscape Design: Creating Garden Spaces 3.
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.

HS 252 Landscape Graphic Communication 2.
Prerequisite: Horticultural Science Majors.
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.
HS 280 Hands-On-Horticulture 3.
This course will provide students a fundamental and practical understanding of applied techniques in horticulture. Students will learn basic horticulture, 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.

HS 290 Horticulture: Careers and Opportunities 1.
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.

HS 301 Plant Propagation 4.
Prerequisite: BIO 181 or BO 200.
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.

HS 302 Gardening with Herbaceous Perennials 3.
Prerequisite: BIO 183 or BO 200.
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.

HS 303 Ornamental Plant Identification I 3.
Prerequisite: BIO 181.
Identification, distribution, growth, characteristics, adaptation, and usage of ornamental plants. Emphasizes bedding plants, trees, and gymnosperms.

HS 304 Ornamental Plant Identification II 3.
Prerequisite: BIO 181.
Identification, distribution, growth, characteristics, adaptation, and usage of ornamental plants. Emphasizes shrubs, ground covers, vines, bulbs, and interior landscape plants.

HS 357 Site Design and Construction Materials 4.
Prerequisite: Landscape Horticulture (11HORTTHL) students, HS 252 and HS 342.
Site design of small scale landscape design projects including: understanding two-dimensional and three-dimensional representation of landform, landform manipulation, surveying and measuring, base map development, site analysis, grading and drainage plans, small circulation systems (pedestrian and vehicular), pavement, functional role of plants, designing site structures (steps, ramps, walls, and fences), documenting and analyzing user information, and special population site requirements. Exploration of appropriate construction materials and their properties occurs concurrently with the above topics. Field trips will be required.

HS 400 Residential Landscaping 6.
Prerequisite: HS 211, 212, 342, LAR 430, Corequisite: LAR 457.
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.

HS 401 Landscape Construction Studio 6.
Prerequisite: THL Majors, HS 357, 400.
Small scale landscape design with a concentrated focus on detail design and construction documentation. Development of skills in designing, drawing, and building landscape features. Opportunities for hands-on experiences.

HS 411 Nursery Management 3.
Prerequisite: BIO 181, SSC 200, Junior standing.
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.

HS 416 Planting Design 4.
Prerequisite: Landscape Horticulture (11HORTTHL) concentration, HS 400.
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.

HS 418 Digital Media Graphic for Landscape Designers 3.
Prerequisite: HS 242 and HS 400.
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.

HS 421 Temperate-Zone Tree Fruits: Physiology and Culture 3.
Prerequisite: BIO 181 or BO 200.
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 to North Carolina.

HS 422 Small Fruit Production 3.
Prerequisite: BIO 181, SSC 200, HS 201.
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.

HS 423 Viticulture 3.
Prerequisite: Junior standing or Senior standing.
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.
HS 428 Service-Learning in Urban Agriculture Systems 1.
Prerequisite: SSC 200 or equivalent, BIO 181 or 183, and CH 101.
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.

HS 431 Vegetable Production 4.
Prerequisite: BIO 181, SSC 200.
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.

HS 432 Permaculture: Sustainable Living 3.
Permaculture means "permanent culture," (or "permanent agriculture") 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, through lectures, discussions, field trips, and required projects, a design/thinking methodology that seeks to provide for our physical needs, food, water, shelter, energy, etc., while doing so in an environmentally friendly, sustainable manner. The Saturday field trips and the weekend mountain trip are all optional.

HS 440 Greenhouse Management 3.
Prerequisite: SSC 200 and HS 201.
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.

HS 442 Floriculture Crop Production 3.
Prerequisite: SSC 200, HS 201.
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.

HS 451 Plant Nutrition 3.
Prerequisite: SSC 200.
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.

HS 462 Postharvest Physiology 3.
Prerequisite: PB 421.
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.

HS 471 Tree and Grounds Maintenance 4.
Prerequisite: SSC 200.
Principles and practices of tree and grounds maintenance. Physical (water) and chemical (fertility) properties of urban soils. Tree and shrubbery: physiology, selection, transplanting, pruning, fertilization, and protection. Weed biology and nonchemical and chemical management options.

HS 492 Horticulture Internship 1-6.
Prerequisite: Sophomore standing.
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.

HS 493 Independent Study in Horticultural Science 1-6.
Prerequisite: Sophomore standing.
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.

HS 495 Experimental Courses in Horticultural Science 1-6.
Independent study under faculty supervision of horticultural topics in the student's area of interest not available in regular course offerings. Offering of new courses on a trial basis.

HS 502 Plant Disease: Methods & Diagnosis 2.
Prerequisite: PP 315.
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.

HS 523 Viticulture 3.
Prerequisite: BS Horticulture/Plant Science or permission from the instructor.
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. One Saturday field-trip will be scheduled. Students may not receive credit for both HS 423 and HS 523.

HS 532 Introduction to Permaculture 3.
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.
HS 533 Public Garden Administration 3.
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 discussing the public finances and fund raising; educational programming; visitor services; and careers in public gardens. Two Saturday off-campus field trips are required.

HS 541 Plant Breeding Methods 3.
Prerequisite: ST 511, Corequisite: ST 512.
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.

HS 550 Environmental Nursery Production 3.
Prerequisite: HS 411, Nursery Management, or an equivalent course.
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 and current research addressing these challenges and sampling procedures and interpretation will be learned. Graduate status and an undergraduate nursery production or management course or working knowledge of nursery production required.

HS 562 Postharvest Physiology 3.
Pre- and post-harvest factors that affect market quality of horticultural commodities with an emphasis on technologies to preserve quality and extend storage life of crops.

HS 583 Advanced Floral Crop Production and Handling 3.
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.

HS 590 Special Problems in Horticultural Science 1-6.

HS 601 Professional Presentation Skills in Horticultural Science 2.
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.

HS 610 Special Topics in Horticultural Science 1-6.
Investigation of special theoretical problems at 600 level in horticultural science not related to a thesis problem; new 600-level courses during developmental phase.

HS 615 Advanced Special Topics 1-6.
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.

HS 658 Master’s Supervised Teaching 1-3.
Prerequisite: Master’s student.
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.

HS 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master’s student.
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.

HS 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master’s student.
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.

HS 690 Master’s Examination 1-6.
Prerequisite: Master’s student.
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.

HS 693 Master’s Supervised Research 1-9.
Prerequisite: Master’s student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

HS 695 Master’s Thesis Research 1-9.
Prerequisite: Master’s student.
Thesis research.

HS 696 Summer Thesis Research 1.
Prerequisite: Master’s student.
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.

HS 698 Master’s Thesis Preparation 1-9.
Prerequisite: Master’s student.
Original research on specific problems in fruit, vegetable and ornamental crops.

HS 701 Plant Metabolism 1.
Prerequisite: (CH 223 or CH 227) and PB 421.
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.

HS 702 Biology of Plant Hormones 1.
Prerequisite: BO 421, (GN 411 or BCH 451).
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.
HS 703 Breeding Asexually Propagated Crops 1.
Prerequisite: CS 413.
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.

HS 704 Plant Nomenclature 1.
Prerequisite: PB 421.
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.

HS 705 Physiology Of Flowering 1.
Prerequisite: PB 421.
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.

HS 706 Fruit Development and Postharvest Physiology 1.
Prerequisite: PB 421.
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.

HS 707 Environmental Stress Physiology 1.
Prerequisite: PB 421.
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.

HS 717 Weed Management Systems 1.
Prerequisite: CS 414.
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 weeksof semester. Drop date is by last day of 3rd week of minicourse.

HS 720 Molecular Biology In Plant Breeding 3.
Prerequisite: CS(GN,HS) 741.
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.

HS 725 Pesticide Chemistry 1.
Prerequisite: (CH 201 or CH 203) and (CH 221 or CH 225).
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.

HS 727 Pesticide Behavior and Fate In the Environment 2.
Prerequisite: CS(HS,SSC,TOX)725,SSC 200.
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.

HS 729 Herbicide Behavior In Plants 2.
Prerequisite: BO 751 and BO 752 and CS(HS,SSC) 725.
Chemical, physiological and biochemical actions of herbicides in plants including uptake, translocation, metabolism and mechanism of action.

HS 745 Quantitative Genetics In Plant Breeding 1.
Prerequisite: CS(GN, HS) 741, ST 512, course in quantitative genetics recommended.
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.

HS 746 Breeding Methods 2.
Prerequisite: CS (GN, HS) 741, ST 512.
Theory and principles of plant breeding methodology including population improvement, selection procedures, genotypic evaluation, cultivar development and breeding strategies.

HS 790 Special Problems in Horticultural Science 1-3.
HS 815 Advanced Special Topics 1-6.
Investigation of theoretical problems at 600 level in horticultural science not related to a thesis problem; new 600-level courses during development phase.

HS 860 Plant Breeding Laboratory 1.
Prerequisite: CS(GN,HS)741.
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.

HS 861 Plant Breeding Laboratory 1.
Prerequisite: CS(GN,HS)741.
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.

HS 885 Doctoral Supervised Teaching 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 of the assignment.

HS 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation Research.
**ID - Industrial Design Courses**

**ID 201 Basic Industrial Design Studio I** 6.
Prerequisite: D104 and D105; Corequisite: ID 215, ID 255, and ID 318.
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, department approved minor, and department approved elective ("swing") studio for all other College of Design majors.

**ID 202 Basic Industrial Design Studio II** 6.
Prerequisite: ID 201, ID 215, ID 255, ID 318; Corequisite: ID 315, ID 418.
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.

**ID 215 Introduction to digital Techniques** 3.
Prerequisite: D 104, D 105.
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; desktop publishing applications for design and production of presentation documentation; and visual editors for creating and managing web sites. Industrial design majors, department approved minor, and department approved elective for all other college of design majors.

**ID 255 Contemporary Manufacturing Processes I** 3.
Prerequisite: D 104, D 105.
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.

**ID 256 Contemporary Manufacturing Processes II** 3.
Prerequisite: ID 255.
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 Electroic for all other College of Design Majors.

**ID 262 Professional Practice in Industrial Design** 3.
Issues and situations encountered in a design practice. Topics include patents, trademarks, contracts, basic marketing skills within corporations and in free-lance design.

**ID 292 Special Topics in Industrial Design** 1-3.
Topics of current interest in Industrial Design. Normally used to develop new courses.

**HSS - Humanities and Social Sciences Courses**

**HSS 100 CHASS Computer Literacy** 0.
Prerequisite: Departmental designated computer literacy course.
Computer Literacy Certification for majors in College of Humanities and Social Sciences.

**HSS 120 Introduction to Humanities & Social Sciences** 2.
Prerequisite: New Freshmen with majors in the College of Humanities and Social Sciences Only.
Introduction to Humanities and Social Science disciplines by providing comparative disciplinary perspectives on a topic that is studied by CHASS faculty in different disciplines. The course will also facilitate exploration of CHASS and University resources, policies and procedures, and address skills for academic, personal, and career success. First-year entering CHASS majors only.

**HSS 298 Study Abroad Topics in Humanities and Social Sciences** 1-6.
Study Abroad Programs: selected topics in the humanities and social sciences.

**HSS 392 International and Crosscultural Communication** 3.
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.

**HUM - Humanities Courses**

**HUM 295 Humanities Special Topics** 3.
Special topics course offering for the general education Humanities category.

**HUMG - Humanities and Global Knowledge Courses**

**HUMG 295 Humanities and Global Knowledge Special Topics** 3.
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.

**HUMU - Humanities and U.S. Diversity Courses**

**HUMU 295 Humanities and U.S. Diversity Special Topics** 3.
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.
Prerequisite: ID 202, ID 255, ID 315, ID 418; Corequisite: ID 415 (Fall), ID 445 (Spring).
Individual and team-oriented design experiences that expand upon and combine intellectual and manual skills required for the practice of industrial design. Emphasis on identifying and solving design problems through manipulation of design theory, application of human factors, product safety awareness, universal design principles, ecological/environmental concerns, appropriate combination of materials and manufacturing techniques, and presentation of concepts. Extensive integration of computer technology, including 3-D digital modeling, rapid prototyping, interactive virtual product visualization, and world-wide web-based presentation.

ID 315 Digital Product Modeling 3.
Prerequisite: ID 215.
Progression of digital experiences that expand upon and combine the intellectual and conceptual skills required for 3-dimensional design visualization. Emphasis on solving design problems through development and manipulation of 3-dimensional form within the virtual environment.

ID 318 Ideation I 3.
Prerequisite: D 104, D 105.
The ideation process of conceiving, developing and recording ideas two-dimensionally. These techniques defined and practiced as an extension of understanding the human idea motor process.

ID 400 Advanced Industrial Design Studio Series 6.
Prerequisite: ID 255, ID 300, ID 315, ID 418, ID 445.
A series of advanced studio experiences that expands upon and combines intellectual and manual skills required for the practice of industrial design. 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.

ID 415 Advanced Digital Product Modeling 3.
Prerequisite: ID 315.
Advanced concepts for planning and executing efficient workflow practices for manufacturable product surfaces. Emphasis on theory and application of three-dimensional surface modeling tools, accurate development of wire frame geometry, rapid prototyping and animation techniques. Introduction of animations to aid with dynamic visual analysis of digital product design concepts.

ID 418 Ideation II 3.
Prerequisite: ID 318.
This is an advanced course which expands the ideation process with greater emphasis directed toward the creative development and recording of conceptual design phase.

ID 444 History of Industrial Design 3.
The history of industrial design examines the field of industrial design in relationship to developments in engineering, applied and theoretical sciences, and developments in aesthetic theories. It covers the periods from the early enlightenment (1700s) through present day issues. Students will examine such relationships in detail in three short presentations and a comprehensive term paper. As a four-hundred level course, students are expected to be able to work independently and expand their knowledge well beyond lectures and readings.

ID 445 Human-Centered Design 3.
Junior standing or above.
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 Junior or Graduate standing in Major.

ID 490 Industrial Design International Studio 6.
Prerequisite: Junior standing in Major. Approval of Study Abroad Office.
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.

ID 492 Special Topics in Industrial Design 1-3.
Junior standing or above.
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 or Graduate standing in Major.

ID 494 Internship in Industrial Design 1-6.
Prerequisite: Junior standing, 3.0 GPA or better.
Supervised field experience in product design offices, galleries, museums and other related organizations. Maximum of 6 credit hours.

ID 495 Independent Study in Industrial Design 1-3.
Prerequisite: Junior standing in Industrial Design and 3.0 GPA or better. 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 Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

ID 500 Advanced Industrial Design (Series) 6.
Prerequisite: Portfolio review.
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.

ID 511 Industrial Design Materials and Processes I 3.
Prerequisite: Graduate standing.
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.

ID 512 Industrial Design Materials and Processes II 3.
Prerequisite: Graduate standing.
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.
**IDS - Interdisciplinary Studies Courses**

**IDS 201 Environmental Ethics 3.**
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.

**IDS 210 Introduction to American Studies 3.**
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.

**IDS 211 Eating through American History 3.**
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.

**IDS 295 Special Topics in Interdisciplinary Studies 1-12.**
Detailed investigation of an interdisciplinary topic. Topic and mode of study to be determined by faculty member and/or teach team.

**IDS 303 Humans and the Environment 3.**
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.

**IDS 310 Animals in the Global Community 3.**
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.

**IDS 490 Interdisciplinary Methods and Issues 3.**
Prerequisite: Interdisciplinary Studies Self-Design Majors, Senior standing.
Capstone seminar for students in the IDS self-design major. Intensive study of student's area of concentration, leading to a major research paper.

**IDS 495 Special Topics in Interdisciplinary Studies 1-12.**
Examination of selected topics of an interdisciplinary nature.

**IDS 496 Topics in Film and Interdisciplinary Studies 3.**
Detailed examination of film within interdisciplinary contexts. Specific topics will vary from semester to semester.

**IDS 498 Independent Study in Interdisciplinary Studies 1-12.**
Independent investigation and discussion of a selected topic of an interdisciplinary nature. 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.

**IEP - IEP Intensive English Program Courses**
IMM - Immunology Courses

IMM 595 Special Topics 1-3.

IMM 610 Special Topics 1-3.

IMM 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

IMM 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

IMM 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

IMM 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

IMM 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

IMM 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
For students who have completed all credit hour requirements and full-time enrollment of the master's degree and are writing and defending their theses.

IMM 705 Immunotoxicology 2.
Prerequisite: TOX 701.
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.

IMM 751 Immunology 3.
Prerequisite: BCH 451, GN 411, MB 351.
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.

IMM 755 Immunoparasitology 2.
Prerequisite: MB 751.
Helminth and protozoal parasite immune evasion and immunomodulation; consequences of parasite-induced immunopathogenesis; learning from failed attempts to develop protective vaccines against protozoa and helminths.

IMM 757 Comparative Immunology 3.
Prerequisite: MB 751 or MB 441 or BIO 414.
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.

IMM 783 Advanced Immunology 3.
Prerequisite: MB (IMM) 751.
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.

IMM 795 Special Topics 1-3.

IMM 807 Seminar in Veterinary Microbiology/Immunology 1.
Presentation of ongoing research and current topics in microbiology.

IMM 810 Special Topics 1-3.

IMM 816 Advanced Topics In Immunology 1.
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.

IMM 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

IMM 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

IMM 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
IPGK - Interdisciplinary Perspectives and Global Knowledge Courses

IPGK 295 Interdisciplinary Perspectives and Global Knowledge Special Topics 2-3.
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.

IPUS - Interdisciplinary Perspectives and U.S. Diversity Courses

IPUS 295 Interdisciplinary Perspectives and U.S. Diversity Special Topics 2-3.
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.

IS - International Studies Courses

IS 200 Introduction to International Studies 3.
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.

IS 393 Intermediate Seminar in International Studies 3.
Prerequisite: IS 200.
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.

IS 395 Special Topics in International Studies 1-3.
Prerequisite: IS 393.
An intensive study of selected international issues, global dimensions and implications, leading to a major research paper.

ISE - Industrial and Systems Engineering Courses

ISE 110 Computer-Based Modeling for Engineers 3.
Prerequisite: E 115, Corequisite: MA 141.
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: E115 and Corequisite: ISE216.
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.

ISE 216 Product Development and Rapid Prototyping 3.
Corequisite: ISE 215.
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.

ISE 311 Engineering Economic Analysis 3.
Prerequisite: Grade of C or better in MA 141.

ISE 315 Introduction to Computer-Aided Manufacturing 1.
Prerequisite: ISE 215 and Co-requisite: ISE 316.
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.

ISE 316 Manufacturing Engineering I - Processes 3.
Prerequisite: MSE 200 and ISE 216; Co-requisite: ISE 315.
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.

ISE 331 Furniture Manufacturing Processes I 3.
Prerequisite: ISE 330.
Furniture manufacturing technology emphasizing mass production equipment capabilities and capacities. Relationship of product characteristics to machine selection and process planning activities. Introduction to computer-controlled machining and integrated manufacturing systems.

Prerequisite: C- or better in ST 371; C or better in ISE 110.
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, learning curve analysis and pre-determined time systems. Ergonomics component includes job screening methods, anthropometry, workstation and hand-tool design, and methods for reducing hazard exposure and controlling cumulative trauma disorders.

ISE 361 Deterministic Models in Industrial Engineering 3.
Prerequisite: (MA 303 or MA 341 or MA 405) and C or better in ISE 110.
Introduction to mathematical modeling, analysis techniques, and solution procedures applicable to decision-making problems in a deterministic environment. Linear programming models and algorithms and associated computer codes are emphasized.

ISE 362 Stochastic Models in Industrial Engineering 3.
Prerequisite: C or better in ISE/TE 110 and (MA 303 or MA 341 or MA 405) and C- or better in ST 371 or ST 370.
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 analysisof problems, capacity planning, inventory control, waiting lines, and system reliability and maintainability.

ISE 368 Control of Production and Service Systems 3.
Prerequisite: ISE 361; C- or better in ST 371.
Planning and control of production and service systems. Production organization flow and inventory control methods: Systems approach.

ISE 416 Manufacturing Engineering II - Automation 3.
Prerequisite: ISE 316.
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.

ISE 417 Database Applications in Industrial & Systems Engineering 3.
Prerequisite: C or better in ISE 110.
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.

ISE 441 Introduction to Simulation 3.
Prerequisite: MA 242, ST 372, C or better in ISE 110.
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.

ISE 443 Quality Design and Control 3.
Prerequisite: ST 372.
ISE 452 Advanced Human-Machine Systems Design 3.
Prerequisite: CE 214 and ISE 352.
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).

ISE 453 Design of Production, Logistics, and Service Systems 3.
Prerequisite: ISE 361 and ST 372; Corequisite: ISE 311.
Principles and practice in design of facilities and logistics networks. Integration of supply chain design, capacity planning, facility layout, material handling, and storage and warehousing issues into overall production system design. Emphasis on economic justification of alternative designs and use of computer software to aid design process. Group projects.

ISE 462 Advanced Stochastic Models in Industrial Engineering 3.
Prerequisite: ISE 362.
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.

ISE 495 Project Work in Industrial Engineering 1-6.
Prerequisite: Junior standing.
Special investigations, study or research related to the field of industrial engineering. In a given semester several students and/or student groups may be working in widely divergent areas under the direction of several members of the faculty.

ISE 498 Senior Design Project 3.
Prerequisite: 3 of the following 5 (ISE 311, ISE 452, ISE 408, ISE 441, ISE 453).
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.

ISE 501 Introduction to Operations Research 3.
Prerequisite: MA 421 or ST 421 or ST 371 and ST 372.
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.

ISE 505 Linear Programming 3.
Prerequisite: MA 405.
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.

ISE 510 Applied Engineering Economy 3.
Prerequisite: Undergrad. courses in engineering economics and ST.
Engineering economy analysis of alternative programs including tax and inflation aspects, sensitivity analysis, risk assessment, decision criteria. Emphasis on applications.

ISE 515 Manufacturing Process Engineering 3.
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.

ISE 519 Database Applications in Industrial and Systems Engineering 3.
Prerequisite: ISE 110.
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.

ISE 520 Healthcare Systems Performance Improvement I 3.
Prerequisite: ST 372, ISE 352, ISE 361, and ISE 441.
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.

ISE 521 Healthcare Systems Performance Improvement II 3.
Prerequisite: ISE 520.
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.

ISE 540 Human Factors In Systems Design 3.
Prerequisite: IE 452 or PSY 340, Corequisite: ST 507 or 515.
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.
ISE 541 Occupational Safety Engrg 3.

ISE 543 Musculoskeletal Mechanics 3.
Prerequisite: BIO 125 or BAE(BIO) 225 or Graduate standing. 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.

ISE 544 Occupational Biomechanics 3.

ISE 546 Management Decision and Control Systems 3.
Prerequisite: CSC 423 or BUS 541. 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.

ISE 553 Modeling and Analysis of Supply Chains 3.
Prerequisite: ISE 351 and ST 372. 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.

ISE 589 Special Topics In Industrial Engineering 3.
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.
Seminar discussion of industrial engineering problems for graduate students. Case analyses and reports.

ISE 610 Special Topics in Industrial Engineering 3.
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 1-6.
Independent study providing opportunity for individual students to explore topics of special interest under direction of a member of faculty.

ISE 639 Advanced Directed Study in Industrial Engineering 1-6.
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.

ISE 646 Research Practicum in Occupational Biomechanics 3.
Biomechanics research topic development, literature evaluation, experimental design, use of bioinstrumentation, data collection, basic data interpretation, statistical analysis, manuscript preparation.

ISE 677 Industrial Engineering Projects 1-6.
Prerequisite: MIE candidates. Investigation and written report on assigned problems germane to industrial engineering. Maximum of six credits to be earned for MIE degree.

ISE 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student. 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.

ISE 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student. 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.

ISE 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student. 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.

ISE 693 Master's Supervised Research 1-9.
Prerequisite: Master's student. Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student. 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. 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.

ISE 707 Real-Time Control of Automated Manufacturing 3.
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; multiprocessor systems; local area networks; inter-task communication; and development of multi-tasking control systems. Design development of control system.
ISE 708 Integer Programming 3.
Prerequisite: MA 405, OR (MA,IE) 505, Corequisite: Some familiarity with computers (e.g., CSC 112).
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 that should enable them to adapt ideas presented in course to integer programming problems they may encounter.

ISE 709 Dynamic Programming 3.
Prerequisite: MA 405, ST 421.
Introduction to theory and computational aspects of dynamic programming and its application to sequential decision problems.

ISE 711 Capital Investment Economic Analysis 3.
Prerequisites: ISE 311 and ST 371.
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 computers for capital budgeting.

ISE 712 Bayesian Decision Analysis For Engineers and Managers 3.
Prerequisite: ST 371 or ST 421.
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.

ISE 714 Product Manufacturing Engineering for the Medical Device Industry 3.
Prerequisite: ISE 515.
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.

ISE 715 Manufacturing Process Engineering 3.
Manufacturing process engineering, primary, secondary, finishing and assembly processes. Concurrent engineering, process planning, group technology, manufacturing analyses and application of economic analyses.

ISE 716 Automated Systems Engineering 3.
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.

ISE 718 Micro/Nano-Scale Fabrication and Manufacturing 3.
Prerequisite: ISE 316 or graduate standing in the college of engineering.
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.

ISE 723 Production Planning, Scheduling and Inventory Control 3.
Prerequisite: OR 501 and ST 511.
An analysis of Production-Inventory systems. Discussion of commonly used planning and scheduling techniques. Introduction to use of mathematical modeling for solution of planning and scheduling problems. Interface with quality control and information systems.

ISE 726 Theory of Activity Networks 3.
Prerequisite: OR 501, OR/IE,MA 505.
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.

ISE 731 Multi-Attribute Decision Analysis 3.

ISE 740 Engineering Psychology of Human-computer Interaction 3.
Prerequisite: IE/PSY 540 or CSC 554.
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.

ISE 741 Systems Safety Engineering 3.
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.

ISE 742 Environmental Stress, Physiology and Performance 3.

ISE 743 Ergonomic Performance Assessment 3.
Prerequisite: PSY 200, ST 507 and 508.
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.
ISE 744 Human Information Processing 3.
Prerequisite: PSY 200, ST 507 and 508.
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.

ISE 745 Human Performance Modeling 3.
Prerequisite: ST 507 or 515 or equivalent; IE (PSY) 540, CSC 554 or IE (PSY) 744.

ISE 747 Reliability Engineering 3.
Prerequisite: ST 511.
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 analysis of fault trees; analysis of Markovian and non-Markovian models; and optimization of reliability models.

ISE 748 Quality Engineering 3.
Prerequisite: OR 501, ST 511.
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.

ISE 750 Concurrent Engineering 3.
Approaches to concurrent engineering, concurrent engineering of printed wiring boards, design for testability, design for assembly, process selection, interface to feature-based computer-aided design systems, concurrent engineering of metal parts, concurrent engineering performance measurement, concurrent engineering and computer-integrated manufacturing.

ISE 754 Logistics Engineering 3.
Prerequisite: ISE 453.
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: MA 303, ST 371.
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.

ISE 761 Queues and Stochastic Service Systems 3.
Prerequisite: MA 421.
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.

ISE 762 Computer Simulation Techniques 3.
Prerequisite: ST 512 and a scientific programming language.
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.

ISE 766 Network Flows 3.
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.

ISE 767 Upper Extremity Biomechanics 3.
Gross and fine anatomy of upper extremity; properties of tendons and synovial fluid; epidemiology; disorders of shoulder, elbow, wrist, hands, fingers; 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.

ISE 768 Spine Biomechanics 3.
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.

ISE 772 Stochastic Simulation Design and Analysis 3.
Prerequisite: (CSC,ECE,IE,OR) 762 and ST 516.
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.

ISE 777 Concurrent Engineering 3.
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.

ISE 789 Advanced Special Topics In Industrial Engineering 3.
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.

ISE 790 Advanced Special Topics System Optimization 1-3.
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.

ISE 791 Advanced Special Topics in Manufacturing 1-3.
Advanced topics in some phase of manufacturing systems using traditional course format. Identification of various specific topics and prerequisites for each section from term to term.

ISE 793 Advanced Special Topics in Production 1-3.
Advanced topics in some phase of production systems using traditional course format. Identification of various specific topics and prerequisites for each section from term to term.
ISE 794 Advanced Problems in Ergonomics 1-3.
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.

ISE 796 Research Practicum in Occupational Biomechanics 1-3.
Biomechanics research topic development, literature evaluation, experimental design, use of bioinstrumentation, data collection, basic data interpretation, statistical analysis, manuscript preparation.

ISE 801 Seminar 1.
Seminars discussion of industrial engineering problems for graduate students. Case analyses and reports.

ISE 802 Area Seminar in Ergonomics 1.
Prerequisite: Graduate standing or PBS status.
Introduction to ergonomics as an area of study; historical aspects; contemporary issues; ethical questions; overview of campus research, facilities and courses in the area; consideration of information sources, financial support for research proposals and employment opportunities.

ISE 803 Seminar in Product Safety and Liability 1.
Prerequisite: Graduate standing.

ISE 804 Seminar in Applied Ergonomics 1.
Discussion of contemporary issues involving ergonomic approaches to design of work, products and systems. Survey of current ergonomics research and methodologies and their application to areas of faculty and student interest, such as: industrial ergonomics, occupational safety, manufacturing, transportation, computer systems and process control.

ISE 812 Special Topics in Mathematical Programming 1-3.
Prerequisite: IE(MA,OR) 505.
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 is 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.

ISE 815 Advanced Special Topics in Industrial Engineering 1-3.
Advanced topics in some phase of industrial engineering. Identification of various specific topics and prerequisites for each section from term to term.

ISE 816 Advanced Special Topics Sys Opt 1-3.
Advanced topics in some phase of system optimization. Identification of various specific topics and prerequisite for each section from term to term.

ISE 817 Advanced Special Topics Manufacturing 1-3.
Advanced topics in some phase of manufacturing systems. Identification of various specific topics and prerequisites for each section from term to term.

ISE 818 Advanced Special Topics Production 1-3.
Advanced topics in some phase of production systems. Identification of various specific topics and prerequisites for each section from term to term.

ISE 837 Directed Study in Industrial Engineering 1-6.
Independent study providing opportunity for individual students to explore topics of special interest under direction of a member of faculty.

ISE 839 Advanced Directed Study in Industrial Engineering 1-6.
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.

ISE 861 The Design of Production Systems 1-3.
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.

ISE 877 Industrial Engineering Projects 1-6.
Prerequisite: MIE candidates.
Investigation and written report on assigned problems germane to industrial engineering. Maximum of six credits to be earned for MIE degree.

ISE 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

ISE 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation Research.

ISE 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

LAR - Landscape Architecture Courses

LAR 200 Landscape Architecture Introductory Studio 6.
Prerequisite: Design Majors and D 104.
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.
LAR 210 Digital Drawing for Landscape Architecture 3.
Prerequisite: LAR Majors.
Digital modeling and computer aided design in landscape architecture. Integration of digital data in visualization of past, existing and future designs.

LAR 211 Digital Design Media for Landscape Architecture 3.
Prerequisite: LAR Majors.
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.

LAR 221 Introduction to Environment and Behavior for Designers 3.
Integration of behavioral and environmental systems related to design. Exploration of humane, ecologically sound design alternatives.

LAR 222 Perception and Behavior for Designers 3.
Perceptual systems, linkages among them, and linkages between them and language and culture as these affect the design process.

LAR 292 Special Topics in Landscape Architecture 1-3.
Topics of current interest in Landscape Architecture. Normally used to develop new courses.

LAR 400 Landscape Architecture Studio 6.
Prerequisite: D 105, LAR 200, or Departmental Head Approval.
Projects cover small scale design, urban landscapes, community design, and environmental management. Design process stressed, including attention to project organization, design synthesis and realization.

LAR 430 Site Planning 3.
Prerequisite: LAR 400 or LAR 501.
Technical operations and environmental landscape controls for site development. Site analysis, grading and drainage, earthwork, horizontal and vertical control for road alignment. Graphic exercises.

LAR 444 History of Landscape Architecture 3.
The history of designed landscapes. Environmental, social and cultural factors which influence human made landscapes presented with history and art of landscape architecture.

LAR 457 Landscape Construction Materials, Methods and Documentation 3.
Prerequisite: LAR 400 or LAR 502.
Materials, standards, and construction methods used to implement landscape architectural designs. Development of construction documents.

Prerequisite: Junior Standing in the College of Design and Approval of the International Study Abroad Office.
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.

LAR 492 Special Topics in Landscape Architecture 1-3.
Topics of current interest in Landscape Architecture. Normally used to develop new courses.

LAR 494 Internship in Landscape Architecture 1-3.
Prerequisite: Junior standing in Landscape Architecture; 3.0 GPA or better.
Supervised field experience in landscape architecture office, related design office, or governmental agency. Students work in an office or agency for up to 12 hours per week. A daily work journal and a final paper summarizing the work experience are required.

LAR 495 Independent Study in Landscape Architecture 1-3.
Prerequisite: Junior standing in Landscape Architecture 3.0 GPA or better.
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 completed by the student and faculty member prior to registration by the department.

LAR 500 Landscape Design Studio 6.
Prerequisite: Graduate standing.
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 towns and neighborhoods.

Prerequisite: MLA Majors.
Introduction of basic design and landscape architecture concepts through design problems, discussions, and readings.

LAR 502 Landscape Description Studio 6.
Prerequisite: LAR 501.
Describing landscapes by systematically analyzing their natural and cultural systems and experiential qualities to comprehensively define design problems and inform design decisions. Individual and team work on small to large-scale projects in urban and non-urban settings. Reading, writing, site observation, precedent study, user input, and participatory activities. Exploring ethical issues and how other (creative) people describe and use landscapes.

LAR 503 Landscape Architecture Construction Studio 6.
Prerequisite: BLA Majors or MLA Majors.
Studio integrates construction issues into the design experience. Involves visits to built sites, construction sites, and construction manufacturing companies.

LAR 505 Landscape Architecture Final Project Studio 6.
Individual semester long projects demonstrating capabilities in a full range of design and production skills.

LAR 510 Graphics for Landscape Architects 3.
Prerequisite: Graduate standing, Corequisite: LAR 500.
A series of demonstrations and exercises to give students exposure to and experience with conventional techniques of graphic representation and presentation.

LAR 511 Community Design Policy 3.
Prerequisite: Graduate standing.
Exploration of theory and practices of social policy impact on designed environment and users of that environment. Study of public community development process studied in relation to built environment.
LAR 521 Values, Theory and Methods of Landscape Architecture 3.  
Prerequisite: Graduate standing. 
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.

LAR 522 Research Methods and Final Project Development 3.  
Explores future career paths, introduces methods of critical inquiry, critique, and research in landscape architecture.

LAR 565 International Landscape Architecture Design Studio 6.  
Prerequisite: Graduate standing the College of Design and approval of the International Study Abroad Office.  
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.

LAR 576 Community Design 3.  
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.

LAR 577 Sustainable Communities 3.  
Prerequisite: Graduate standing, Master's student in the School of Design or Department of City and Regional Planning (UNC-Chapel Hill).  

LAR 578 Ecological Design 3.  
Prerequisite: Graduate standing, Master's student in the School of Design or Department of City and Regional Planning (UNC-Chapel Hill).  
An integrative approach to human and natural systems. Ecological scale, function, spatial structure, and human-ecosystem interaction will be examined through case studies at a variety of scales. Ecological concepts will be linked to design and planning principles.

LAR 579 Human Use of the Urban Landscape 3.  
Prerequisite: Graduate standing, Master's student in the School of Design or Department of City and Regional Planning (UNC-Chapel Hill).  
Techniques for documenting and analyzing user needs at site planning scale. Methods of integrating user needs into design programming in design and redesign projects. Community participation methods. Examples of best practice in design of user-intensive settings in residential, health, education, and recreation. Principles of Universal Design. Fieldwork oriented.

LAR 582 Special Topics In Landscape Architecture 1-3.  
Prerequisite: Graduate standing.  
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.

LAR 630 Independent Study 1-6.  
Prerequisite: Graduate standing.  
Special problems in various aspects of design developed under direction of a faculty member on a tutorial basis.

LAR 679 Final Project Studio In Landscape Architecture 1-6.  
Prerequisite: LAR 697.  
Graduate students sufficiently prepared may undertake selected research investigations. A proposal for such investigations must be submitted prior to consent for enrollment.

LAR 685 Master's Supervised Teaching 1-3.  
Prerequisite: Master's student.  
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.

LAT - Foreign Language - Latin Courses

LAT 101 Elementary Latin I 3.  
Beginning course in Classical Latin, emphasizing elementary grammatical form and basic syntax. Readings based on brief selections from Roman authors, including Cicero and Catullus.

LAT 102 Elementary Latin II 3.  
Continuation of Latin 101. Completion of the study of elementary grammar. Readings from a variety of Latin authors, including texts on mythological themes.
LAT 201 Intermediate Latin I 3.
Prerequisite: LAT 102.
Introduction to Latin prose and poetry. Emphasis on increased reading skill. Review of grammar fundamentals and exposure to new and more complex syntax. Examination of cultural significance of readings.

LAT 202 Intermediate Latin II 3.
Prerequisite: LAT 201.
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.

LAT 399 Directed Readings in Latin 3.
Prerequisite: LAT 202.
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.

LOG - Logic Courses

LOG 201 Logic 3.

LOG 335 Symbolic Logic 3.
Prerequisite: LOG 201 or MA 225.
Introduction to modern symbolic logic; the concept of proof, mathematical induction, recursion and the relationship between formal and informal theories (examples: group theory, Peano arithmetic). The Gödel Theorems and the mathematical study of logic.

LOG 435 Advanced Logic & Metamathematics 3.
Prerequisite: LOG 335. Credit is not allowed for both LOG 435 and LOG 535.
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.

LOG 437 Model Theoretic Semantics 3.
Prerequisite: LOG 201 or MA 225.
Introduction to model-theoretic semantics and its applications in logic, foundations of mathematics, philosophy, and computer science. No can receive credit for LOG 437 & 537.

LOG 535 Advanced Logic and Metamathematics 3.
Prerequisite: Graduate standing (but the essential requirement is the mathematical sophistication requisite in a graduate mathematics course. Examples: MA 403, MA 408, MA 410, MA/CSC 416, MA 421, MA 425, CSC 333, CSC 417). Credit is not allowed for LOG 535 & 435.
No one may receive credit for both LOG 435 and LOG 535. 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. Successful completion of mathematics or computer science courses that emphasize proofs, particularly at the 400 level as evidence of requisite.

LOG 537 Model Theoretic Semantics 3.
Prerequisite: Graduate standing and one of the following courses: MA/LOG 335, LOG 435, one MA or CSC course at the 400-level or above. Credit is not allowed for both LOG 537 and LOG 437.
This course is an introduction to the fundamental concepts and methods of model-theoretic semantics and its applications in logic, foundations of mathematics, philosophy, and computer science. No can receive credit for both LOG 437 and LOG 537.

LOG 598 Special Topics in Logic 1-6.
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.

LPS - Leadership in the Public Sector Courses

LPS 200 Introduction to Public Leadership 3.
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.

LPS 201 The Humanitarian Response to Conflict 3.
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 increasingly in the present, there is an intersection between military and humanitarian operations in conflict zones.

LPS 202 Essentials of Fundraising for Leaders in Public and Non-Profit Institutions 3.
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.

LPS 205 International Leadership for the Public Sector 3.
LPS 315 Public Leadership
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 drawing on literature in political science, self-assessment of student's leadership characteristics and examination of outlets for political leadership activity.

LPS 320 Research Methodology for the Public Sector
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.

LPS 400 Advanced Military Leadership Theory
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.

LPS 425 Leadership in the Public & Nonprofit Sectors Capstone
Prerequisite: LPS Majors need to have passed LPS 200.
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.

LPS 490 Undergraduate Internship in Leadership in the Public Sector 1-3
Prerequisite: LPS 200.
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 internship proposal. Students must provide own transportation for internship. Intern liability insurance is required.

LSC - Life Sciences First Year Courses

LSC 101 Critical and Creative Thinking in the Life Sciences
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).

LSC 103 Exploring Opportunities in the Life Sciences
R: 11LSFY or 17LSFY.
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.

LSC 170 First Year Seminar in the Life Sciences
R: 11LSFY or 17LSFY.
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.

LSC 295 Special Topics in Life Science 1-3.
R: 11LSFY or 17LSFY.
New courses offered on a temporary or trial basis for Life Sciences First Year students.

M - Management Courses

M 100 Professionalism, Diversity, and Academic Success in Management
Introduction to expectations and opportunities in the College of Management. Overview of curricula, academic requirements, and career opportunities in business administration, accounting, and economics. Discussion of expectations for academics and career success including professionalism, diversity, and inclusiveness. Overview resources and support services.

M 298 Special Topics in Management 1-6.
Presentation of material normally not available in regular course offering.
M 300 Leadership and Professional Development.
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.

MA - Mathematics Courses

MA 101 Intermediate Algebra
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.

MA 103 Topics in Contemporary Mathematics
Prerequisite: MA 101 or equivalent completed in high school.
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.

MA 103A Topics in Contemporary Mathematics
AG1 Only and MAA 102.
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.

MA 105 Mathematics of Finance
Prerequisite: MA 101 or equivalent completed in high school.
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.

MA 107 Precalculus I
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.. 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.

MA 111 Precalculus Algebra and Trigonometry
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.. 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.

MA 108 Precalculus II
Prerequisite: C- or better in MA 107.
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.

MA 114 Introduction to Finite Mathematics with Applications
Prerequisite: MA 101 or equivalent completed in high school.
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.

MA 116 Introduction to Scientific Programming (Math)
Prerequisite: MA 141, and either COS 100 or E 115; Corequisite: MA 241.
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. Prerequisites: MA 141 and either PMS 100 or E115. Corequisite: MA 241.

MA 121 Elements of Calculus
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.

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.

MA 131 Calculus for Life and Management Sciences
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.

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.

MA 132 Computational Mathematics for Life and Management Sciences
Prerequisite: C- or better in MA 121 or MA 131.
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.
MA 141 Calculus I 4.
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.
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.

MA 151 Calculus for Elementary Education I 3.
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.
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.

MA 152 Calculus for Elementary Education II 3.
Prerequisite: MA 151.
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.

MA 205 Elements of Matrix Computations 3.
Prerequisite: C- in MA 121, 131, or 141.
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 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.

MA 225 Foundations of Advanced Mathematics 3.
Prerequisite: MA 241.
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.

MA 231 Calculus for Life and Management Sciences B 3.
Prerequisite: MA 131 or MA 141; Credit is not allowed for both MA 231 and MA 241.
Differential equations - population growth, flow processes, finance and investment models, systems; functions of several variables - partial derivatives, optimization, least squares, multiple integrals; Lagrange multiplier method - chain rule, gradient; Taylor polynomials and series; numerical methods. MA 121 is not an accepted prerequisite for MA 231.

MA 241 Calculus II 4.
Prerequisite: MA 141 with grade of C- or better or AP Calculus credit. Credit is not allowed for both MA 241 and MA 231.
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.

MA 242 Calculus III 4.
Prerequisite: MA 241 with grade of C- or better or AP Calculus credit, or Higher Level IB credit.

MA 293 Special Topics in Mathematics 1-6.
Freshman-sophomore level experimental course offerings or directed individual study.

MA 302 Numerical Applications to Differential Equations 1.
Prerequisite: MA 241.
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.

MA 303 Linear Analysis 3.
Prerequisite: MA 241.
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.

MA 305 Introductory Linear Algebra and Matrices 3.
Prerequisite: MA 241 or MA 231 with MA 132.
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.

MA 306 College Geometry 3.
Prerequisite: MA 225.

Prerequisite: MA 116, MA 141, MA 241; Corequisite: MA 242.
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.
MA 325 Introduction to Applied Mathematics 3.
Prerequisite: (MA 231 or MA 242) and (MA 116 or CSC 112 or CSC 114 or CSC 116).
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.

MA 331 Differential Equations for the Life Sciences 3.
P: MA 231 or MA 241; X: Credit.
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 which automates and simplifies the process of modeling biological systems. Credit cannot be given for both MA 341 and MA 331.

MA 335 Symbolic Logic 3.
Introduction to modern symbolic logic; the concept of proof, mathematical induction, recursion and the relationship between formal and informal theories (examples: group theory, Peano arithmetic). The Godel Theorems and the mathematical study of logic.

Prerequisite: MA 242 or (MA 132 and MA 231).

MA 351 Introduction to Discrete Mathematical Models 3.
Prerequisite: MA 224, 225, 231 or 241.
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.

MA 401 Applied Differential Equations II 3.
Prerequisite: MA 341; Credit not allowed for both MA 401 and MA 501.
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.

P: (MA 341 or MA 405) and programming proficiency (MATLAB, C++, Java, Fortran, or other language).
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.

MA 403 Introduction to Modern Algebra 3.
Prerequisite: MA 225.
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.

MA 405 Introduction to Linear Algebra 3.
Prerequisite: MA 241 (MA 225 recommended); Corequisite: MA 341 is recommended.
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 225 and MA 405.
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.

MA 408 Foundations of Euclidean Geometry 3.
Prerequisite: MA 225.
An examination of Euclidean geometry from a modern perspective. The axiomatic approach with alternative possibilities explored using models.

MA 410 Theory of Numbers 3.
Prerequisite: One year of calculus.
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.

MA 412 Long-Term Actuarial Models 3.
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.
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.

MA 413 Short-Term Actuarial Models 3.
Prerequisite: MA 241 or MA 231, and one of MA 421, ST 301, ST 305, ST 370, ST 371, ST 380, ST 421...
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.

MA 416 Introduction to Combinatorics 3.
Prerequisite: MA 225 or CSC 226.
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.
MA 421 Introduction to Probability 3.
Prerequisite: MA 242.
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.

MA 425 Mathematical Analysis I 3.
Prerequisite: MA 225 (MA 407 desirable).
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.

MA 426 Mathematical Analysis II 3.
Prerequisite: MA 425 and 405.
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.

MA 427 Introduction to Numerical Analysis I 3.
Prerequisite: MA 341 or 301 and programming language efficiency.
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.

MA 428 Introduction to Numerical Analysis II 3.
Prerequisite: MA 405 or MA 305 and programming language proficiency.
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.

MA 430 Mathematical Models in the Physical Sciences 3.
Prerequisite: MA 341 and MA 405.
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.

MA 432 Mathematical Models in Life and Social Sciences 3.
Prerequisite: MA 341, (MA 305 or MA 405), and programming proficiency; Corequisite: (MA 421 or ST 371).
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).

MA 433 History of Mathematics 3.
Prerequisite: One year of calculus.
Development of mathematical thought and evolution of mathematical ideas examined in a historical setting. Biographical and historical content supplemented and reinforced by study of techniques and procedures used in earlier eras.

MA 437 Applications of Algebra 3.
Prerequisite: MA 403 or 407, MA 405.
Error correcting codes, cryptography, crystallography, enumeration techniques, exact solutions of linear equations, and block designs.

MA 440 Game Theory 3.
Prerequisite: MA 231 or MA 242.
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.

MA 444 Problem Solving Strategies for Competitions 1.
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.

MA 450 Methods of Applied Mathematics I 3.
Prerequisite: MA 341.
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.

MA 451 Methods of Applied Mathematics II 3.
Prerequisite: MA 341.
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.

MA 491 Reading in Honors Mathematics 1-6.
Prerequisite: Membership in honors program.
A reading (independent study) course available as an elective for students participating in the mathematics honors program.

MA 493 Special Topics in Mathematics 1-6.
Directed individual study or experimental course offerings.

MA 494 Major Paper in Math 1.
Corequisite: MA class at the 400-level or above.
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.

MA 499 Independent Research in Mathematics 1-6.
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.

MA 501 Advanced Mathematics for Engineers and Scientists I 3.
Prerequisite: MA 341; credit not allowed for both MA 501 and MA 401.
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.

MA 502 Advanced Mathematics for Engineers and Scientists II 3.
Prerequisite: MA 341.
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, atmost, one of the following: MA 405, MA 512, MA 513.
MA 504 Introduction to Mathematical Programming 3.  
Prerequisite: MA 242, MA 405.  
Basic concepts of linear, nonlinear and dynamic programming theory. Not for majors in OR at Ph.D. level.

MA 505 Linear Programming 3.  
Prerequisite: MA 405.  
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.

MA 507 Analysis For Secondary Teachers 3.  
Prerequisite: Graduate standing.  
A course to update and broaden secondary teacher's capability and point-of-view with respect to topics in analysis. Historical development, logical refinement and applications of concepts such as limits, continuity, differentiation and integration. May be taken for graduate credit for certificate renewal by secondary school teachers. Credit towards graduate degree may be allowed only for students in mathematics education.

MA 508 Geometry For Secondary Teachers 3.  
Prerequisite: Graduate standing.  
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.

MA 509 Abstract Algebra For Secondary Teachers 3.  
Prerequisite: Graduate standing.  
From advanced viewpoint, an investigation of topics in algebra from high school curriculum. Theory of equations, polynomial rings, rational functions and elementary number theory. Course may be taken for graduate credit for certificate renewal by secondary school teachers. Credit towards a graduate degree may be allowed only for students in mathematics education.

MA 510 Selected Topics In Mathematics For Secondary Teachers 3.  
Prerequisite: Graduate standing.  
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 certificate renewal by secondary school teachers. Credit towards a graduate degree may be allowed only for students in mathematics education.

MA 511 Advanced Calculus I 3.  
Prerequisite: MA 341.  
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.

MA 512 Advanced Calculus II 3.  
Prerequisite: MA 341.  
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.

MA 513 Introduction To Complex Variables 3.  
Prerequisite: MA 242.  
Operations with complex numbers, derivatives, analytic functions, integrals, definitions and properties of elementary functions, multivalued functions, power series, residue theory and applications, conformal mapping.

MA 515 Analysis I 3.  
Prerequisite: MA 426.  

MA 518 A First Course in Differential Geometry 3.  
Prerequisite: MA 405 and proficiency in multivariable calculus.  
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.

MA 520 Linear Algebra 3.  
Prerequisite: MA 405.  

MA 521 Abstract Algebra I 3.  
Prerequisite: MA 405 and MA 407.  
Groups, normal subgroups, quotient groups, Cayley's theorem, Sylow's theorem. Rings, ideals and quotient rings, polynomial rings. Elements of field theory.

MA 522 Computer Algebra 3.  
Prerequisite: MA 407 or MA 521 and MA 405 or MA 520.  
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.

MA 523 Linear Transformations and Matrix Theory 3.  
Prerequisite: MA 405.  
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.

MA 524 Combinatorics I 3.  
Prerequisite: MA 405 and MA 407.  
Enumerative combinatorics, including placements of balls in bins, the twelvelofold way, inclusion/exclusion, sign-reversing involutions and lattice path enumeration. Partially ordered sets, lattices, distributive lattices, Moebius functions, and rational generating functions.

MA 526 Algebraic Geometry 3.  
Prerequisite: MA 521.  
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.
MA 531 Dynamic Systems and Multivariable Control I 3.  
Prerequisite: MA 341, MA 405.  
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.

MA 532 Ordinary Differential Equations I 3.  
Prerequisite: MA 341, 405, 425 or 511, Corequisite: MA 426 or 512.  
Existence and uniqueness theorems, systems of linear equations, fundamental matrices, matrix exponential, nonlinear systems, plane autonomous systems, stability theory.

MA 534 Introduction To Partial Differential Equations 3.  
Prerequisite: MA 425 or MA 511, MA 341, Corequisite: MA 426 or 512.  

MA 537 Nonlinear Dynamics and Chaos 3.  
Prerequisite: MA 341 and MA 405.  
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.

MA 540 Uncertainty Quantification for Physical and Biological Models 3.  
Prerequisite: MA 341 and basic knowledge of probability, linear algebra, and scientific computation.  
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.

MA 544 Computer Experiments In Mathematical Probability 3.  
Prerequisite: MA 421.  
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.

MA 546 Probability and Stochastic Processes I 3.  
Prerequisite: MA 421 and MA 425 or MA 511.  
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, erodicty, conditional expectations, continuous-time Markov chains, laws of large numbers, central limit theorem and large deviations.

MA 547 Financial Mathematics 3.  
Prerequisite: MA(ST) 546.  

Prerequisites: (MA 421 or ST 421), MA 341, and MA 405.  
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.

MA 549 Financial Risk Analysis 3.  
Prerequisites: MA 405 and (MA 421 or ST 421) and (MA/ST 412 or MA/ST 413).  
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 backtest and stress-test models.

MA 551 Introduction to Topology 3.  
Prerequisite: MA 426.  
Set theory, topological spaces, metric spaces, continuous functions, separation, cardinality properties, product and quotient topologies, compactness, connectedness.

MA 555 Introduction to Manifold Theory 3.  
Prerequisite: MA 426 or MA 512.  
(See MA - Mathematics.).

Prerequisite: MA 407.  
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.

MA 565 Graph Theory 3.  
Prerequisite: CSC 224 or MA 351.  
MA 573 Mathematical Modeling of Physical and Biological Processes I 3.
Prerequisite: MA 341 and knowledge of high-level programming language.
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.

MA 574 Mathematical Modeling of Physical and Biological Processes II 3.
Prerequisite: MA/BMA 573.
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.

MA 580 Numerical Analysis I 3.
Prerequisite: MA 405; MA 425 or MA 511; high-level computer language. 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.

MA 583 Introduction to Parallel Computing 3.
Prerequisite: CSC 302 or MA 402 or MA/CSC 428 or MA/CSC 580. 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: MA 501; knowledge of a high level programming language. 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. 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.

MA 591 Special Topics 1-6.

MA 676 Master's Project 3.
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 written and oral report on the project required.

MA 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

MA 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

MA 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

MA 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

MA 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis Research.

Prerequisite: Master's student.
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.
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.

MA 706 Nonlinear Programming 3.
Prerequisite: OR/IE/MA 505 and MA 425.
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 attention directed toward current research and recent developments in the field.

MA 708 Integer Programming 3.
Prerequisite: MA 405, OR (MA,IE) 505, Corequisite: Some familiarity with computers (e.g., CSC 112).
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 that should enable them to adapt ideas presented in course to integer programming problems they may encounter.
MA 715 Analysis II 3.
Prerequisite: MA 515.

MA 716 Advanced Functional Analysis 3.
Prerequisite: MA 715.
Advanced topics in functional analysis such as linear topological spaces; Banach algebra, spectral theory and abstract measure theory and integration.

MA 719 Vector Space Methods in System Optimization 3.
Prerequisite: MA 405, 511.
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.

MA 720 Lie Algebras 3.
Prerequisite: MA 520, MA 521.

MA 721 Abstract Algebra II 3.
Prerequisite: MA 521.
Field extensions, Galois theory, modules, tensor products, exterior products.

MA 722 Computer Algebra II 3.
Prerequisite: MA 522.
Effective algorithms for symbolic matrices, commutative algebra, real and complex algebraic geometry, and differential and difference equations. The emphasis is on the algorithmic aspects.

MA 723 Theory of Matrices and Applications 3.
Prerequisite: MA 520 or 523.
Canonical forms, functions of matrices, variational methods, perturbation theory, numerical methods, nonnegative matrices, applications to differential equations, Markov chains.

MA 724 Combinatorics II 3.
Prerequisite: MA 524.
Polytopes(V-polytopes and H-polytopes). Fourier-Motzkin elimination, Farkas Lemma, face numbers of polytopes, graphs of polytopes, linear programming for geometors, Balinski's Theorem, Steiniz' Theorem, Schlegel diagrams, polyhedral complexes, shellability, and face rings.

MA 725 Lie Algebra Representation Theory 3.
Prerequisite: MA 720.

MA 731 Dynamic Systems and Multivariable Control II 3.
Prerequisite: MA 531.

MA 732 Ordinary Differential Equations II 3.
Prerequisite: MA 532, Corequisite: MA 515.
Existence-uniqueness theory, periodic solutions, invariant manifolds, bifurcations, Fredholm's alternative.

MA 734 Partial Differential Equations 3.
Prerequisite: MA 534, Corequisite: MA 515.

MA 746 Introduction To Stochastic Processes 3.
Prerequisite: MA 405 and MA(ST) 546 or ST 521.
Markov chains and Markov processes, Poisson process, birth and death processes, queuing theory, renewal theory, stationary processes, Brownian motion.

MA 747 Probability and Stochastic Processes II 3.
Prerequisite: MA(ST) 546.
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.

MA 748 Stochastic Differential Equations 3.
Prerequisite: MA(ST) 747.

MA 753 Algebraic Topology 3.
Prerequisite: MA 551.
Homotopy, fundamental group, covering spaces, classification of surfaces, homology and cohomology.

MA 755 Introduction To Riemannian Geometry 3.
Prerequisite: MA 555.
Tensor algebra on vector spaces and tensor fields on manifolds; Koszul connections; parallel transport; torsion and curvature of connections; the Bianchi identities; metric tensor fields; metric and Levi-Civita connections; the Riemannian curvature, Ricci and Einstein tensors. Special topics: general relativity, embedding theory, integration on manifolds, the Gauss-Bonnet theorem, De Rahm cohomology.

MA 766 Network Flows 3.
Prerequisite: OR(IE,MA) 505.
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.
MA 771 Biomathematics I 3.
Prerequisite: Advanced calculus, reasonable background in biology.
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.

MA 772 Biomathematics II 3.
Prerequisite: BMA 771, elementary probability theory.
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, Lyapunov 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.

MA 773 Stochastic Modeling 3.
Prerequisite: BMA 772 or ST (MA) 746.

Prerequisite: BMA 771 or MA/OR 731; BMA 772 or MA 401 or MA 501.

MA 778 Measure Theory and Advanced Probability 3.
Prerequisite: MA 426; ST 521 or MA(ST) 546.

MA 779 Advanced Probability 3.
Prerequisite: MA 425 and ST 521.
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.

MA 780 Numerical Analysis II 3.
Prerequisite: MA 580.
Approximation and interpolation, Fast Fourier Transform, numerical differentiation and integration, numerical solution of initial value problems for ordinary differential equations.

MA 784 Nonlinear Equations and Unconstrained Optimization 3.
Prerequisite: MA 580.

MA 785 Numerical Solution of Ordinary Differential Equations 3.
Prerequisite: MA 511 or 512.
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 405 or 520 and MA 501 or 534; knowledge of a high level programming language.
Nonlinear discrete equations; Newton and monotone methods for nonlinear equations; computational algorithms and applications; finite difference methods; convergence, stability and error estimates; multiplicity of solutions and bifurcation; asymptotic behavior of solutions; and coupled systems of equations.

MA 790 Advanced Special Topics System Optimization 1-3.
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.

MA 791 Special Topics In Real Analysis 1-6.

MA 792 Special Topics In Algebra 1-6.

MA 793 Special Topics In Differential Equations 1-6.

MA 795 Special Topics In Topology 1-6.

MA 796 Special Topics In Combinatorial Analysis 1-6.

MA 797 Special Topics In Applied Mathematics 1-6.

MA 798 Special Topics In Numerical Analysis 1-6.

MA 810 Special Topics 1-3.

MA 812 Special Topics In Mathematical Programming 1-3.
Prerequisite: IE(MA,OR) 505.
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.

MA 816 Advanced Special Topics Sys Opt 1-3.
Advanced topics in some phase of system optimization. Identification of various specific topics and prerequisite for each section from term to term.
MA 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

MA 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation Research.

MA 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

MAA - Math in Agriculture and Related Sciences Courses

MAA 102 Mathematics in Agriculture and Related Sciences 3.
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.

MAE - Mechanical Aerospace Engr Courses

MAE 206 Engineering Statics 3.
Prerequisite: Cumulative GPA 2.5 or higher and a grade of C or better in both MA 241 and PY 205.
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.

MAE 208 Engineering Dynamics 3.
Prerequisite: 2.5 GPA or higher, MA 242, C- or better in MAE 206 or CE 214.
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.

MAE 250 Introduction to Aerospace Engineering 1.
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.

MAE 251 Aerospace Vehicle Performance 3.
Prerequisite: Cumulative GPA 2.5 or higher and a grade of C or better in both MA 241 and PY 205.

MAE 252 Aerodynamics I 3.
Prerequisite: MAE 251 and (MA 341 or MA 301).
Fundamentals of perfect fluid theory with applications to incompressible flows over airfoils, wings, and flight vehicle configurations.

MAE 253 Experimental Aerodynamics I 1.
Prerequisite: (MA 341 or MA 301) and C- or better in MAE 261; Corequisite: MAE 355.
Subsonic wind tunnel, instrumentation, data acquisition techniques, technical report preparation. Experiments involve pressure and force/moment measurements of various aerospace vehicle components with supplemental flow visualization.

MAE 301 Engineering Thermodynamics I 3.
Prerequisite: MA 242, PY 208 or 202.
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 analysis of basic power cycles is introduced.

MAE 302 Engineering Thermodynamics II 3.
Prerequisite: CSC 112 or CSC 114, C- or better in MAE 301.
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.

MAE 305 Mechanical Engineering Laboratory I 1.
Prerequisite: C- or better in MAE 208 or CE 215.
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.).

MAE 306 Mechanical Engineering Laboratory II 1.
Prerequisite: MAE 305, Corequisite: MAE 310.
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).
MAE 308 Fluid Mechanics 3.
Prerequisite: MA 242, (C- or better in MAE 208 or CE 215). Corequisite: (MA 341 or MA 301) and (MAE 301 or MSE 301).
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.

MAE 310 Heat Transfer Fundamentals 3.
Prerequisite: (MA 341 or MA 301), C- or better in MAE 301. Corequisite: MAE 308.
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 heat transfer relations relevant to mechanical engineers. Heat transfer by the mechanism of radiation heat transfer.

MAE 314 Solid Mechanics 3.
Prerequisite: MA 242, C- or better in (MAE 206 or CE 214). Corequisite: (MSE 200 or MSE 201, or BME 203, or BAE 315).

MAE 315 Dynamics of Machines 3.
Prerequisite: MA 341, C- or better in MAE 208 or CE 215.
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.

MAE 316 Strength of Mechanical Components 3.
Prerequisite: ME, AE, or NE Majors, C- or better in MAE 314 or CE 313.
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.

MAE 351 Aerodynamics II 3.
Prerequisite: MAE 252, C- or better in MAE 301.
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.

MAE 352 Experimental Aerodynamics II 1.
Prerequisite: MAE 253, Corequisite: MAE 351.
Advanced stability and control experiments in the subsonic wind tunnel and external compressible flow experiments in the supersonic wind tunnel.

MAE 361 Dynamics & Controls 3.
Prerequisite: (MA 341 or MA 301), and C- or better in (MAE 208 or CE 215).
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 by root-locus, Nyquist, Bode plots, servo-mechanisms, gain and phase margin, and compensation. Control system design emphasized.

MAE 371 Aerospace Structures I 3.
Prerequisite: C- or better in MAE 251 and (MAE 314 or CE 313).
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.

MAE 372 Aerospace Vehicle Structures Lab 1.
Corequisite: MAE 371.
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.

MAE 403 Air Conditioning 3.
Prerequisite: MAE 302, MAE 310, MAE 308.

MAE 405 Controls Lab 1.
Prerequisite: (MAE 306 or C- or better in MAE 261); Corequisite: (MAE 461 or MAE 435).
Laboratory experiments demonstrate the essential features of classical and modern control theory for single-input and single-output systems.

Prerequisite: MAE 302, MAE 310.
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.

MAE 407 Steam and Gas Turbines 3.
Prerequisite: MAE 302 and (MAE 308 or MAE 252).
Fundamental analysis of the theory and design of turbomachinery flow passages; control and performance of turbomachinery; gas-turbine engine processes.

MAE 408 Internal Combustion Engine Fundamentals 3.
Prerequisite: MAE 302.

MAE 410 Modern Manufacturing Processes 3.
Prerequisite: MAE 316 or MAE 371.
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, micro-fabrication, 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.
MAE 412 Design of Thermal System.  
Prerequisite: MAE 302, MAE 308, MAE 310.  
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.

MAE 415 Analysis for Mechanical Engineering Design.  
Prerequisite: MAE 315 and (MAE 316 or MAE 371).  
Integration of the physical sciences, mathematics, and engineering to solve real-world design problems. 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. Formal written communication of results.

MAE 416 Mechanical Engineering Design.  
Prerequisite: MAE 415.  
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.

MAE 421 Design of Solar Thermal Systems.  
Prerequisite: MAE 302, MAE 310.  

MAE 430 Applied Finite Element Analysis.  
Prerequisite: MAE 301 and (MAE 316 or MAE 371).  
Finite element modeling techniques for solving real-world engineering problems are discussed. Theory of finite element discretization is highlighted following 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.

MAE 435 Principles of Automatic Control.  
Prerequisite: (MA 341 or MA 301) and MAE 315.  
Study of linear feedback control systems using transfer functions. Transient and steady state responses. Stability and dynamic analyses using time response and frequency response techniques. Compensation methods. Classical control theory techniques for determination and modification of the dynamic response of a system. Synthesis and design applications to typical mechanical engineering control systems. Introduction to modern control theory.

MAE 440 Non-Destructive Testing and Evaluation.  
Prerequisite: MAE 302, MAE 308, MAE 315, MAE 316.  
Fundamental aspects of automotive engineering. Examines various automotive systems (engine, brakes, etc.) as well as their interactions in such areas as safety and performance. Current practices and development for the future.

MAE 442 Automotive Engineering.  
Prerequisite: MAE 302, MAE 308, MAE 315, MAE 316.  
Fundamental aspects of automotive engineering. Examines various automotive systems (engine, brakes, etc.) as well as their interactions in such areas as safety and performance. Current practices and development for the future.

MAE 451 Experimental Aerodynamics III.  
Prerequisite: MAE 352, Corequisite: MAE 455, MAE 458.  
Laboratory experiments in internal compressible flow and boundary layers in conjunction with MAE 455 and MAE 475. Topics include nozzle flows, constant area duct flows, component/overall performance of a gas turbine, and boundary layer analysis.

MAE 452 Aerodynamics of V/STOL Vehicles.  
Prerequisite: MAE 351, C- or better in MAE 301.  

MAE 455 Boundary Layer Theory.  
Prerequisite: MAE 351.  
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.

MAE 456 Computational Methods in Aerodynamics.  
Prerequisite: MAE 351, Corequisite: MAE 455.  
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.

MAE 457 Flight Vehicle Stability and Control.  
Prerequisite: (MAE 461 or MAE 445) and C- or better in MAE 261..  
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.

MAE 458 Propulsion.  
Prerequisite: MAE 351, C- or better in MAE 301.  
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.

MAE 459 Rocket Propulsion.  
Prerequisite: MAE 351 or MAE 302.  
Study of chemical rockets. This includes nozzle theory, flight performance, thermochemical calculations, and component and system analysis and design.
MAE 467 Introduction to Space Flight 3.
Prerequisite: (MA 341 or MA 301), CSC 112, C- or better in PY 205.
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.

MAE 472 Aerospace Structures II 3.
Prerequisite: MAE 371.
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.

MAE 480 Aerospace Vehicle Design I 3.
Prerequisite: Senior standing, Aerospace Engineering Majors, MAE 356, 472, 462.
A synthesis of previously acquired theoretical and empirical knowledge and application to the design of practical aerospace vehicle systems.

MAE 481 Aerospace Vehicle Design II 3.
Prerequisite: MAE 480.
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.

MAE 482 Engineering Entrepreneurship and New Product Development I 3.
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.

MAE 483 Engineering Entrepreneurship and New Product Development II 3.
Prerequisite: ECE 301, ECE 302, ECE 303, and any two ECE specialization courses.
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.

MAE 484 Engineering Entrepreneurship Senior Design Lab 1.
Prerequisite: MAE/ECE 482; C: MAE/ECE 483.
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.

MAE 495 Special Topics in Mechanical and Aerospace Engineering 1-3.
Offered as needed to present new or special MAE subject matter.

MAE 496 Undergraduate Project Work in Mechanical and Aerospace Engineering 1-6.
Prerequisite: Completion of all required MAE-300 level courses, Corequisite: MAE 415 or MAE 478.
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.

MAE 501 Advanced Engineering Thermodynamics 3.
Prerequisite: MAE 302; MA 401 or MA 511.
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 criteria in different representation; irreversible thermodynamics. Introduction to statistical thermodynamics.

MAE 504 Fluid Dynamics Of Combustion I 3.
Prerequisite: MAE 301 or MAE 252 or MAE 308.

MAE 505 Heat Transfer Theory and Applications 3.
Prerequisite: MAE 310.
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.

MAE 511 Advanced Dynamics with Applications to Aerospace Systems 3.
Prerequisite: MAE 208 or PY 205 and MA 242 and (MA 301 or MA 341).
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.

MAE 513 Principles of Structural Vibration 3.
Prerequisite: MAE 315.
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.

MAE 514 Noise and Vibration Control 3.
Prerequisite: MAE 315.
Discussion of noise and vibration design criteria. Presentation of noise and vibration survey procedures. Discussion of noise and vibration control model. Review of most common equipment noise sources and ways to achieve adequate control. Topics include room acoustics, acoustics of walls, enclosures, vibration isolation and use of scale models.
MAE 515 Advanced Automotive Vehicle Dynamics 3.
Prerequisite: MAE 208 or MAE 315 or MAE 472 or equivalent; or consent of the instructor.
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.

MAE 518 Acoustic Radiation I 3.
Prerequisite: MAE 301 and MAE 308 or MAE 356.
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.

MAE 521 Linear Control and Design For Mimo Systems 3.
Prerequisite: MAE 435, MA 341.
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.

MAE 522 Non Linear System Analysis and Control 3.
Prerequisite: MAE 521 or equivalent.
Nonlinear system analysis, Lyapunov stability theory, absolute stability, feedback linearization, sliding mode control, backstepping control technique, as well as various advanced nonlinear control methods.

MAE 524 Principles of Mechatronic Control 3.
Prerequisite: MAE 315.
Principles of mechatronic control beginning with single and two-degree of freedom systems. Linear feedback, disturbance rejection, state estimation, and filtering. Applications to civil, robotic, automotive, aircraft, space systems. Hands on experiments in linear feedback control and filtering.

MAE 525 Advanced Flight Vehicle Stability and Control 3.
Prerequisite: MAE 457.
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.

MAE 528 Experimental Flight Testing 3.
Prerequisite: Graduate standing, Aerospace Engineering Majors, MAE 525.
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. Collected flight test data is corrected for standard day and analyzed.

MAE 531 Engineering Design Optimization 3.
Prerequisite: Graduate standing in Engineering is recommended.
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.

MAE 532 Smart Structures and Micro-Transducers 3.
Prerequisite: MAE 314, MAE 315, or equivalent.
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.

MAE 533 Finite Element Analysis I 3.
Prerequisite: MAE 316 or MAE 472.

MAE 534 Mechatronics Design 3.
Prerequisite: Structured Programming Experience, Senior/Graduate Standing in WPS/MAE.
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.

MAE 535 Design of Electromechanical Systems 3.
Prerequisite: MA 341.
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.

MAE 536 Micro/Nano Electromechanical Systems 3.
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.

MAE 537 Mechanics Of Composite Structures 3.
Prerequisite: MAE 316 or MAE 472.
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.

MAE 538 Smart Structures and Materials 3.
Prerequisite: MAE 415 or MAE 472.
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.
MAE 539 Advanced Materials 3.
Prerequisite: MSE 201 and MAE 314.
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).

MAE 540 Advanced Air Conditioning Design 3.
Prerequisite: MAE 403, 404.

MAE 541 Advanced Solid Mechanics I 3.
Prerequisite: MAE 316.
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.

MAE 543 Fracture Mechanics 3.
Prerequisite: MAE 316.
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.

MAE 544 Real Time Robotics 3.
Prerequisite: Pascal, C, FORTRAN or Assembly language experience.
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.

MAE 545 Metrology For Precision Manufacturing 3.
Prerequisite: Senior standing in MAE or BS in other curriculum.
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, Abbé principle, error analysis, measurement, and compensation. Precision instruments and operating principles. Hands-on experience with measurement instruments and techniques.

MAE 546 Photonic Sensor Applications in Structure 3.
Prerequisite: MAE 371 or MAE 316.
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.

MAE 550 Foundations Of Fluid Dynamics 3.
Prerequisite: MAE 301 or MAE 252 or MAE 308.
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 parameters. Applications to simple problems in various flow regimes.

MAE 551 Airfoil Theory 3.
Prerequisite: MAE 252.
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.

MAE 553 Compressible Fluid Flow 3.
Prerequisite: MAE 351 or MAE 550.
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.

MAE 554 Hypersonic Aerodynamics 3.
Prerequisite: MAE 553.
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.

MAE 558 Microfluidics and Nanofluidics 3.
Prerequisite: MAE 310 and MA 427.
Macroscopic fluid mechanics, heat and mass transfer. Theories of microfluidics and nanofluidics. Applications in mechanical, biomedical, and chemical engineering. Discussions of journal articles and modern fluid dynamics projects. Expert guest lectures on advanced micro/nanotechnology topics.

MAE 560 Computational Fluid Mechanics and Heat Transfer 3.
Prerequisite: MA 501 or MA 512, MAE 550 or MAE 557, proficiency in the FORTRAN programming language is required.
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.

MAE 561 Wing Theory 3.
Prerequisite: MAE 551.
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.

MAE 562 Physical Gas Dynamics 3.
Prerequisite: MAE 550.

MAE 573 Hydrodynamic Stability and Transition 3.
Prerequisite: MAE 550.
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.
MAE 575 Advanced Propulsion Systems 3.
Prerequisite: Both MAE 458 and MAE 459 or both MAE 302 and MAE 308.
The course will focus on non-turbomachinery, air-breathing hypersonic aeropulsion applications. Specific propulsion systems to be covered include ramjets and scramjets, pulsed detonation engines, and combined cycle engines, with historical perspective.

MAE 581 Space Flight Orbital Mechanics 3.
Orbital mechanics of the 2, 3, and N body problems, orbit perturbations including drag and oblateness, time and celestial coordinate systems, application to special orbits including sun-and geo-synchronous, frozen, constellations, libration points.

MAE 582 Spacecraft Attitude Dynamics & Control I 3.
Inertial and body-fixed reference frames for establishing spacecraft orientation, sequential rotations, quaternions, measuring rotation and rotation rates of rigid body, rigid body dynamics review and momentum exchange techniques, gyroscopic navigation systems, dynamic stability, stabilization methods, and spacecraft maneuvers.

MAE 586 Project Work In Mechanical Engineering 1-6.
Individual or small group investigation of a problem stemming from a mutual student-faculty interest. Emphasis on providing a situation for exploiting student curiosity.

MAE 589 Special Topics In Mechanical Engineering 1-3.
Prerequisite: Advanced Undergraduate standing or Graduate standing. Faculty and student discussions of special topics in mechanical engineering.

MAE 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

MAE 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

MAE 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

MAE 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

MAE 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis Research.

MAE 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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: Graduate standing in Mechanical Engineering, Consent of Adviser.
Individual research in the field of mechanical engineering.

MAE 702 Statistical Thermodynamics 3.
Prerequisite: MAE 501.
Analysis and establishment of conclusions of classical thermodynamics from the microscopic viewpoint. Topics include: ensemble methods, partition functions, translational, rotational and vibrational energy modes of an ideal gas, chemical equilibrium, imperfect gases, dense fluids, critical-point theories, mean free path concepts, Boltzmann equation, hydrodynamic equations from kinetic theory and properties of disordered composite media.

MAE 704 Fluid Dynamics of Combustion II 3.
Prerequisite: MAE 504.

MAE 707 Advanced Conductive Heat Transfer 3.
Prerequisite: MAE 505 or MA 501.

MAE 708 Advanced Convective Heat Transfer 3.
Prerequisite: MAE 550.
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.

MAE 709 Advanced Radiative Heat Transfer 3.
Prerequisite: MAE 505.
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.

MAE 718 Acoustic Radiation II 3.
Prerequisite: MAE 518.
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.
MAE 721 Robust Control with Convex Methods 3.
Prerequisite: Graduate standing in Engineering and Applied Mathematics, MAE 521 or ECE 716.
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, $H_{\infty}$ control, convex optimization technique (LMI), multi-analysis and synthesis, computer-aided analysis and control design.

MAE 725 Geophysical Fluid Mechanics 3.
Prerequisite: MAE 501.
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.

MAE 726 Advanced Geophysical Fluid Mechanics 3.
Prerequisite: MAE 725 or equivalent.
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.

MAE 727 Computational Methods in Structural Vibration 3.
Prerequisite: CE 722 or MAE 513.
Development of computational methods to analyze the field problems in structural vibration for which closed-form solutions generally unavailable. Aimed primarily at linear systems, topics include: linearization and stability, computational methods for the eigensolutions and discretization by local function, global function and hybrid approaches, applications to undamped, damped and spinning assemblages of beams, rods, strings, shafts, membranes and plates.

MAE 730 Modern Plasticity 3.
Prerequisite: Grad. course in elasticity or strength of materials.
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.

MAE 731 Materials Processing by Deformation 3.
Prerequisite: Six hrs. of solid mechanics and/or materials.
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.

MAE 734 Finite Element Analysis II 3.
Prerequisite: MAE 533.
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 formulations, 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.

MAE 742 Mechanical Design for Automated Assembly 3.
Prerequisite: Graduate standing or PBS status in Engineering.
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.

MAE 766 Computational Fluid Dynamics 3.
Prerequisite: MAE 560; proficiency in the FORTRAN programming language is required.
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.

MAE 770 Computation of Reacting Flows 3.
Prerequisite: MAE 560, MAE 766.

MAE 776 Turbulence 3.
Prerequisite: MAE 550.
Development of basic concepts and 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.

MAE 782 Spacecraft Attitude Dynamics & Control II 3.
Classical feed back control theory and application, passive stabilization of single and dual-spin satellites, advanced momentum exchange devices and three axis control, reaction control systems, magnetic torquers and momentum dumping, attitude determination, optimum control of spacecraft attitude.

MAE 783 Space Flight Guidance and Navigation 3.
Prerequisite: MAE 581 and MAE 582 or equivalent.
Topics include the fundamentals of non-linear methods for trajectory optimization, methods of classical orbit determination and applications, differential orbit determination theory and applications, linear, unbiased minimum variance approach to trajectory and parameter estimation, linearized trajectory correction maneuver theory and applications, and application of these methods to real space flight mechanics problems.

MAE 787 Structural Health Monitoring 3.
Prerequisite: MAE 541 or MAE 513 or equivalent.
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.

MAE 789 Advanced Topics In Mechanical Engineering 1-3.
Prerequisite: Graduate standing.
Faculty and graduate student discussions of advanced topics in contemporary mechanical engineering.

MAE 801 Mechanical Engineering Seminar 1.
Faculty and graduate student discussions centered around current research problems and advanced engineering theories.
MAE 830 Doctoral Independent Study 1-3.
Individual investigation of advanced topics under the direction of member(s) of the graduate faculty.

MAE 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

MAE 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation Research.

MAE 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.

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.

MB - Microbiology Courses

MB 101 Introduction to Microbiology and Biochemistry Laboratory Practices 3.
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.

MB 103 Introductory Topics in Microbiology 1.
Introduction to scope and objectives of university education. Emphasis on microbiology. Career opportunities, computers, university resources.

MB 180 Introduction to Microbial Bioprocessing 3.
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.

MB 200 Microbiology and World Affairs 3.
An integrated and comprehensive study of the microbial world and its influence on global events and human affairs.

MB 210 Phage Hunters 3.
This course offers first-year students an opportunity for mentor 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.

MB 211 Phage Genomics 2.
Prerequisite: BIT(MB) 210.
This course offers first-year students an opportunity for mentor research. Student 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.

MB 320 Fundamentals of Microbial Cell Culture 2.
Prerequisite: BIO 183.
This is a half-semester course. This introductory module addresses fundamental cell biology concepts and enables students to gain an understanding of the basic principles of microbiology, culture preparation, physiology and genetics of microbial cell cultures. The lab portion of the course provides students with practical experience in basic laboratory and culture techniques. Students who have completed either MB 352 or MB 354 may not take this course for credit.

MB 325 Fundamentals of Microbial Cell Biotransformations 2.
Prerequisite: BEC(MB) 320 or MB 352.
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 culture. The biological understanding, mathematical models, and engineering controls that enable a 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 BIT(CHE) 463 may not take this course for credit.
MB 351 General Microbiology 3.
Prerequisite: One Biology course (BIO 181, BIO 183, ZO 150 or ZO 160) and one Organic Chemistry course (CH 221 or CH 220).
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.

MB 352 General Microbiology Laboratory 1.
Corequisite: MB 351.
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.

MB 354 Inquiry-Guided Microbiology Lab 1.
Corequisite: MB 351.
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.

MB 360 Scientific Inquiry in Microbiology: At the Bench 3.
Prerequisite: CH 101 and BIO 183.
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. The experimental system of choice for this class is the bacterial growth curve. Prior or current enrollment in MB 352 or MB 354 recommended.

MB 405 Food Microbiology 3.
Prerequisite: MB 351.
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.

MB 406 Food Microbiology Lab 1.
Prerequisite: MB 351 and Corequisite: FS 405 or FS 505.
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.

MB 411 Medical Microbiology 3.
Prerequisite: MB 351.
Comprehensive study of microbial pathogenesis and mammalian host resistance. Diagnosis, prevention, and therapy of common human diseases of microbial origin.

MB 412 Medical Microbiology Laboratory 1.
Prerequisite: MB 352 or MB 354 and Corequisite: MB 411.
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.

MB 414 Microbial Metabolic Regulation 3.
Prerequisite: MB 351 and either BCH 351 or 451.
An integrative perspective on bacterial physiology and metabolism through an analysis of metabolic regulatory functions.

MB 420 Fundamentals of Microbial Cell Biotransformations 2.
Prerequisite: MB 352 OR Corequisite of BEC(MB) 320.
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.

MB 435 Bacterial Pathogenesis 3.
Prerequisite: MB 411 and Jr, Sr, or Graduate Standing.
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.

MB 441 Immunology 3.
P: C- or better in (MB 351 or BCH 351 or BCH 451 or BIO 414 or PB 414 or BIO 421).
Introduction to principles of molecular immunology. Overview of immune system development and function, and discussions of ongoing scientific research regarding immune regulation.

MB 451 Microbial Diversity 3.
Prerequisite: MB 411 and (GN 311 or BCH 351 or BCH 451). 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.

MB 452 Microbial Diversity Lab 2.
Prerequisite: MB 412; Corequisite: MB 451.
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.

MB 455 Microbial Biotechnology 3.
Prerequisite: MB 351 and GN 311.
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.
MB 461 Molecular Virology 3.
Prerequisite: MB 351, MB 411.
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.

MB 480 Current Issues in Microbiology 1.
Prerequisite: SMB majors or minors, Senior standing, and MB 351.
Library research on current topics in all areas of microbiology. Presentation of research results orally and in the form of a major term paper.

MB 492 External Learning Experience 1-6.
Prerequisite: Sophomore standing.
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.

MB 493 Special Problems in Microbiology 1-6.
Prerequisite: Sophomore standing.
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.

MB 495 Special Topics in Microbiology 1-3.
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

MB 501 Biology of Plant Pathogens 3.
Prerequisite: PP 315, or PP 318, or an introductory course in microbiology.
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.

MB 505 Food Microbiology 3.
Prerequisite: MB 351.
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.

MB 506 Food Microbiology Lab 1.
Prerequisite: MB 351 and Corequisite: FS 405 or FS 505.
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.

MB 520 Fundamentals of Microbial Cell Biotransformations 2.
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.

MB 532 Soil Microbiology 4.
Prerequisite: MB 351, CH 220.
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.

MB 535 Bacterial Pathogenesis 3.
Prerequisite: MB 411, Graduate standing.
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.

MB 555 Microbial Biotechnology 3.
Prerequisite: Undergraduate microbiology, genetics, and biochemistry course: MB351, BCH 351, and GN 311.
Overview of industrial microbiology focusing on current biotechnology methods (bacteria, yeast, fungi) employing DNA, 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, biotherapeutic 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.

MB 575 Introduction to Mycology 4.
Prerequisite: BS 125 or BS 181 and 183 or BO 200 or PP 315 or PP 318.

MB 585 Industry Case Studies in Microbial Biotechnology 3.
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 project; and studying intellectual property issues. Written and oral communication skills as well as teamwork, flexibility, and ambiguity management are emphasized. Restricted to MBT students.
MB 590 Topical Problems 1-3.
Prerequisite: Graduate standing.
Informal group discussion of prepared topics assigned by instructor.

MB 601 Seminar 1.

MB 610 Special Topics Microbiology 1-3.

MB 620 Special Problems 1-3.

MB 624 Topical Problems 1-3.
Prerequisite: Graduate standing.

MB 670 Laboratory Research Methods 1-3.
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 to each laboratory. Microbiology graduate students only.

MB 680 Microbiology Research Presentations 1.
Essential elements of structure, delivery, data presentation and use of media in scientific research seminars. Presentation and evaluation of student seminars. Coverage of topical material in microbiology as determined by instructor. Microbiology graduate students only.

MB 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

MB 686 Teaching Experience 1.
Prerequisite: Microbiology Graduate student.
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.

MB 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

MB 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

MB 690 Master's Examination 1-9.
Prerequisite: Master's student.
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.

MB 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

Prerequisite: Master's student.
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.
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.

MB 714 Microbial Metabolic Regulation 3.
Prerequisite: MB 351 and either BCH 351 or 451.
An integrative perspective on bacterial physiology and metabolism through analysis of metabolic regulatory functions.

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.
Prerequisite: BCH 451 or GN 411 or MB 351.
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.

MB 725 Fermentation Microbiology 3.
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.

MB 730 Fungal Genetics and Physiology 3.
Prerequisite: BCH 451, BO 775, GN 411 or PP 501.
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.

MB 751 Immunology 3.
Prerequisite: BCH 451, GN 411, MB 351.
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.
MB 758 Microbial Genetics & Genomics 3.  
*Prerequisite: BCH 451, GN 411.*  
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.

MB 774 Phycology 3.  
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.

MB 783 Advanced Immunology 3.  
*Prerequisite: MB (IMM) 751.*  
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.

MB 790 Topical Problems 1-3.  
MB 801 Seminar 1.

MB 810 Special Topics Microbiology 1-3.  
MB 820 Special Problems 1-3.

MB 824 Topical Problems 1-3.  
*Prerequisite: Graduate standing.*  
MB 870 Doctoral Lab Rotations 1-3.  
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 to each laboratory. Microbiology graduate students only.

MB 880 Doctoral Microbiology Research Presentations 1.  
Essential elements of structure, delivery, data presentation and use of media in scientific research seminars. Presentation and evaluation of student seminars. Coverage of topical material in microbiology as determined by instructor. Microbiology graduate students only.

MB 885 Doctoral Supervised Teaching 1-3.  
*Prerequisite: Doctoral student.*  
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.

MB 886 Teaching Experience 1.  
*Prerequisite: Microbiology Graduate student.*  
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.

MB 890 Doctoral Preliminary Examination 1-9.  
*Prerequisite: Doctoral student.*  
For students who are preparing for and taking written and/or oral preliminary exams.

*Prerequisite: Doctoral student.*  
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

*Prerequisite: Doctoral student.*  
Dissertation research.

MB 896 Summer Dissertation Research 1.  
*Prerequisite: Doctoral student.*  
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.*  
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.

**MBA - Business Administration Courses**

MBA 500 Managerial and Career Effectiveness 0.5-3.  
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.

MBA 503 Survey of Accounting 3.  
Accelerated survey of basic concepts underlying accounting in profit-oriented firms; concepts for decision making in manufacturing; content and interpretation of published financial statements; data measurement; product costing; budgeting. May not be taken for credit by students majoring or minoring in accounting.

MBA 504 Data Analysis & Forecasting Methods for Management 3.  
Role of quantitative modeling in management. Application of tools for data analysis and forecasting, with an emphasis on decision making and analytical skills.

MBA 505 Global Economics for Managers 3.  

MBA 508 Global Management Simulation 1.  
Introductory experience in managerial decision-making for success in the global economy. Immersion in simulation of business functions including finance, operations, marketing, human resource management, information technology, and accounting. Hands-on management of complex corporate forms and analytical tools from multiple functional areas of business. Introduction to effective team-building, leadership, and communication for high-performance in international competition. Restricted to MBA students.

MBA 511 Networking Infrastructure for E-Commerce 3.  
Network infrastructure necessary for electronic commerce, as well as general business needs. Network technologies, architectures, security and applications.
MBA 514 Technology, Law, and the Internet 3.
Legal aspects of technology management. Examination of intellectual property law, mainly focused on software. Contract law for e-commerce as well as warranties and new product development. Cyberlaw issues such as protection of privacy, freedom of expression, crime, and fraud.

MBA 515 Enterprise Systems 3.
Use of enterprise systems in planning, controlling and managing operations. Discussion of ERP and other enterprise systems such as customer relationship management systems. Enterprise systems life cycle. Project using reengineering principles to make business processes more efficient. Hands on experience with NetSuite ERP/CRM and Microsoft Visio. Enterprise systems case studies providing implications for IT management. Technical and end user aspects included.

MBA 518 Enterprise Risk Management 3.
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.

MBA 519 Enterprise Risk Management Practicum 3.
Prerequisite: MBA 518.
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.

MBA 520 Managerial Finance 3.

MBA 521 Advanced Corporate Finance 3.
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.

MBA 523 Investment Theory and Practice 3.
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.

MBA 524 Equity Valuation 3.
Prerequisite: MBA 523.
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.

MBA 525 Taxes and Business Strategy 3.
Importance of tax considerations in business decisions. Framework for understanding how taxes affect business strategy and financing decisions in a wide variety of settings.

MBA 526 International Finance 3.
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.

MBA 527 Corporate Risk Management 3.
Prerequisite: MBA 520.
Fundamentals of corporate risk management from a strategic decision-making perspective. Emphasis on how exposures to financial risks (foreign currency, credit, interest rate, etc.) affect the firm, and how risk exposures can be reengineered to enhance shareholder value. Topics include the major sources of risk, the measurement of risk exposures, methods and strategies of managing and controlling risk and tools of the financial engineer--futures, options, swaps, and other derivatives.

MBA 529 New Firm Financing 3.
Survey of financial management problems at firms from initial formation to initial public offering. Financial components of business plan, design of financial information and control systems, sources of funds for small firms, financing rapid growth, firm valuation for initial public offerings, going public transactions.

MBA 530 People Management 3.
Fundamental principles of organizational behavior and leadership. Individuals, teams and organizations. Staffing, performance management, and incentives. Leadership and influence. Organizational culture. Ethical issues in organizations. Restricted to MBA students.

MBA 536 Creativity in Management 3.
Organizational use of creativity management techniques to generate and synthesize new ideas that can lead to new products or processes. Research-based literature in psychology and management on how companies should and do manage creativity, including processes that can stimulate creative thinking. Models exploring creativity and the workplace. Development, enhancement and evaluation of concepts. Implementation issues.

MBA 540 Operations and Supply Chain Management 3.
Design and management of organizational operations, including both services and manufacturing. Analysis of strategies, processes, planning and control, quality, scheduling, work design, and advanced operations techniques using a variety of managerial and quantitative models. Restricted to MBA students.

MBA 541 Supply Management 3.
Major themes and strategies in supply management. Focus on performance measurement, supplier assessment, negotiations, contracting, cost modeling, supplier relationship management, and supply market analysis in a globally integrated supply chain. Emphasizes collaboration and strategy execution through assessing, establishing metrics/ expectations, contracting, and managing external business relationships. Students will engage in a supply chain simulation that provides insights into application of these concepts, as well as completion of a commodity analysis for an SCRC member company.

MBA 542 Supply Chain Logistics 3.
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. Inventory management. Transportation. Network design.
MBA 543 Planning and Control Systems 3.
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.

MBA 549 Supply Chain Management Practicum 3.
Prerequisite: MBA 540.
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.

MBA 550 Management of Technology and Innovation 3.
Overview of the management of innovation and technology for value creation in increasingly complex and changing business environments. Management of strategic innovation and new product/service development processes within organizations. Implementation issues in innovation strategy. Restricted to MBA students.

MBA 551 Services Management and Marketing 3.
Overview of services management and marketing. Key managerial and marketing components associated with running a service focused business. Introduction to services definitions and taxonomies. Nature of services and analysis of the service encounter via the GAPs model. Customer behavior, expectations and perceptions related to services. Exploration of customer relationships, profitability and return on investment. Articulation of services business strategy. New service development, design, and blue printing processes and issues associated with managing capacity and demand in services businesses.

MBA 552 Managerial Issues in Organizational Culture 3.
Services depend on a successful co-production relationship of individuals from different organizations, with different organizational cultures. This course will focus on skills development to engage in that co-production relationship successfully, “read and speak” the culture of an organization using solid research tools, and use those skills in the practice of a service development within a particular organizational culture context.

MBA 553 Business Process Design and Analysis 3.

MBA 554 Project Management 3.
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.

MBA 555 Product Design and Development 4.
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.

MBA 557 Management Consulting 3.
Overview of management consulting with primary emphasis on the application of consulting methods employed to address business issues within organizations. Overview of the generic issue-based consulting process: identifying and prioritizing issues, identifying root-causes of priority issues, developing interventions to address root-causes and measuring impact of interventions on performance. Explanation of how the concepts, procedures and methods of issue-based consulting concepts and procedures to organization issues in strategy, performance, process and change management.

MBA 560 Marketing Management and Strategy 3.
Market segmentation, targeting, and positioning. Consumer behavior. 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.

MBA 562 Research Methods in Marketing 3.
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.

MBA 563 Product and Brand Management 3.

MBA 564 Business Relationship Management 3.
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.

MBA 570 Managing the Growth Venture 4.
Entrepreneurial planning as an iterative process continually driven by a stream of strategic choices. Social networks, organizational structure and culture, opportunity creation, discovery and evaluation, firm growth and change, intellectual property, employment practices and incentives, innovation, financing, and entrepreneurial improvisation. Creation of a strategic growth plan for a venture.

Commercialization potential of new technologies, products and processes. Marketing, organizational, financial, operational and manufacturing issues. Strategic assessment and planning. Innovation management. Entrepreneurial transfer mechanisms including spinoffs, licensing and high-technology start-ups. Practical application with project and team management skills development.

Prerequisite: MBA/MSE 576.
Theoretical and practical team-based application of systematic evaluation techniques for assessing commercial potential of technologies, products and processes. Prioritization and selection based on technology strategy.
MBA 580 Global Strategy 3.
Practice-oriented capstone course that integrates the concepts, knowledge and skills of the MBA program. Strong global emphasis. Strategic thinking, strategic analysis, creation of competitive advantage. Creation and monitoring of entrepreneurial opportunities. Corporate and business level strategies. Strategic alliances, acquisitions, and restructuring. Restricted to MBA students.

MBA 585 Current Topics in BioSciences Management 3.
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.

MBA 586 Legal and Marketing Dynamics in Pharmaceutical and Biotechnology 3.
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 limiting or affecting pharmaceutical and biomedical marketing Ethical issues in the research and marketing processes.

MBA 590 Special Topics In Business Management 1-6.
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 1-3.
Special topics course dealing with issues not covered in regularly scheduled courses. Restricted to MBA students.

MBA 630 Independent Study In Business Management 1-6.
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.

MBA 688 Non-Thesis Masters Continuous Registration - Half Time Registration 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.

MBA 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
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.

MDS - Multidisciplinary Studies Courses

MDS 595 Special Topics in Multidisciplinary Studies 1-3.
Prerequisite: Graduate standing.

MEA - Marine, Earth, and Atomspheric Sciences Courses

MEA 100 Earth System Science: Exploring the Connections 4.
Prerequisite: Competence in high school algebra and chemistry.

MEA 101 Geology I: Physical 3.
Corequisite: Recommended that MEA 110 be taken concurrently.
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.

MEA 110 Geology I Laboratory 1.
Corequisite: MEA 101 or Prerequisite: MEA 101, MEA 120, MEA 140 or MEA 200.
Scientific methodology applied to the study of common rock-forming minerals, common rocks, topographic maps, geologic structures and geological maps. Field trips.

MEA 120 The Dinosaurian World 3.
Evolution and ecology of dinosaurs related to broader features of Earth history, including plate tectonics, paleoclimatology, mass extinction and the long-term effects of natural selection.

MEA 121 The Dinosaurian World Lab 1.
Corequisite: MEA 120.
Companion to lecture course on "The Dinosaurian World." Adaptive significance of osteological characteristics, ecological correlates of body weight and physical environmental variables, and concepts relating to natural selection, fitness, biodiversity and changes in the planetary environment on various time scales. Discussion, specimen demonstrations and problem solving.

MEA 130 Introduction to Weather and Climate 3.
Prerequisite: For Non-Majors.
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.

MEA 135 Introduction to Weather and Climate Laboratory 1.
Corequisite: MEA 130.
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 instruments and observations; weather map analysis; forecasting principles.

MEA 140 Natural Hazards and Global Change 3.
The science of natural hazards and global change: the impact on human civilization of events in the lithosphere, atmosphere, biosphere, and hydrosphere (e.g., earthquakes, hurricanes, red tides, and floods), and the impact of humans on the global environment (e.g., global warming).

MEA 150 Environmental Issues in Water Resources 4.
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.

MEA 200 Introduction to Oceanography 3.
Corequisite: Recommended that MEA 210 be taken concurrently.
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.
MEC 202 Geology II: Historical 3.
Prerequisite: MEA 100, MEA 101, MEA 120, MEA 140 or MEA 200 and MEA 110; Corequisite: Recommended that MEA 211 be taken concurrently.
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.

MEC 210 Oceanography Lab 1.
Corequisite: MEA 200.
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.

MEC 211 Geology II Laboratory 1.
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.

MEC 213 Introduction to Atmospheric Sciences I 2.
Prerequisite: MA 141.
Introduction to the atmospheric environment. Fundamental concepts and applications of atmospheric physics and dynamics and how they relate to day-to-day and seasonal weather as well as climate change.

MEC 214 Introduction to Atmospheric Sciences II 2.
Prerequisite: MEA 213.
Second course in a series introducing the atmospheric environment. Topics include midlatitude weather systems from planetary scale to mesoscale, climate and climate change, implications and impacts of the climate change, and air pollution.

MEC 220 Marine Biology 3.
Prerequisite: MEA 200 or BIO 181.
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.

MEC 250 Introduction to Coastal Environments 3.
Prerequisite: MEA 200/210 or MEA 101/110.
A global survey of coastal habitats, the processes that shape these dynamic environments, and the physicochemical controls that regulate their indigenous biological communities.

MEC 251 Introduction to Coastal Environments Laboratory 1.
Corequisite: MEA 250.
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.

MEC 300 Environmental Geology 4.
Prerequisite: MEA 101 or MEA 150 or MEA 140 or SSC 200.
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.

MEC 312 Atmospheric Thermodynamics 4.
Prerequisite: MA 141, PY 205; Corequisite: MA 241, PY 208.
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 of water vapor. Atmospheric statics: static stability of moist air; CAPE and vertical acceleration. Focus will be on applying the rigorous framework of classical thermodynamics to derive and solve quantitatively the governing equations describing these processes.

MEC 315 Mathematics Methods in Atmospheric Sciences 4.
Prerequisite: MA 116, MA 141, MA 241; Corequisite: MA 242.
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.

MEC 320 Fundamentals of Air Pollution 3.
Prerequisite: MA 121 or MA 131 or MA 141, CH 201 or CH 203, PY 131 or PY 201 or PY 205 or PY 211.
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.

MEC 321 Fundamentals of Air Quality and Climate Change 3.
Prerequisite: CH 101, CH 201, MA 141, MA 241; Corequisite: PY 205.
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.

MEC 323 Earth System Chemistry 3.
Prerequisite: (CH 201 or CH 203) and (CE 373 or any MEC course).
Chemistry of the earth with an emphasis on the interactions of the biosphere, geosphere and atmosphere. The origin and chemical evolution of the solar system, chemical cycles in the environment, and the impact of man on biogeochemical processes.

MEC 369 Terrestrial Paleontology 4.
Prerequisite: BIO 181 or MEA 202 or MEA 120.
Evolution of terrestrial life traced through geologic time, accenting the functional significance of adaptations and the history of terrestrial ecosystems. Required field trips.

MEC 410 Introduction to Mineralogy and Petrology 4.
Prerequisite: (MEA 100, MEA 101, MEA 120, MEA 140 or MEA 200), and MEA 110 and CH 101/102.
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.
ME 411 Marine Sediment Transport 3.
Prerequisite: MEA 101 or MEA 200, MA 241, PY 201 or PY 205.
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 to the deep sea and interpretation of sediment transport processes from sedimentary structures. Credit not allowed for both MEA 411 and MEA 562.

ME 412 Atmospheric Physics 3.
Prerequisite: MA 242, PY 208.
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.

ME 415 Climate Dynamics 3.
Prerequisite: MEA 412 and MEA 422.
A physically based treatment of climate change, climate variability, and climate models, for upper-level undergraduate meteorology majors.
Topics include Earth’s energy balance and the greenhouse effect, drivers of future and past climate change, and climate model projections of global warming and its implications. Cannot receive credit for both MEA 415 and MEA 515.

ME 421 Atmospheric Dynamics I 3.
Prerequisite: MA 242 and PY 208 and MEA 312.
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-spherical and pressure coordinates. Scale analysis and simplifications. Cases of horizontal flow: geostrophic and gradient wind, ageostrophy and acceleration; thermal wind and vorticity.

ME 422 Atmospheric Dynamics II 3.
Prerequisite: MEA 421.
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.

ME 425 Introduction to Atmospheric Chemistry 3.
Prerequisite: MA 141, CH 201, (PY 205, PY 211 or MEA 320).
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.

ME 433 Forensic Geology 4.
Prerequisite: MEA 101.
Application of geology to crime investigation, ranging from violent crime to fraud and liability in property management. Role of a geologist as expert witness. Application of analytical techniques, e.g., petrographic microscopy, trace-element analysis, remote sensing, digital mapping, and image analysis. Tour of the SBI lab and a certified gemology lab. Identification of art fraud by pigment analysis and a corresponding tour of the NC Museum of Art.

ME 435 Engineering Geology 3.
Prerequisite: MEA 101 and Junior standing in Colleges of Agriculture and Life Sciences, Engineering, Natural Resources, College of Sciences or Textiles.
Application of both geology and geotechnical engineering to engineering projects. Illustrations of relevant materials properties and techniques utilized in describing subsurface conditions.

ME 440 Igneous and Metamorphic Petrology 4.
Prerequisite: MEA 410.
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.

ME 443 Synoptic Weather Analysis and Forecasting 4.
Prerequisite: MEA 421.
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.

ME 444 Mesoscale Analysis and Forecasting 4.
Prerequisite: MEA 443.
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, crosstrophically-induced circulations, thunderstorms, mesoscale convective, and severe convective weather.

ME 449 Principles of Biological Oceanography 3.
Biological productivity and trophic relationships in plankton, nekton and benthos; community ecology of selected habitats (estuaries, intertidal zones, coral reefs, deep sea); and adaptation of organisms to the marine environment. Credit is not allowed for both MEA/BIO 449 and MEA/BIO 549.

ME 450 Introductory Sedimentary Petrology/Stratigraphy 4.
Prerequisite: MEA 410.
Properties, classification, geologic occurrences, and origin of minerals and rocks formed by physical, chemical, and biologic processes at and near the earth’s surface. Principles of division of stratified terrains into natural units, correlation of strata, interpretation of depositional environments and facies. Required field trips.

ME 451 Structural Geology 4.
Prerequisite: MEA 410.
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.

ME 454 Marine Physical-Biological Interactions 3.
Prerequisite: MEA 460 and MEA/ZO 449.
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 MEA 454 and 554.
ME 455 Micrometeorology 3.
Prerequisite: MEA 422 or MAE 308.
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; semiemprirical 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.

ME 458 Introduction to Tropical Meteorology 3.
Prerequisite: MEA 422.

ME 459 Field Investigation of Coastal Processes 5.
Prerequisite: MEA 250.
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 academes, 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.

ME 460 Principles of Physical Oceanography 3.
Prerequisite: MA 241 or MA 231; Corequisite: PY 203, PY 208 or PY 212.
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; conservations equation; air-sea interaction; global fluxes and general description of major ocean currents. Credit is not allowed for both MEA 460 and MEA 540.

ME 461 Undergraduate Cruise Experience 1.
Corequisite: MEA 200 or MEA 220.
Broad exposure to planning and execution of oceanographic research operations, including demonstration of techniques and equipment regularly used aboard ships and familiarization with acquisition and processing of oceanographic data via preparation for and participation in a demonstration cruise under the guidance of NCSU oceanography faculty members.

ME 462 Observational Methods and Data Analysis in Marine Physics 3.
Prerequisite: MEA 460.
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.

ME 463 Fluid Physics 3.
Prerequisite: MA 341 and PY 208.
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.

ME 464 Ocean Circulation Systems 3.
Prerequisite: MEA 460.
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.

ME 465 Geologic Field Camp 4.
Prerequisite: MEA 450 and MEA 451.
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.

ME 466 Preparatory Course for Field Camp 1.
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.

ME 467 Marine Meteorology 3.
Prerequisite: MEA 422 or MEA 460.
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.

ME 469 Ecology of coastal Resources 3.
Prerequisite: MEA 250 and MEA 220 or MEA 449.
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.

ME 470 Introduction to Geophysics 3.
Prerequisite: PY 208 or PY 212.
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.

ME 471 Exploration and Engineering Geophysics 3.
Prerequisite: PY 208 or PY 211.
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.

ME 473 Principles of Chemical Oceanography 3.
Prerequisite: CH 201 or CH 203.
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.
MEA 476 Worldwide River and Delta Systems: Their Evolution and Human Impacts 3.
Prerequisite: Senior undergraduate or Graduate standing.
Survey of major world rivers and deltas, such as the Amazon, Mississippi, Yello, Yangtze, Mekong, Ganges-Brahmaputra, Indus, Nile, etc. Descriptions of their initiation, development, and evolution processes. Definitions 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.

MEA 479 Air Quality 3.
Prerequisite: CE 373, CE 382; or CHE 311 (CHE Majors); or MEA 421 (MEA Majors), Corequisite: ST 370; ST 380 (MEA Majors).
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.

MEA 481 Geomorphology: Earth's Dynamic Surface 3.
Prerequisite: (MEA 100, MEA 101, MEA 120, MEA 140 or MEA 200) and MEA 110.
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.

MEA 485 Introduction to Hydrogeology 3.
Prerequisite: (MEA 101 or MEA 202), (MA 131 or MA 141), (CH 201 or CH 203), and (PY 201, PY 205, or PY 211).
Basic science of groundwater flow in geological media. Saturated and unsaturated flow, Darcy's equation, heterogeneity and anisotropy, flow nets, 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.

MEA 493 Special Topics in MEAS 1-6.
Directed individual study or experimental course offering.

MEA 495 Senior Seminar in the Marine, Earth, and Atmospheric Sciences 1.
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 are presented. Students reflect on future career goals and plans.

MEA 498 Internship in MEAS 1-6.
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.

MEA 507 Discipline-based Education Research in the Geosciences 3.
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; describe how they would determine if student work meets defined learning goals; create effective geoscience learning environments for lecture and lab settings; analyze the teaching of others using validated instruments; and design a geoscience teaching and learning research project.

MEA 510 Air Pollution Meteorology 3.
Prerequisite: MAE 308 or MEA 455 or MEA 700.
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, fogmigation and trapping; removal processes; effects of buildings and hills; effects of local winds.

MEA 511 Introduction to Meteorological Remote Sensing 3.
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 judge adequacy of purpose for their applications.

MEA 512 Satellite Meteorology 3.
Prerequisite: MA 241, Corequisite: MEA 443.
Basic background in satellite orbits, coordinate systems and image navigation; description of sensors and techniques for quantitative measurement of atmospheric variables. Applications of satellite data in analysis of weather systems; evolution of convective systems, tropical disturbances and mid-latitude cyclones as revealed by visible and infrared imagery; current research in satellite applications.

MEA 513 Radar Meteorology 3.
Prerequisite: MEA 412, MEA 422, CSC 112, ST 380.

MEA 514 Advanced Physical Meteorology 3.
Prerequisite: MEA 412, MEA 421.
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.

MEA 515 Climate Dynamics 3.
Prerequisite: MEA 412 and MEA 422.
A physically based treatment of climate change, climate variability, and climate models, for upper-level undergraduate meteorology majors. Topics include Earth’s energy balance and the greenhouse effect, drivers of future and past climate change, and climate model projections of global warming and its implications. Cannot receive credit for both MEA 415 and MEA 515.
MEA 525 Introduction to Atmospheric Chemistry 3.
Prerequisite: MA 141, CH 201, (PY 205, PY 211 or MEA 320).
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.

MEA 540 Principles of Physical Oceanography 3.
Prerequisite: MA 231 and PY 212.
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.

MEA 549 Principles of Biological Oceanography 3.
Prerequisite: BIO 181.
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.

MEA 554 Marine Physical-Biological Interactions 3.
Prerequisite: MEA 460/560 and MEA 449 or MEA(ZO)549.
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 boundary. Credit is not allowed for both MEA 454 and 554.

MEA 562 Marine Sediment Transport 3.
Prerequisite: MEA 101 or MEA 200, MA 241, PY 201 or PY 205.
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 and the interpretation of sediment transport processes from sedimentary structures. Credit not allowed for both MEA 411 and MEA 562.

MEA 570 Geological Oceanography 3.
A comprehensive overview of the geological aspects of oceanography. Topics include: a) marine geophysics and the evolution of ocean basins, b) sedimentological processes and the formation of marine deposits, c) marine geochemistry and authigenic sedimentation, d) paleoceanography and the interpretation of marine stratigraphy.

MEA 573 Principles of Chemical Oceanography 3.
Prerequisite: CH 201 or CH 203.
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.

MEA 574 Advanced Igneous Petrology 3.
Prerequisite: MEA 440.
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 410.
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.

MEA 579 Principles of Air Quality Engineering 3.
Prerequisite: CE 373, CE 382; or CHE 311(CHE Majors); or MEA 421(MEA Majors), Corequisite: ST 370; ST 380(MEA Majors).
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.

MEA 580 Air Quality Modeling and Forecasting 4.
Prerequisite: CSC 112, MEA 425/525, CE 479/579.
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.

MEA 581 Fluid Mechanics in Natural Environments 3.
Prerequisite: CE 382 or MEA 463 or permission of instructor.
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.

MEA 582 Geospatial Modeling and Analysis 3.
The course explains digital representation and analysis of geospatial phenomena and provides foundations in methods and algorithms used in GIS analysis and modeling. Special focus is on terrain modeling, georometry, watershed analysis and introductory GIS-based modeling of landscape process (water, sediment). This course includes analysis from lidar data, 3D visualization, and principles of open source GIS. Introductory level knowledge of GIS or surveying/ geomatics principles is required.

MEA 585 Physical Hydrogeology 3.
Prerequisite: MEA 101, MEA 110, MA 241, and PY 201 or PY 205.
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.

MEA 591 Special Topics in Marine Science 1-3.
Opportunity for advanced undergraduate and graduate students to study timely special problem areas in Marine Science and Engineering.
ME 592 Special Topics in Earth Sciences 1-6.
Special topics in earth sciences, provided to groups or to individuals.

ME 593 Special Topics in Atmospheric Science 1-3.
Special topics in atmospheric science, provided to groups or to individuals.

ME 599 Regional Geology of North America 1-6.
Prerequisite: MEA 101 or MEA 120, Senior standing.

ME 601 Seminar 1.
Prerequisite: Graduate standing.
Presentation by each student of one seminar on his/her current research.

ME 611 Special Topics in Marine Sciences 1-6.
Special topics in earth sciences, provided to groups or to individuals.

ME 612 Special Topics in Earth Sciences 1-3.
Special topics in atmospheric science, provided to groups or to individuals.

ME 613 Special Topics Atmospheric Sciences 1-6.

ME 615 Graduate At-Sea Laboratory 1.
Corequisite: 500 level Oceanography Course.
Specialized experience in planning and execution of oceanographic research operations, including practice with techniques and equipment regularly used aboard ships and familiarization with acquisition and processing of oceanographic data via preparations for and participation in a research cruise under the guidance of NCSU faculty members.

ME 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

ME 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

ME 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

ME 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

ME 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's Student.
Thesis Research.

ME 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

ME 700 Environmental Fluid Mechanics 3.
Prerequisite: MA 241, PY 208.
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.

ME 702 Advanced Cloud and Precipitation Physics 3.
Prerequisite: MEA 421 or MEA 412.
Analysis of microstructure of warm and cold clouds and precipitation, cloud microphysics-dynamics interactions, formation of cloud droplets, growth of cloud droplets by condensation, initiation of rain in nonfreezing clouds, formation and growth of ice crystals, precipitation theories, planned and inadvertent weather modification, and the problem of acid rain.

ME 703 Atmospheric Aerosols 3.
Prerequisite: (CH 201 or CH 203) and (PY 205 or PY 211), Corequisite: MEA 412.
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.

ME 705 Dynamic Meteorology 3.
Prerequisite: MEA 422.
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.

ME 706 Meteorology of the Biosphere 3.
Prerequisite: (PY 205 or PY 211) and (CH 201 or CH 203) and (MA 101 or MA 111).
For graduate students in the life sciences, presenting physical principles governing the states and processes of atmosphere in contact with earth's surface of land, water and life. Exchanges of heat, mass and momentum analyzed for various conditions of atmosphere and surface and as function of season, time and geographic location.
MEA 707 Planetary Boundary Layer 3.
Prerequisite: MEA 455 or MEA 721.
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.

MEA 708 Atmospheric Turbulence 3.
Prerequisite: MAE 550 or MEA 700 or MEA 707.

MEA 710 Atmospheric Dispersion 3.
Prerequisite: MAE 550 or MEA 700 or MEA 510.

MEA 712 Mesoscale Modeling 3.
Prerequisite: MEA 705.
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.

MEA 713 Mesoscale Dynamics 3.
Prerequisite: MEA 700 and MEA 705.

MEA 714 Atmospheric Convection 3.
Prerequisite: MEA 412, MEA 700, MEA 705.
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.

MEA 715 Dynamics of Mesoscale Precipitation System 3.
Prerequisite: MEA 444.
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.

MEA 716 Numerical Weather Prediction 3.
Prerequisite: MEA 705, CSC (MA) 427 and some FORTRAN programming experience.
Physical and mathematical basis of numerical weather prediction with computer experiments to demonstrate principles and techniques. Derivation of sets of prediction equations consistent with scale analysis and dynamical constraints; atmospheric waves and filtered equations; numerical methods and computational instabilities; filtered and primitive equation models; NWS operational models.

MEA 717 Advanced Weather Analysis 3.
Prerequisite: MEA 444, MEA 705.
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.

MEA 719 Climate Modeling 3.
Prerequisite: MEA 705.

MEA 720 Coastal Meteorology 3.
Prerequisite: MEA 455.
Importance and complexity of coastal meteorological processes; modification induced by surface inhomogeneities; development of internal boundary layers; thermally induced internal boundary layers; coastal fumigation processes; structure and development of sea and land breezes; analytical and numerical modeling of sea breezes; coastal fronts; storm surges; prediction models for storm surges; cold air outbreaks; baroclinic boundary layer processes near coastal areas.

MEA 721 Air-Sea Interaction 3.
Prerequisite: MEA 422 or MEA 560.
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.

MEA 725 Geophysical Fluid Mechanics 3.
Prerequisite: MAE 701.
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.

MEA 726 Advanced Geophysical Fluid Mechanics 3.
Prerequisite: MAE 725.
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.
MEA 735 Fourier Analysis of Geophysical Data 3.
Prerequisite: MA 341 and ST 511.

MEA 741 Synoptic Physical Oceanography 3.
Prerequisite: MEA 560.
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 their movements.

MEA 743 Ocean Circulation 3.
Prerequisite: MEA 700 or PY 411.
Basic study of mechanics of ocean circulation with emphasis on various simple models of circulation systems.

MEA 744 Dynamics of Shelf Circulation 3.
Prerequisite: MEA 700.
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.

MEA 750 Marine Benthic Ecology 3.
Prerequisite: ZO 402, ZO 509 or ZO 760 or MEA(ZO) 550.
Marine benthic systems in deep sea and in shallow waters, focusing upon abiotic and biotic processes regulating density, diversity and taxonomic and functional composition. Discussions of benthic-pelagic coupling, predation, interspecific competition, biogeography, sampling problems, evolutionary trends, trophic structure and community organization.

MEA 752 Marine Plankton Ecology 3.
Prerequisite: BCH 451 and MA 121 and ZO 419.
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.

MEA 754 Advances In Marine Community Ecology 3.
Prerequisite: ZO 402 or ZO 760 or MEA(ZO) 750.
Current research and biological and physical processes structuring shallow and deep water benthic communities. Recent research on competition, predation, disturbance, succession, animal-sediment-flow interactions, life history tactics and experimental design in marine benthic biology. Student discussion of current issues and critique of recent papers.

MEA 759 Organic Geochemistry 3.

MEA 760 Biogeochemistry 3.
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.

MEA 762 Marine Geochemistry 3.
Prerequisite: CH 331, MEA 560.
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.

MEA 763 Geochemistry 3.
Prerequisite: CH 331 or 431.

MEA 779 Advanced Air Quality 3.
Prerequisite: (CH 201 or CH 203) and MEA(CE) 479.
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.

MEA 785 Chemical Hydrogeology 3.
Prerequisite: (CH 201 or CH 203) and (MEA 585 or CE 584).

MEA 788 Advanced Structural Geology 3.
Prerequisite: MEA 451.
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 principles and techniques in the field.

MEA 789 Topics In Appalachian Geology 3.
Prerequisite: MEA 440, 450 and 451.
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.

MEA 790 Geotectonics 3.
Prerequisite: MEA 440, 450, 451.
In-depth examination of current ideas in plate tectonic theory. Plate tectonic controls on orogeny, orogenic belts, magmatism and metallogeny.

MEA 791 Advanced Special Topics in Marine Science 1-3.
Opportunity for advanced undergraduate and graduate students to study timely special problem areas in Marine Science and Engineering.

MEA 792 Advanced Special Topics in Earth Sciences 1-3.
Special topics in earth sciences, provided to groups or to individuals.
ME 793 Advanced Special Topics in Atmospheric Science 1-3.
Special topics in atmospheric science, provided to groups or to individuals.

ME 794 Regional Tectonics 3.
Prerequisite: MEA 440, 450, 451.
Methods of study of tectonic history of major geologic regions in North America and other areas of world through the application of stratigraphy, petrology and structural geology. Synthesizing regional tectonic patterns and events.

ME 796 Exploration And Engineering Geophysics 3.
Prerequisite: MEA 470 or PY 208.
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.

ME 801 Seminar 1.
Prerequisite: Graduate standing.
Presentation by each student of one seminar on his/her current research.

ME 810 Special Topics 1-3.

ME 811 Special Topics in Marine Sciences 1-6.
Special topics in earth sciences, provided to groups or to individuals.

ME 812 Special Topics in Earth Sciences 1-3.
Special topics in atmospheric science, provided to groups or to individuals.

ME 813 Special Topics in Atmospheric Sciences 1-6.
Special topics in earth sciences, provided to groups or to individuals.

ME 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Dissertation Research.

ME 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

MES - Mechanical Engineering Systems Courses

MES 300 Systems Engineering 4.
Prerequisite: C- or better in MAE 206.
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.

MES 305 Mechanical Engineering Systems Lab I 1.
Prerequisite: ME 201 and MAE 206.
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.

MES 401 MES Capstone Design I 3.
Prerequisite: MES 300 and MAE 316; Corequisite: MAE 310 and MAE 415.
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.

MES 402 MES Capstone Design II 4.
Prerequisite: MES 401.
This course is the second of the two semester senior engineering design and manufacturing experience. In MES 402, students manage their design project through the completion of a critical design review, a production readiness review, manufacturing and fabrication, a test readiness review and a final verification review. Students develop written and verbal communication skills through reports and presentations and gain insight into engineering design practices through guest lectures from local engineers. Students must provide any transportation needed for this course. MES majors only.

MES 405 Mechanical Engineering Systems Lab II 2.
Prerequisite: MES 305, MAE 314, MAE 308; Corequisite: MAE 435, MAE 310.
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.
MIE - Management Innovation

Entrepreneurship Courses

MIE 201 Introduction to Business Processes 3.
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.

MIE 300 Business Career Planning 1.
Integration of work values, career interests, and skills and corporate environments and career fields related to business management. Development of planning and skills to enhance marketability for placement into professional career paths in business. Minimal fee assessed to cover cost of career tests administered during course.

MIE 305 Legal and Regulatory Environment 3.
Introduction to contract, tort and agency law, the judicial system, common law, statutory law, and constitutional law. Review and discussion of the major legal and regulatory issues affecting business including ethics, fiduciary duty, white collar crime, dispute resolution, intellectual property, international, and product safety laws. Credit is not allowed for both BUS 305 and MIE 305.

MIE 306 Managing Ethics in Organizations 3.
Prerequisite: MIE 201.
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 Business majors only.

MIE 310 Introduction to Entrepreneurship 3.
Prerequisite: MIE 201.
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.

Prerequisite:MIE 201, Sophomore standing.
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.

MIE 335 Organizational Behavior 3.
Prerequisite: 9 hrs. of social science or 6 hours of social science plus MIE 201.
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.

MIE 410 Business Opportunity Analysis 3.
Prerequisite: MIE 310.
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.

MIE 411 Managing the Growth Venture 3.
Prerequisite: MIE 310.
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.

MIE 412 Finance and Accounting for Entrepreneurs 3.
Prerequisite: MIE 310.
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.

MIE 413 New Venture Planning 3.
Prerequisite: MIE 310.
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.

MIE 414 The Legal Dynamics of Entrepreneurship 3.
Prerequisite: MIE 310.
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, risk management.

MIE 416 The Legal Dynamics of Entrepreneurship 3.
Prerequisite: MIE 413.
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 an evaluation of the venture and a formal presentation including a summary of work completed and the implications of the work for each student's project. Students need to provide their own transportation to off-campus sites.

MIE 418 Social Entrepreneurship Practicum 3.
Corequisite: MIE 413.
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 that includes a summary of the work completed and the implications of that work each student's project. Some individual off-campus travel is required.
MIE 431 Compensation: Pay Systems 3.
Prerequisite: MIE 330.
Direct compensation philosophy, strategy, and policy. Merit pay, individual, and group incentive plans. Legal, regulatory, economic, and strategic issues affecting direct compensation. Strategies for developing an internally consistent and market-competitive pay structure to enhance organizational performance. Pay for international and contingent workers.

MIE 432 Labor and Employee Relations 3.
Prerequisite: MIE 330.
Utilizing textbook, readings, lectures, and practitioner presentations, students will become familiar with theories and principles of Labor-Management relations and the interchange between unions and employers. The course will review approaches to clarify, manage, reduce and resolve conflicts and to negotiate collective bargaining agreements.

MIE 433 Compensation: Benefits 3.
Prerequisite: MIE 330.
Legally mandated benefits including Social Security, Medicare, Workers’ Compensation, and Unemployment Insurance. Discretionary benefits including pensions, health insurance, paid time off, and flexible benefits. Employer benefit policies and their role in total compensation. Attracting, retaining, motivation, and retiring workers. Differences in benefits across industries, occupations, and company size. International variation in the use of employee benefits.

MIE 434 Compensation Systems 3.
Prerequisite: MIE 330.
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.

MIE 435 Leadership and Management 3.
Prerequisite: MIE 330.
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 and the use of language in leadership embodiment of leadership traits; effective traits and characteristics of great leaders.

MIE 436 Training and Development 3.
Prerequisite: MIE 330.
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.

MIE 438 Staffing 3.
Prerequisite: MIE 330.
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.

MIE 439 Human Resources Forum 3.
Prerequisite: MIE 330.
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.

MIE 480 Business Policy and Strategy 3.
Prerequisite: BUS/MIE 305, BUS 360, BUS 370, MIE 330, and (BUS/ST 350 or ST 302 or ST 361 or ST 370 or ST 372), and (ENG 331 or ENG 332 or ENG 333).
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. Please note: effective Fall 2015 ACC/BUS 340 will be added to the requirements.

MIE 495 Special Topics in MIE 1-6.
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.
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 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.

MIS - International Studies Courses

MIS 598 Special Topics in International Studies 1-3.
Prerequisite: Advanced Undergraduate standing, PBS status, or Graduate standing.
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.

MIS 601 Colloquium in International Studies 3.
Prerequisite: Graduate standing.
Selected topics in international studies required for writing and oral presentation of MIS capstone paper.

MIS 630 Independent Study 1-6.
Prerequisite: MIS standing.
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.

MIS 651 Internship in International Studies 1-6.
Prerequisite: MIS standing.
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 this experience.
MIS 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

MIS 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

MIS 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

MIS 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

MS - Military Science Courses

MS 101 Introduction to Leadership and Values I 1.
Prerequisite: Freshman standing or Sophomore standing.
This course introduces students to fundamental components of service as an officer in the United States 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.

MS 102 Basic Military Leadership 1.
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.

MS 201 Intermediate Leadership Theory I 2.
Prerequisite: MS 101.
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 and be prepared to apply these skills, and be prepared for the Advanced Military Science Program.

MS 202 Intermediate Leadership Theory II 2.
Prerequisite: MS 101.
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 understand fundamental principles of leadership, and be prepared to intensity practical application in subsequent coursework.

MS 295 Special Topics in Military Leadership 3.
Intensive supervised study in applied military leadership and management in an organization or historically applied scenario. Departmental approval required.

MS 301 Military Leadership and Training Management 3.
Prerequisite: ROTC advanced course cadet.
Organizational leadership and processes in the Army; leadership activities and key management functions. Management and conduct of group training activities.

MS 302 Intermediate Small Unit Tactics 3.
Prerequisite: ROTC advanced course cadets.
Planning, organizing and executing military operations at the squad and platoon level. Focus on the leader's actions, map reading, and navigation.

MLS 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

MLS 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

MLS - Liberal Studies Courses

MLS 501 Seminar in Liberal Studies 3.
Prerequisite: Admission to M.A. in liberal studies.
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.

MLS 630 Independent Study 1-6.
Prerequisite: Admission to M.A. in liberal studies.
Advanced independent study of an interdisciplinary topic under supervision of a faculty member.

MLS 676 Independent Project 3.
Prerequisite: Admission to M.A. in liberal studies.
Advanced independent research on an interdisciplinary project under supervision of a faculty member.

MLS 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

MLS 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.
MS 401 Advanced Military Science - Leadership and Systems Management 3. Prerequisite: MS 301, MS 302.
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.

MS 402 Advanced Military Science - Military Justice, Ethics and Professionalism 3. Prerequisite: MS 401.
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.

MS 495 Special Topics in Military Science 3. 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.

MSE - Materials Science and Engineering Courses

MSE 200 Mechanical Properties of Structural Materials 3. Prerequisite: Grade of C or better in CH 101.
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.

MSE 201 Structure and Properties of Engineering Materials 3. Prerequisite: Grade of C or better in CH 101.
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.

MSE 203 Introduction to the Materials Science of Biomaterials 3. Prerequisite: C- or better in CH 101, CH 102 and PY 205.
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.

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.

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.

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.

MSE 300 Structure of Materials at the Nanoscale 3. Prerequisite: C- or better in MSE 201.
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.

MSE 301 Introduction to Thermodynamics of Materials 3. Prerequisite: MSE 201 or MSE 203; MSE majors must have a C- or better in MSE 201.

MSE 320 Introduction to Defects in Solids 3. Prerequisite: C- or better in MSE 201.
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.

MSE 335 Experimental Methods for Analysis of Material Properties 2. Prerequisite: C- or better in MSE 201.
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.

MSE 350 Mechanics of Materials 3. Prerequisite: MA 341.
Covers fundamental topics in stress analysis and mechanics of materials including statics and structures, elasticity, plasticity, fracture, fatigue, testing methods, and engineering applications.
MSE 355 Electrical, Magnetic and Optical Properties of Materials 3. 
Prerequisite: PY 208 and MA 341.
Fundamental treatment of the electronic properties of materials, including the electrical, magnetic and optical characteristics. The role of electrons, band structure, and Brilliouin 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.

MSE 360 Kinetic Processes in Materials 3. 
Prerequisite: MA 341 and MSE 301.
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.

MSE 362 Biomaterials Characterization 3. 
Prerequisite: (CH 220 or 221 or 225) and (BME 203 or MSE 200 or MSE 201).
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.

MSE 370 Microstructure of Inorganic Materials 3. 
Prerequisites: MSE 300, MSE 301, and MSE 320.
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.

Prerequisite: CH 220 and MSE 300.
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.

MSE 409 Nuclear Materials 3.
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.

MSE 420 Mechanical Properties of Materials 3. 
Prerequisite: MSE 370 and MSE 380.
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.

MSE 423 Introduction to Materials Engineering Design 1. 
Prerequisite: Senior standing in MSE.
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.

MSE 440 Processing of Metallic Materials 3. 
Prerequisite: MSE 360 and MSE 370. Corequisite: MSE 420.
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.

MSE 445 Ceramic Processing 3. 
Prerequisite: MSE 370.
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.

MSE 455 Polymer Technology and Engineering 3. 
Prerequisite: MSE 380.
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.

MSE 456 Composite Materials 3. 
Prerequisite: MSE 420.
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.

MSE 460 Microelectronic Materials 3. 
Prerequisite: MSE 355.
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.
MSE 465 Introduction to Nanomaterials 3.
*Prerequisite: MSE 201.*
Introduction to nanoparticles, nanotubes, nanowires, and nanostructured films, emphasizing their synthesis, structural and property characterization, novel physical and chemical properties, applications, and contemporary literature.

MSE 470 Materials Science and Engineering Senior Design Project 3.
*Prerequisite: MSE 423.*
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.

MSE 480 Materials Forensics and Degradation 3.
*Prerequisite: MSE 370 and MSE 380.*
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.

MSE 485 Biomaterials 3.
*Prerequisite: BME 203 and BIO 183.*
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.

MSE 490 Special Topics in Materials Engineering 1-4.
Offered as needed for the development of new courses in materials engineering, including areas such as metals, ceramics, polymers, or micro electronic materials.

MSE 495 Materials Engineering Projects 1-6.
*Prerequisite: Junior standing or Senior standing.*
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.

MSE 500 Modern Concepts in Materials Science 3.
*Prerequisite: Graduate standing.*
Fundamentals of structure, structure modification and properties of materials with emphasis on structure-property relationships and modern theory of solids.

MSE 509 Nuclear Materials 3.
*Prerequisite: MSE 201.*
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.

MSE 510 Physical Metallurgy 3.
*Prerequisite: MAT 321, MAT 450, Corequisite: MAT 430.*
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.

MSE 539 Advanced Materials 3.
*Prerequisite: MSE 201 and MAE 314.*
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).

MSE 540 Processing of Metallic Materials 3.
*Prerequisite: MAT 321, MAT 450, Corequisite: MAT 431.*
Fundamental concepts of solidification and their application to foundry and welding practices; metal forming concepts applied to forging, rolling, drawing, and sheet forming operations; machining mechanisms and methods; powder metallurgy; advanced processing methods including rapid solidification and mechanical alloying. Credit for both MAT 440 and MSE 540 is not allowed.

MSE 545 Ceramic Processing 3.
*Prerequisite: MAT 434, MAT 435.*
Powder synthesis, characterization, colloidal processing, forming method, theory of sintering, aspects of microstructural control. Credit for both MAT 445 and MSE 545 is not allowed.

MSE 555 Polymer Technology and Engineering 3.
*Prerequisite: MSE 424 or equivalent.*
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.

MSE 556 Composite Materials 3.
*Prerequisite: MAT 450.*
Basic principles underlying properties of composite materials as related to properties of individual constituents and their interactions. Emphasis on design of composite systems to yield desired combinations of properties.

MSE 560 Microelectronic Materials Science and Technology 3.
*Prerequisite: MAT 331, Corequisite: MAT 431.*
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.

MSE 561 Organic Chemistry Of Polymers 3.
Principles of step reaction and addition polymerizations; copolymerization; emulsion polymerization; ionic polymerization; characterization of polymers; molecular structure and properties.
MSE 565 Introduction to Nanomaterials 3.
Prerequisite: MSE 500.
Introduction to nanoparticles, nanotubes, nanowires, and nanostructured thin films, emphasizing their synthesis, structural and property characterization, novel physical and chemical properties, applications and contemporary literature.

MSE 575 Polymer Technology and Engineering 3.
Prerequisite: MAT 424.
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: Graduate standing.
Commercialization potential of new technologies, products and processes. Marketing, organizational, financial, operational and manufacturing issues. Strategic assessment and planning. Innovation management. Entrepreneurial transfer mechanisms including spinoffs, licensing and high-technology start-ups. Practical application with project and team management skills development.

Prerequisite: MBA/MSE 576.
Theoretical and practical team-based application of systematic evaluation techniques for assessing commercial potential of technologies, products and processes. Prioritization and selection based on technology strategy.

MSE 580 Materials Forensics and Degradation 3.
Prerequisite: MSE 370 and MSE 380.
Covers principles and practice 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.

MSE 601 Seminar 1.
Reports and discussion of special topics in materials science and engineering and allied fields.

MSE 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

MSE 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

MSE 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

MSE 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

MSE 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
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.

MSE 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

MSE 702 Defects In Solids 3.
Prerequisite: MSE 500.

MSE 703 Interaction of Electrons with Materials 3.
Prerequisite: MSE 500.
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.

MSE 704 Interaction of Photons with Materials 3.
Prerequisite: MSE 703.
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.

MSE 705 Mechanical Behavior Of Engineering Materials 3.
Prerequisite: MAT 450, MAT 702.
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.
MSE 706 Phase Transformations and Kinetics 3.
Prerequisite: MAT 700, MAT 710, and MSE 500.
Homogeneous and heterogeneous nucleation, spinodal decomposition, interface and diffusion-controlled growth, formal theory of transformation kinetics, precipitation, coarsening, order-disorder, and martensitic transformations.

MSE 708 Thermodynamics Of Materials 3.
Prerequisite: MAT 301 and MSE 500.
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.

MSE 710 Elements Of Crystallography and Diffraction 3.
Crystal symmetry, lattices and space groups; elementary diffraction by crystalline matter; experimental methods of x-ray diffraction.

MSE 712 Scanning Electron Microscopy 3.
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.

Prerequisite: MAT 710.
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: MSE 715.
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.

MSE 731 Materials Processing by Deformation 3.
Prerequisite: Six hrs. of solid mechanics and/or materials.
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.

MSE 741 Principles of Corrosion 3.
Prerequisite: MAT 201 and CH 431 or MAT 301.
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.

MSE 751 Thin Film and Coating Science and Technology I 3.
Prerequisite: MAT 700.
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.

MSE 752 Thin Film and Coating Science and Technology II 3.
Prerequisite: MSE 751.

MSE 757 Radiation Effects on Materials 3.
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.

MSE 760 Materials Science in Processing of Semiconductor Devices 3.
Prerequisite: MAT 460 and MSE 500.
Ion implantation and doping for advanced semiconductor devices, thin films and epitaxy, silicides, ohmic contacts and interconnection metallurgy, oxidation and nitridation, gettering of impurities and dopant segregation phenomena, electromigration, electronic packaging materials science and advanced device concepts.

MSE 761 Polymer Blends and Alloys 3.
Prerequisite: CHE 316 or MAT 301.
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.

MSE 763 Characterization Of Structure Of Fiber Forming Polymers 3.
Prerequisite: MA 301, PY 208.
Characterization methods include X-ray diffraction, microscopy, infrared, thermal and magnetic resonance.

MSE 770 Defects, Diffusion and Ion Implantation In Semiconductors 3.
Prerequisite: MAT 701.
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.

MSE 771 Materials Science of Nanoelectronics 3.
Prerequisite: MSE 500.
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.
MSE 775 Structure of Semicrystalline Polymers 3.
Prerequisite: MAT 425.
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.

MSE 791 Advanced Topics in Materials Science and Engineering 1-3.
Prerequisite: Graduate standing.
Special studies of advanced topics in materials science and engineering.

MSE 795 Advanced Materials Experiments 1-3.
Prerequisite: Senior standing or Graduate standing.
Advanced engineering principles applied to a specific experimental project dealing with materials. A seminar period provided; required written report.

MSE 801 Seminar 1.
Reports and discussion of special topics in materials science and engineering and allied fields.

MSE 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

MSE 890 Doctoral Preliminary Exam 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation Research.

MSE 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

MT - Medical Textiles Courses

MT 105 Introduction to Medical Textiles 3.
Prerequisite: MT 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.
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 healthcare settings, 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.

MT 323 Introduction to Theory and Practice of Medical Fiber and Yarn Formation 3.
Prerequisite: (PY 211 or PY 205) and (PCC 203 or CH 221 or CH 225 or TE 200).
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 biopolymeric fibers used in medical textiles. The common methods of yarn manufacture are introduced.

MT 366 Biotextile Product Development 3.
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.
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.

MT 381 Medical Textile and the Regulatory Environment 3.
Prerequisite: Junior standing.
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.

MT 432 Biotextiles Evaluation 3.
Prerequisite: MT 323 and BIO 183; Corequisite: MT 366 or TE 466.
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.
MT 471 The Chemistry of Synthetic and Natural Bipolymers 3.
Prerequisite: CH 220 or 221 or 225.
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, polyanhydrides and polyethers.

MUS - Music Courses

MUS 103 Music Theory I 3.
Prerequisite: MUS 120 or Rudiments Placement Test. Co-requisite: MUS 104.
Continuation of the principles taught in MUS 120. Topics include rhythm and meter, modes and non-diatonic scales, harmonic analysis, cadences, non-harmonic tones, phrase structure, musical texture, and basic part-writing principles.

MUS 104 Aural Skills I 1.
Prerequisite: MUS 120 or aural skills placement test; Co-requisite: MUS 103.
The development of 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.

MUS 107 Class Piano I 1.
Introduction to playing the piano by learning the basics of music notation, five-finger scales, and beginner's repertoire based on hand position.

MUS 112 Men's Choir 1.
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.

MUS 113 Women's Choir 1.
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.

MUS 114 Chamber Singers 1.
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.

MUS 115 State Chorale 1.
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.

MUS 120 Rudiments of Music 3.
Rudiments of music 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, and triads.

MUS 121 Raleigh Civic Symphony 1.
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.

MUS 122 Raleigh Civic Chamber Orchestra 1.
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.

MUS 131 Marching Band 1.
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 be provided. Audition required. May be repeated up to 10 semesters.

MUS 132 Varsity Band 1.
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 be provided. Audition required. May be repeated up to 10 semesters.

MUS 133 Wind Ensemble 1.
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 up to 10 semesters.

MUS 140 Jazz Improvisation 1.
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.

MUS 141 Jazz Combo II 1.
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.

MUS 142 Jazz Ensemble II 1.
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.
MUS 143 Jazz Combo I 1.
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.

MUS 144 Jazz Ensemble I 1.
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.

MUS 150 Vocal Techniques 1.
Development and practice of vocal techniques suitable to solo and ensemble singing in a variety of musical styles, both historical and contemporary.

MUS 152 Pipes and Drums 1.
Rehearsal and performance of music for bagpipes and drums, including individual practice techniques, traditional performance practices, 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.

MUS 180 Introduction to Musical Experiences 3.
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.

MUS 181 Exploring Music Theory 3.
Prerequisite: Ability to read music.
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.

MUS 200 Understanding Music: Global Perspectives 3.
Music as universal human phenomenon. Global approach to music’s elements and concepts like melody, rhythm, and timbre; and how it functions in relationship to religious belief, observation, and experience; its role in the formation, expression, and contestation of social identity; and its expressive power in the exposition of narrative and drama.

MUS 201 Introduction to Music Literature I 3.
Survey of Western art music from antiquity to the mid-18th century, with an emphasis on the characteristic forms and styles of he 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.

MUS 202 Introduction to Music Literature II 3.
Survey of Western art music from the mid-18th century to the present, with an emphasis on he characteristic forms and styles of he 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.

MUS 203 Music Theory II 3.
Prerequisite: MUS 103 or Music Theory 1 Placement Test.
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 binary and ternary forms.

MUS 204 Aural Skills II 1.
Prerequisite: MUS 104 or Aural Skills I Placement Test.
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.

MUS 205 Introduction to Music in Western Society 3.
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.

MUS 206 America’s Music 3.
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.

MUS 207 Class Piano II 1.
Prerequisite: MUS 107.
The study and performance of intermediate piano repertoire.

MUS 208 Piano Pedagogy 2.
Prerequisite: MUS 390 or MUS 207; C: MUS 390.
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.

MUS 230 Introduction to African-American Music 3.
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.

MUS 260 History of Jazz 3.
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.

MUS 295 Special Topics in Music 1-3.
Special Topics in Music.

MUS 300 Chamber Music Performance 1.
Prerequisite: Satisfactorily passing audition.
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.

MUS 305 Music Composition 3.
Prerequisite: MUS 103 or MUS 203.
Study and creation of musical works. Emphasis on writing original music and works imitative of conventional and contemporary musical styles.
MUS 306 Music Composition with Computers 3.
Prerequisite: Some knowledge of music or computer science (e.g. CSC 200).
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).

MUS 310 Music of the 17th and 18th Centuries 3.
Evolution of European music from 1600 to 1920, 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.

MUS 315 Music of the 19th Century 3.
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.

MUS 320 Music of the 20th Century 3.
Prerequisite: One 3-hour MUS class.
Study of Western Art Music from 1900 to present, emphasizing significant composers, repertoire, and compositional procedures and trends, including traditional, atonal, serial, aleatoric, electronic and computer music.

MUS 330 Music Drama 3.
Survey of staged musical works spanning four centuries. Emphasis on large-scale dramatic works in the genres of opera, operetta, and musical theater. Designed for students with musical and/or theatrical experience.

MUS 350 Music of Asia 3.
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.

MUS 360 Women In Music 3.
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.

MUS 390 Applied Music 1.
Prerequisite: Music Minors Only.
Individual instruction in voice or instrumental performance. Includes development of technique basic to voice or instrument, as well as advancement of artistry, musicianship, and repertoire.

MUS 493 Recital 1.
Prerequisite: 4 Semesters of MUS 390 for Performance Concentration.
MUS 493: Recital is the capstone for a student in the Music Minor performance concentration. Students receive weekly 45-minute individual instruction culminating in a public recital. Students also receive instruction in organizing the recital.

MUS 495 Special Topics in Music 3.
Examination of selected topics in music.

MUS 498 Independent Study in Music 1-3.
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 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.

NE - Nuclear Engineering Courses

NE 201 Introduction to Nuclear Engineering 2.
Prerequisite: Grade of C or better in MA 241, PY 205.
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.

NE 202 Radiation Sources, Interaction and Detection 4.
Prerequisite: PY 208 and CSC 112.
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.

NE 235 Nuclear Reactor Operations Training 2.
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.

NE 301 Fundamentals of Nuclear Engineering 4.
Prerequisite: Grade of C or better in MA 341, CSC 112, C- or better in NE 202.
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. Laboratory sessions include neutron detection and measurement, reactor instrumentation, and reactivity measurements.

NE 400 Nuclear Reactor Energy Conversion 4.
Prerequisite: MAE 301 and a C- or better in NE 301.
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.

NE 401 Reactor Analysis and Design 4.
Prerequisite: C- or better in NE 301, Corequisite: MA 401.
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 and thermalization models and transient isotopics. Laboratory observations and correlation of reactor measurements with theory.
NE 402 Reactor Engineering 3.
Prerequisite: MAE 308 and either NE 400 or MAE 310.
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.

NE 404 Radiation Safety and Shielding 3.
Prerequisite: NE 301 with a grade of C- or better or NE 419.
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.

NE 405 Reactor Systems 3.
Prerequisite: NE 401, NE 402.
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.

NE 406 Nuclear Engineering Senior Design Preparation 1.
Prerequisite: NE 401, Corequisite: NE 402.
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.

NE 408 Nuclear Engineering Design Project 3.
Prerequisite: NE 406.
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.

NE 409 Nuclear Materials 3.
Prerequisite: MSE 201.
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.

NE 412 Nuclear Fuel Cycles 3.
Prerequisite: NE 401.
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.

NE 418 Nuclear Power Plant Instrumentation 3.
Prerequisite: ECE 221 or ECE 331.
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 characteristics. 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.

NE 419 Introduction to Nuclear Energy 3.
Prerequisite: PY 202 or PY 208.
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. Credit will not be given for both NE 400 and NE 500.

NE 501 Reactor Analysis and Design 3.
Prerequisites: NE 520, MA 401, and CSC 112.
Introductory course in reactor analysis and design. Includes one-group neutron transport and multigroup diffusion models, analytical and numerical criticality searches, and reactor power distribution and calculation models for homogeneous and heterogeneous reactors, slowing down models, introduction to perturbation theory. Credit for both NE 401 and NE 501 is not allowed.

NE 502 Reactor Engineering 3.
Prerequisite: MAE 308.
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.

NE 504 Radiation Safety and Shielding 3.
Prerequisite: NE 401 or NE 520.
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.

NE 505 Reactor Systems 3.
Prerequisite: NE 401, NE 402.
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.

NE 509 Nuclear Materials 3.
Prerequisite: MSE 201.
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.
NE 512 Nuclear Fuel Cycles 3.
Prerequisite: NE 401.
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.

NE 520 Radiation and Reactor Fundamentals 3.
Prerequisite: MA 341 and PY 208.
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.

NE 521 Principles of Radiation Measurement 3.
Prerequisites: NE 202.
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.

NE 528 Introduction to Plasma Physics and Fusion Energy 3.
Prerequisite: MA 401 and PY 208.
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.

NE 531 Nuclear Waste Management 3.
Prerequisite: MA 341.
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 and governing equations for the evaluation of waste management systems with emphasis on the safety assessment of waste disposal facilities. Regulations and policy issues.

NE 591 Special Topics In Nuclear Engineering I 3.
Credits Arranged.

NE 592 Special Topics In Nuclear Engineering II 3.
Credits Arranged.

NE 601 Seminar 1.
Discussion of selected topics in nuclear engineering.

NE 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

NE 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

NE 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

NE 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

NE 691 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

NE 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

NE 721 Nuclear Laboratory Fundamentals 3.
Prerequisite: MA 401 and NE 401.
Laboratory 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.

NE 722 Reactor Dynamics and Control 3.
Prerequisite: NE 401 or NE 520.
Methods of describing and analyzing dynamic behavior of systems. These methods applied to reactor systems and the effects of feedbacks studies. Methods of measuring the behavior of reactor systems and development of logic systems for control and safety.
NE 723 Reactor Analysis 3.
Prerequisite: NE 401 or NE 520.
Basic models of neutron motion and methods of calculating neutron flux distributions in nuclear reactors. Emphasis on multigroup diffusion theory. Critically search, neutron slowing down models, resonance absorption, thermalization and heterogeneous cell calculations. Objective is to enable students to read literature and perform relevant analysis in reactor physics.

NE 724 Reactor Heat Transfer 3.
Prerequisite: NE 402 and NE 401 or NE 520.
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.

NE 726 Radioisotopes Measurement Applications 3.
Prerequisite: NE 401 or NE 520.
Introduction to student 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.

NE 727 Nuclear Engineering Analysis 3.
Prerequisite: NE 401 or NE 520.
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.

NE 729 Reactor Theory and Analysis 3.
Prerequisite: NE 723, NE 727.
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.

NE 730 Radiological Assessment 3.
Prerequisite: NE 404 or NE 504.
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.

NE 732 Principles of Industrial Plasmas 3.
Prerequisite: NE/PY 528.
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.

NE 740 Laboratory Projects In Nuclear Engineering 3.
Prerequisite: NE 721.
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.

NE 745 Plasma Laboratory 3.
Prerequisite: NE 528 or PY 508 or PY 509.
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.

NE 746 Fusion Energy Engineering 3.
Prerequisite: NE 528.
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.

NE 751 Nuclear Reactor Design Calculations 3.
Prerequisite: NE 723.
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 of relevant analytic and numerical methods facilitates computer program development by students.

NE 752 Thermal Hydraulic Design Calculations 3.
Prerequisite: NE 724.
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.

NE 753 Reactor Kinetics and Control 3.
Prerequisite: NE 722.
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.

NE 755 Reactor Theory and Analysis 3.
Prerequisite: NE 723, NE 727.
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.

NE 757 Radiation Effects On Materials 3.
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.

NE 761 Radiation Detection 3.
Prerequisite: NE 726.
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 Mössbauer and other resonance phenomena.
NE 762 Radioisotope Applications 3.
Prerequisite: NE 726.
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.

NE 770 Nuclear Radiation Attenuation 3.
Prerequisite: NE 727.
Physical theory and mathematical analysis of the penetration of neutrons, gamma-rays and charged particles. Analytical techniques including point kernels, transport theory, Monte Carlo and numerical methods. Digital computers employed in the solution of practical problems.

NE 780 Magnetohydrodynamics & Transport in Plasmas 3.
Prerequisite: NE 528, NE/PY 414 and 415.
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, Corequisite: MA 775.
Kinetic theory, waves, and non-linear phenomena in magnetized plasmas. First principles approach to the treatment of instabilities and other collective effects.

NE 795 Advanced Topics In Nuclear Engineering I 1-3.
A study of recent developments in nuclear engineering theory and practice.

NE 796 Advanced Topics In Nuclear Engineering II 3.
A study of recent developments in nuclear engineering theory and practice.

NE 801 Seminar 1.
Discussion of selected topics in nuclear engineering.

NE 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

NE 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

NE 893 Doctoral Supervised Research 1-9.
Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

NE 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

NPS - Nonprofit Studies Courses

NPS 340 Fundamentals of Grant Development for Nonprofits 3.
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 successful grant proposals.

NPS 395 Special Topics in Nonprofit Studies 1-6.
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 Internship in Nonprofit Studies 4.
Prerequisite: PS 203, COM 466.
The 150-hour internship provides students with the opportunity to apply the knowledge, skills, and abilities gained through their coursework in the minor in Nonprofit Studies to a nonprofit organizational work setting. The course will include a bi-weekly, two-hour seminar that focuses on careers in the nonprofit sector and nonprofit employment strategies. Students will discuss and reflect upon the service-learning themes of the minor in Nonprofit Studies as they relate to their ongoing internship experiences. Departmental approval required.

NPS 498 Capstone Seminar in Nonprofit Studies 1.
Prerequisite: PS 203, COM 466, Corequisite: NPS 490.
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.

NR - Natural Resources Courses

NR 100 Introduction to Natural Resources 2.
Orientation to natural resources management. Case study of a current natural resource management issue including biophysical, economic, social and political dimensions. Field experience with local natural resources issues. Career orientation and counseling. Open only to first year Department of Forestry and Environmental Resources students or by permission of instructor.

NR 293 Independent Study in Natural Resources 1-6.
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 by the student and faculty member prior to registration by the department.
NR 294 Independent Study in Natural Resources 1-6.
Independent Study for Natural Resources students at the freshman and sophomore level developed under the direction of a faculty member.

NR 295 Special Topics in Natural Resources 1-3.
Special Topics in Natural Resources at the 200 level for offering of courses on an experimental basis.

NR 300 Natural Resource Measurements 4.
Prerequisite: (PB 360 or BIO 360) and ST 311.
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.

NR 301 Practicum for Professional Development I 1.
Prerequisite: Junior standing, NR Majors.
Instruction in professional report writing and presentation, resume preparation and interview skills, professional ethics and practices, job searching skills; review and critique of professional seminars and documents from NR 501 students; preparation for summer work experience.

NR 303 Humans and the Environment 3.
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.

Prerequisite: Sophomore standing.
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.

NR 360 Internship Experience 3.
Prerequisite: NR 301 and Junior standing.
Internship experience with a natural resource agency or company. Most internships require working and living off-campus.

NR 400 Natural Resource Management 4.
Prerequisite: Senior standing in NR, ETM, FOM, or FW.
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.

NR 401 Practicum for Professional Development II 1.
Prerequisite: NR majors, NR 360.
Preparation and presentation of journal on summer work experience, final report and oral presentation of summer work activities; instruction in presentation techniques; review and critique of seminars and documents; mentoring NR 301 students.

NR 406 Conservation of Biological Diversity 3.
Prerequisite: Junior standing.
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 preservation and management.

Prerequisite: SSC 200 and (PB 360 or BIO 360).
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.

NR 421 Wetland Assessment, Delineation and Regulation 3.
Prerequisite: SSC 200, (PB 360 or BIO 360), and (FOR 339 or PB 405).
Wetland definitions and systems of classification and functional assessment; methods for assessing ecological functions of wetlands; identification and delineation of jurisdictional wetlands; US Army Corps of Engineers procedures; application of federal and state regulatory programs. Five Saturday field trips are required. Credit will not be given for both NR 421 and NR 521.

Prerequisite: Junior standing.
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.

NR 484 Environmental Impact Assessment 4.
Prerequisite: ET 310 or NR 300 or FOR 260 or SSC 442.
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.

NR 491 Special Topics in Forestry and Related Natural Resources 1-4.
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.

NR 493 Independent Study in Natural Resources 1-6.
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" be completed by the student and faculty member prior to registration by the department.

NR 494 Independent Study in Natural Resources 1-6.
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" be completed by the student and faculty member prior to registration by the department.
NR 500 Natural Resource Management 3.
Prerequisite: ARE 336 and either ST 311 or ST 350; Graduate standing. 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. Graduate students expected to provide more in-depth critique of planning process. Credit will not be allowed for both NR 400 and NR 500.

NR 521 Wetland Assessment, Delineation, and Regulation 3.
Prerequisite: SSC 200, BO 360, FOR 212 or BO 405, and FOR 420. 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 of federal and state regulatory programs. Two required weekend field trips.

NR 548 Historical Environments 3.
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.

NR 554 Introduction to Data Analysis in Natural Resources 3.
Prerequisite: ST 512. Data examination for errors, data cleaning, data summary, statistical analyses options using various procedures of the SAS software and R with an emphasis on natural resource applications. Interpretation of SAS program outputs. Discussions of individual data problems. Hands-on use of computers and the SAS and R software.

NR 571 Current Issues in Natural Resource Policy 3.
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.

NR 595 Special Topics in Natural Resources 1-6.
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.

NR 601 Graduate Seminar 1.
Weekly seminar in which students register for course present the results of research and special projects. Invitation to all graduate students and faculty in department to attend and join discussion.

NR 610 Special Topics in Natural Resources 1-6.
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.

NR 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student. 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.

NR 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student. 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.

NR 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student. 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.

NR 690 Master's Examination 1-6.
Prerequisite: Master's student. 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.

NR 693 Master's Supervised Research 1-9.
Prerequisite: Master's student. Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student. Thesis Research.

NR 696 Summer Thesis Research 1.
Prerequisite: Master's student. 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. 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.

NS - Naval Science Courses

NS 100 Naval Science Lab 0.
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.

NS 110 Introduction to Naval Science 2.
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.

NS 210 Leadership and Management 3.
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.
NS 225 Navigation 4.
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.

NS 315 Naval Engineering 3.
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.

NS 325 Naval Weapons Systems 3.
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.

NS 330 Evolution of Warfare 3.
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.

NS 415 Naval Operations 4.
Prerequisite: NS 225 Navigation.
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.

NS 420 Naval Leadership and Ethics 3.
Prerequisite: Senior standing.
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.

NS 430 Amphibious Warfare 3.
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.

NSGE - Natural Sciences Courses
NSGE 295 Natural Sciences Special Topics 1-4.
Special topics course offering for the general education Natural Sciences category.

NSGK - Natural Sciences and Global Knowledge Courses
NSGK 295 Natural Sciences and Global Knowledge Special Topics 3.
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.

NTR - Nutrition Courses
NTR 220 Food and Culture 3.
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.

NTR 301 Introduction to Human Nutrition 3.
Prerequisite: Sophomore standing.
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.

NTR 330 Public Health Nutrition 3.
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.

NTR 401 Advanced Nutrition and Metabolism 3.
Prerequisite: (NTR 301 or NTR 415) and (CH 221 or CH 220 or CH 225).
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.

NTR 410 Maternal and Infant Nutrition 3.
Prerequisite: NTR 301.
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.

NTR 415 Comparative Nutrition 3.
Prerequisite: ANS 225 or ANS 230 or CH 220 or CH 223 or CH 227.
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.
NTR 419 Human Nutrition and Chronic Disease 3.
Prerequisite: Junior standing, ANS 230, or ANS/FS/NTR 301 or ANS/ NTR/PO 415.
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.

NTR 420 Community Nutrition 4.
Prerequisite: NTR 301 and junior standing required.
This course exposes students to nutrition-related community programs, agencies, and activities. Through service-learning experiences, students will apply course material to teach nutrition in the community. Course topics will also cover behavior change models, educational pedagogies, and nutrition among diverse populations. Students are expected to provide their own transportation for the community service in the greater Raleigh area. Instructor consent required; Credit will not be given for both NTR 420 and NTR 520.

NTR 421 Life Cycle Nutrition 3.
Prerequisite: NTR 301 and junior standing required.
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.

NTR 454 Lactation, Milk and Nutrition 3.
Prerequisite: ANS 230 or FS/NTR 400; BCH 451 or ZO 421.
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.

NTR 490 Senior Capstone Experience in Nutrition 4.
Prerequisite: Nutrition Science majors only; Senior status required.
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.

NTR 492 External Learning Experience 1-6.
Prerequisite: Sophomore standing.
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.

NTR 493 Special Problems in Nutrition 1-6.
Prerequisite: Sophomore standing.
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.

NTR 495 Special Topics in Nutrition 1-3.
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

NTR 500 Principles of Human Nutrition 3.
Prerequisite: CH 220 and (CH 221 or CH 223) and (ZO 160 or BIO 181/183).
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.

NTR 501 Advanced Nutrition and Metabolism 3.
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.

NTR 510 Maternal and Infant Nutrition 3.
P: NTR 301 or NTR 500.
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.

NTR 515 Advanced Comparative Nutrition 3.
An in-depth presentation of core nutrition principles stressing the role nutrient availability plays in digestive and metabolic adaptations of a variety of animal species. Consideration will be given to translational biomedical nutrition issues that apply to both human and animal health. Students are expected to develop a term paper suitable for submission in a peer-reviewed scientific journal that reviews the latest information in metabolic or digestive adaptations of a specific species as related to nutritional processes. Credit will not be allowed for both ANS/NTR/PO 415 comparative Nutrition and NTR/PO 515 Advanced Comparative Nutrition.

NTR 520 Community Nutrition 4.
Prerequisite: NTR 301 and junior standing required.
This course exposes students to nutrition-related community programs, agencies, and activities. Through service-learning experiences, students will apply course material to complete a needs assessment for a target audience, design and implement a program, and evaluate the program's effectiveness. Course topics will also cover behavior change models, educational pedagogies, and nutrition among diverse populations. Twenty hours of service is required. Students are expected to provide their own transportation for the community service in the greater Raleigh area. Instructor consent required; Credit will not be awarded for both NTR 420 and NTR 520.
NTR 521 Life Cycle Nutrition 3.
Prerequisite: NTR 301 or other introductory human nutrition course.
This course focuses on the physiological changes and nutritional needs throughout the life cycle. Additionally, students will explore psychological and environmental influences 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. Students will apply course content to real-world settings through individual and/or group service-learning projects.

NTR 525 Advanced Feed Science and Technology 3.
Prerequisite: PO/ANS/NTR 415 or ANS 230 or related feed industry experience.
Feed mill management, equipment, maintenance, operation, safety, and regulations pertaining to feed manufacturing. Feed ingredient purchasing, inventory, storage, quality evaluation, and computerized feed formulation. Advanced NTR 525 topics include more detailed aspects of feed science and technology, feed mill design and process flow, operations management, feed quality assurance, regulations, and computer applications. The Distance Education section will have independent study assignments in place of lab experience. Credit will not be given for both PO/ANS 425 and NTR 525.

NTR 550 Applied Ruminant Nutrition 3.
Prerequisite: ANS 230 or ANS(NTR,PO) 415.
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.

NTR 554 Lactation, Milk, and Nutrition 3.
Prerequisite: ANS 230 or FS/NTR 400; BCH 451 or ZO 421.
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.

NTR 555 Exercise Nutrition 3.
Prerequisite: NTR 400/500.
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.

NTR 557 Nutraceuticals and Functional Foods 3.
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.

NTR 561 Equine Nutrition 3.
Prerequisite: ANS 230 or ANS 225 or ANS (NTR,PO) 415 or PO/NTR 515.
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.

NTR 594 Special Topics in Nutrition 1-6.

NTR 601 Master’s Seminar 1.

NTR 624 Topical Problems In Nutrition 1-6.
Prerequisite: Graduate standing or Senior standing.
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.

NTR 625 Advanced Special Problems In Nutrition 1-6.
Prerequisite: Graduate standing.
Directed research in a specialized phase of nutrition designed to provide experience in research methodology and philosophy.

NTR 685 Master’s Supervised Teaching 1-3.
Prerequisite: Master’s student.
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.

NTR 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master’s student.
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.

NTR 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master’s student.
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.

NTR 690 Advanced Special Problems In Nutrition 1-6.
Prerequisite: Graduate standing.
Directed research in a specialized phase of nutrition designed to provide experience in research methodology and philosophy.

NTR 693 Master’s Supervised Research 1-9.
Prerequisite: Master’s student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

NTR 695 Master’s Thesis Research 1-9.
Prerequisite: Master’s student.
Thesis research.

NTR 696 Summer Thesis Research 1.
Prerequisite: Master’s student.
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.
NTR 699 Research In Nutrition 1-9.
Prerequisite: Graduate standing.
Original research preparatory to the thesis for Master of Science or Doctor of Philosophy degree.

NTR 701 Protein and Amino Acid Metabolism 3.
Prerequisite: BCH 453, ZO 421, a 400-level nutrition course.
Study of protein and amino acid metabolism, regulation, dietary requirements and techniques for their investigation in human and other animals.

NTR 706 Vitamin Metabolism 2.
Prerequisite: BCH 453 and an introductory NTR course.
Structures, chemical and physical properties, functions, deficiency symptoms, distribution, absorption, transport, metabolism, storage, excretion and toxicity of vitamins in humans and domestic animals. Nutritional significance of essential fatty acids and metabolism of prostaglandins, prostacyclins and leukotrienes.

NTR 708 Energy Metabolism 3.
Prerequisite: BCH 453 and an introductory NTR course.
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.

NTR 730 Human Nutrition 3.
Prerequisite: FS 400 or NTR 415 or 419; BCH 451.
Biochemical and physiological bases of nutrition. Human nutrient requirements, assessment of nutritional status, clinical and subclinical disorders resulting from nutrient deficiencies or inadequacies.

NTR 764 Advances in Gastrointestinal Pathophysiology 3.
Prerequisite: PHY 503, PHY 504.
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.

NTR 775 Mineral Metabolism 3.
Prerequisite: ANS(NTR,PO) 415, BCH 451 and ZO 421.
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.

NTR 785 Digestion and Metabolism in Ruminants 3.
Prerequisite: Graduate standing.
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.

NTR 790 Advanced Feed Formulation 3.
Prerequisite: NTR(FM) 525.
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.

NTR 794 Special Topics in Nutrition 1-3.

NTR 801 Doctoral Seminar 1.

NTR 824 Topical Problems In Nutrition 1-6.
Prerequisite: Graduate standing or Senior standing.
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.

NTR 825 Advanced Special Problems In Nutrition 1-6.
Prerequisite: Graduate standing.
Directed research in a specialized phase of nutrition designed to provide experience in research methodology and philosophy.

NTR 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

NTR 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

NTR 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

NW - Nonwovens Courses

NW 503 Materials, Polymers, and Fibers used in Nonwovens 3.
Prerequisite: MA 141, PY 205, PCC 203.
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.
NW 504 Introduction to Nonwovens Processes and Products 3.
Prerequisite: MA 141; PY 205, Corequisite: TT503.
Fiber web/nonwoven fabrics produced directly from fibers or their precursors. Physical and chemical nature of local bonding and fiber entanglement. Viable process for producing these fabrics. Economic justification for process and production. Product/process interaction. Plant visits whenever possible.

NW 505 Advanced Nonwovens Processing 3.
Prerequisite: TT/NW503, TT/NW504.
An in-depth understanding of the mechanisms and processes used in the production of nonwoven materials. Design and operation of these mechanisms and processes. Process flow, optimization of process parameters, influence of process parameters on product properties.

NW 506 Bonding Principles in Nonwovens 3.
Prerequisite: MAE 308, MAE 310, TT/NW505.
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.

NW 507 Nonwoven Characterization Methods 3.
Prerequisite: ST 361, Corequisite: TT/NW 505.

NW 508 Nonwoven Product Development 3.
Prerequisite: TTNW505, TT/NW505.

OR - Operations Research Courses

OR 501 Introduction to Operations Research 3.
Prerequisite: MA 421 or ST 421 or ST 371 and ST 372.
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.

OR 502 Introduction to Systems Theory 3.
Prerequisite: MA 341, ST 371.
Modeling of systems and their dynamics in variety of contexts: systems identification, controllability and observability; operational methods and their use in modeling; analysis and synthesis of systems; optimization.

OR 504 Introduction to Mathematical Programming 3.
Prerequisite: MA 242, MA 405.
Basic concepts of linear, nonlinear and dynamic programming theory. Not for majors in OR at Ph.D. level.

OR 505 Linear Programming 3.
Prerequisite: MA 405.
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.

OR 506 Algorithmic Methods in Nonlinear Programming 3.
Prerequisite: MA 301, MA 405, knowledge of computer language, such as FORTRAN or PL1.

OR 531 Dynamic Systems and Multivariable Control I 3.
Prerequisite: MA 341, MA 405.
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.

OR 537 Computer Methods and Applications 3.
Prerequisite: CSC 112 and (MA 341 or MA 305).
Computational approaches to support civil planning, analysis, evaluation and design. Applications to various areas of civil engineering, including construction, structures, transportation and water resources.

OR 565 Graph Theory 3.
Prerequisite: MA 231 or MA 405.

OR 579 Introduction to Computer Performance Modeling 3.
Prerequisite: CSC 312 and MA 421, Corequisite: CSC 501.
Workload characterization, collection and analysis of performance data, instrumentation, tuning, analytic models including queuing network models and operational analysis, economic considerations.

OR 591 Special Topics in Operations Research 1-3.
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.

Prerequisite: OR Major or OR Minor.
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.
OR 610 Special Topics in Operations Research 1-3.
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.

OR 615 Advanced Special Topics in Operations Research 3.
Prerequisite: OR 501, OR(E,MA) 505.
Course allows individual students or small groups of students to take on studies of special areas in OR which fit into their particular program and which may not be covered by other OR courses. The work directed by a qualified faculty member and in some instances by visiting professors. The subject matter in any year dependent on students and faculty members.

OR 652 Practicum in Operations Research 1-3.
Prerequisite: OR 501, OR 505, OR 709 and OR 761.
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.

OR 685 Master’s Supervised Teaching 1-3.
Prerequisite: Master’s student.
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.

OR 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master’s student.
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.

OR 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master’s student.
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.

OR 690 Master’s Examination 1-6.
Prerequisite: Master’s student.
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.

OR 693 Master’s Supervised Research 1-9.
Prerequisite: Master’s student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

OR 695 Master’s Thesis Research 1-9.
Prerequisite: Master’s student.
Thesis research.

OR 696 Summer Thesis Research 1.
Prerequisite: Master’s student.
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.

OR 699 Master’s Thesis Preparation 1-9.
Prerequisite: Master’s student.
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.

OR 705 Large-Scale Linear Programming Systems 3.
Prerequisite: OR 505 and FORTRAN programming experience.
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.

OR 706 Nonlinear Programming 3.
Prerequisite: OR(E,MA) 505 and MA 425.
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 attention directed toward current research and recent developments in the field.

OR 708 Integer Programming 3.
Prerequisite: MA 405, OR (MA,E) 505, Corequisite: Some familiarity with computers (e.g., CSC 112).
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 that should enable them to adapt ideas presented in course to integer programming problems they may encounter.

OR 709 Dynamic Programming 3.
Prerequisite: MA 405, ST 421.
Introduction to theory and computational aspects of dynamic programming and its application to sequential decision problems.

OR 719 Vector Space Methods in System Optimization 3.
Prerequisite: MA 405, 511.
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.

OR 726 Theory of Activity Networks 3.
Prerequisite: OR(E,MA) 505.
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.

OR 731 Dynamic Systems and Multivariable Control II 3.
Prerequisite: OR(E,MA) 531.
OR 747 Reliability Engineering 3.
Prerequisite: ST 511.
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 analysis of fault trees; analysis of Markovian and non-Markovian models; and optimization of reliability models.

OR 760 Applied Stochastic Models in Industrial Engineering 3.
Prerequisite: MA 303, ST 371.
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.

OR 761 Queues and Stochastic Service Systems 3.
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.

OR 762 Computer Simulation Techniques 3.
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.

OR 766 Network Flows 3.
Prerequisite: OR(EIE,MA) 505.
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.

OR 772 Stochastic Simulation Design and Analysis 3.
Prerequisite: (CSC,ECE,IE,OR) 762 and ST 516.
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.

OR 773 Stochastic Modeling 3.
Prerequisite: BMA 772 or ST (MA) 746.

OR 774 Partial Differential Equation Modeling in Biology 3.
Prerequisite: BMA 771 or MA/OR 731; BMA 772 or MA 401 or MA 501.

OR 790 Advanced Special Topics System Optimization 1-3.
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.

OR 791 Advanced Special Topics 1-3.

OR 801 Seminar in Operations Research 1.
Prerequisite: OR Major or OR Minor.
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.

OR 810 Special Topics in Operations Research 1-3.
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.

OR 812 Special Topics in Mathematical Programming 1-3.
Prerequisite: IE(MA,OR) 505.
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.

OR 815 Special Topics in Operations Research 3.
Prerequisite: OR 501, OR(EIE,MA) 505.
Course allows individual students or small groups of students to take on studies of special areas in OR which fit into their particular program and which may not be covered by other OR courses. The work directed by a qualified faculty member and in some instances by visiting professors. The subject matter in any year dependent on students and faculty members. Credits Arranged.

OR 816 Advanced Special Topics Sys Opt 1-3.
Advanced topics in some phase of system optimization. Identification of various specific topics and prerequisite for each section from term to term.

OR 852 Practicum in Operations Research 1-3.
Prerequisite: OR 501, OR 505, OR 709 and OR 761.
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.

OR 862 Scheduling and Routing 3.
Prerequisite: IE 723, OR 501, OR(MA) 504.
In-depth study of analytical models of problems arising in the scheduling of single and parallel processors, flow shops and job shops and in routing and scheduling of delivery vehicles. Emphasis on analysis, solution methodologies and underlying theory. Discussion of recent trends and outstanding problems from both theoretical and applied points of view.

OR 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.
PA - Public Administration Courses

PA 311 Public Policy Analysis and Evaluation 3.
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.

PA 332 Human Resource Management in Public Sector 3.
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.

PA 410 Public Administration for Police Supervisors 3.
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.

PA 411 Managing Police Organizational Behavior 3.
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.

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.

PA 420 State and Local Economic Development Policy 3.
In many communities, both rural and urban, the most immediate policy problem confronting public leaders is how to improve the local economy. The purpose of this course is to introduce public leaders to the tasks and challenges in policy development for improving the economies of communities. This course introduces students to the strategies for attracting and retaining public and private investments in a local economy. An individual semester long project will be completed by each student that presents an original economic development strategy, program or project for a specific community (city/town or county).

PA 501 Effective Writing for Public Managers 1.
Focus on professional writing and emphasis on the types of documents most frequently written by public managers. Drafting, editing, audience assessment, and persuasive writing. Student composition of memos, position papers, proposals and instructions.

PA 507 The Public Policy Process 3.
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.

PA 508 Government & Public Administration 1.
Prerequisite: Graduate standing or PBS status.
Public administration and policy making in U.S. political system. Covers Presidency, Congress, Supreme Court, Federal Reserve System, state and local government, intergovernmental relations. Credit is not allowed if student has prior credit for 3 or more undergraduate American government courses.

PA 509 Applied Political Economy 3.
Prerequisite: EC/ARE 401.
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.

PA 510 Ethics and Professional Practice 1.5.
Prerequisite: MPA student, Corequisite: PA 601.
Workshop on ethical responsibilities of public and nonprofit administrators and codes of ethics used by their professional organizations. Knowledge and problem-solving skills to assess ethical challenges encountered in public and nonprofit administration.
PA 511 Public Policy Analysis 3.
Prerequisite: Graduate standing or PBS status.
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.

PA 512 The Budgetary Process 3.
Prerequisite: Graduate standing or PBS status.
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.

PA 513 Public Organization Behavior 3.
Prerequisite: Graduate standing or PBS status.
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.

PA 514 Management Systems 3.
Prerequisite: Six hours of graduate PA course work.
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.

PA 515 Research Methods and Analysis 3.
Prerequisite: ST 311.
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.

PA 520 Seminar in Urban Management 3.
Prerequisite: Graduate standing or PBS status.
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).

PA 521 Government and Planning 3.
Prerequisite: Graduate standing or PBS status.
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.

PA 522 Intergovernmental Relations in the United States 3.
Prerequisite: Graduate standing or PBS status.
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.

PA 523 Municipal Law 3.
Prerequisite: Graduate standing.
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.

PA 525 Organizational Development and Change Management 3.
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.

PA 530 Financial Management in the Public Sector 3.
Prerequisite: Graduate standing or PBS status.

PA 531 Human Resource Management in Public and Nonprofit Organizations 3.
Prerequisite: Graduate standing or PBS status.
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).

PA 532 Contract Negotiation and Mediation in the Public and Nonprofit Sectors 3.
Prerequisite: Graduate standing or Management Development Certificate Program and 6 hours of 500-level course work.
Three inter-related leadership skills - negotiation, contracting, and mediation-essential for achieving organizational success. Skills for negotiating with partners, for facilitation among colleagues, for crafting and monitoring contracts for equipment, services, or performance, and for using alternate dispute resolution techniques, primarily mediation.

PA 535 Problem Solving for Public and Nonprofit Managers 3.
Prerequisite: PA 513.
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.

PA 536 Management of NonProfit Organizations 3.
Prerequisite: PBS status or Graduate standing.
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 contract on nonprofits: incorporation, lobbying, and tax policies.

PA 538 Nonprofit Budgeting and Financial Management 3.
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.
PA 539 Fund Development 1.5.
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.

PA 541 Geographic Information Systems for Public Administration 3.
Prerequisite: Graduate standing. PBS status, Advanced Undergraduate standing with 12 hours in PS program.
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.

PA 545 Administrative Law 3.
Prerequisite: Graduate standing or PBS status.
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.

PA 546 Seminar in Program Evaluation 3.
Prerequisite: Graduate standing and 6 hours of 500-level courses.
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 methodologies. Seminar concepts applied through evaluative projects conducted for public agencies.

PA 550 Environmental Policy 3.
Prerequisite: Advanced Undergraduate standing including 12 hours of PS program, Graduate standing or PBS status.
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.

PA 553 Disaster, Crisis and Emergency Management and Policy 3.
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.

PA 555 Administration of Criminal Justice 3.
Prerequisite: PS 311 or Graduate standing.
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. 3.

PA 580 Independent Study 1-6.
Prerequisite: Graduate standing or PBS status.
Independent research or readings by graduate students under direct supervision of individual faculty members. Students' work evaluated, based on reports, papers and exams.

PA 598 Special Topics in Public Administration 1-6.
Prerequisite: Advanced Undergraduate standing including 12 hours in PS program, Graduate standing or PBS status.
Detailed investigation of contemporary topics in fields of public administration. Topic and mode of study determined by program faculty.

PA 601 Effective Public Communications 1.5.
Corequisite: PA 510.
Written and oral skills and applications needed by public and nonprofit administrators. 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. MPA students.

PA 635 Readings and Research 1-3.
Prerequisite: Graduate standing.
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.

PA 640 Grantwriting 1.
Survey of funding environment; how to identify foundations, corporation and government funding sources, write proposals, and evaluate proposals.

PA 650 Internship in Public Affairs 1-6.
Prerequisite: Minimum 9 hours graduate work.
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 work experience.

PA 651 Advanced Practical Training 1-3.
Prerequisite: 12 graduate 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.

PA 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

PA 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

PA 689 Non-Thesis Masters Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.
PA 696 Summer Thesis Research 1.  
**Prerequisite:** Master's student.  
For graduate students whose programs of work specify a formal course work during a summer session and who will be devoting full time to thesis research.

PA 715 Quantitative Policy Analysis 3.  
**Prerequisite:** ST 407, ST 511, ST 513.  
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.

PA 761 Foundation of Public Administration 3.  
**Prerequisite:** Graduate standing.  
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.

PA 762 Public Organization Theory 3.  
**Prerequisite:** Graduate standing.  
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.

PA 763 Public Policy Process 3.  
**Prerequisite:** Graduate standing.  
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.

PA 764 Budgeting and Financial Management 3.  
**Prerequisite:** PA 512.  
Examination of budgetary and financial management processes in governmental and nonprofit agencies. Budgetary and financial management theory, practice, and unanswered research questions.

PA 765 Quantitative Research in Public Administration 3.  
**Prerequisite:** PA 515; ST 507.  
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.

PA 766 Advanced Quantitative Research in Public Administration 3.  
**Prerequisite:** PA 765.  
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.

PA 770 Contemporary Public Management 3.  
**Prerequisite:** PA 514.  
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.

PA 771 Seminar on Nonprofit Organizations 3.  
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 1-99.  
**Prerequisite:** Graduate standing or PBS status.  
Independent research or readings by graduate students under direct supervision of individual faculty members. Students' work evaluated, based on reports, papers and exams.

PA 798 Special Topics in Public Administration and Policy 1-3.  
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.

PA 803 Advanced Research Design 3.  
**Prerequisite:** Doctoral student in Public Administration; PA 765, Corequisite: At least two graduate methodology or statistics courses.  
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.

PA 810 Special Topics in Public Administration 1-6.  
**Prerequisite:** Advanced Undergraduate standing including 12 hours in PS program, Graduate standing or PBS status.  
Detailed investigation of contemporary topics in fields of public administration. Topic and mode of study determined by program faculty.

PA 835 Readings and Research 1-3.  
**Prerequisite:** Graduate standing.  
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.

PA 885 Doctoral Supervised Teaching 1-3.  
**Prerequisite:** Doctoral student.  
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.

PA 890 Doctoral Preliminary Examination 1-9.  
**Prerequisite:** Doctoral student.  
For students who are preparing for and taking written and/or oral preliminary exams.

**Prerequisite:** Doctoral student.  
Instruction in research and research under the mentorship of a member of the Graduate faculty.
Prerequisite: Doctoral student.
Dissertation research.

PA 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

PB - Plant Biology Courses

PB 103 Perspectives on Botany 1.
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.

PB 200 Plant Life 4.
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. Credit cannot be given for both BO 200 and BO 250.

PB 205 Our Green World 3.
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).

PB 208 Agricultural Biotechnology: Issues and Implications 3.
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.

PB 213 Plants and Civilization 3.
Prerequisite: BIO 125, BIO 105 or PB 200.
Economic social, political, religious, and medical roles of plants and plant products in human civilization. Foods, beverages, drugs, fibers, oils, latexes, religious symbols and elements.

PB 215 Medicinal Plants 3.
Prerequisite: CH 101 and any one of the following courses: BIO 125, BIO 181, PB 200, ZO 150, ZO 160.
Plants and their derived pharmaceuticals in Western medicine and in herbal medicine.

PB 219 Plants in Folklore, Myth, and religion 3.
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.

PB 220 Local Flora 3.
Prerequisite: BIO 125 or PB 200.
Structural terminology of vascular plants, field identification of plant species using popularized field guides, description of plant community types and their soil and topographic features.

PB 250 Plant Biology 4.
An introduction for Life Science majors to the ecology, structure, function, processes, reproduction and evolution of higher plants. BIO 181 and BIO 183 or BIO 125; Students may not receive credit for both BO 200 and BO 250.

PB 277 Space Biology 3.
Prerequisite: BIO 105 or BIO 140 or BIO 181 or BIO 183 or PB 200.
Overview of the biology of plants, animals and humans in the space environment, including gravitational biology, aerospace medicine, search for extraterrestrial life, terraforming and life support.

PB 295 Special Topics in Botany 1-4.
Trial offerings of new or experimental courses in Botany at the early undergraduate level.

PB 321 Introduction to Whole Plant Physiology 3.
Prerequisite: (BIO 183 or PB 200 or PB 250) and CH 101/102.
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.

PB 330 Evolutionary Biology 3.
Prerequisite: C or better in BIO 181 and BIO 183.
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.

PB 345 Economic Botany 3.
Prerequisite: BIO 181 or PB 200 or PB 250.
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.

PB 346 Economic Botany Lab 1.
Prerequisites: BIO 181 or PB 200 or PB 250; Co-requisite: PB 345.
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.

PB 360 Ecology 4.
Prerequisite: C or better in BIO 181.
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.
PB 400 Plant Structure and Diversity 4.
Prerequisite: BIO 181 or PB 200 or PB 250.
Survey of the structure and diversity of plants. Emphasis on anatomy, including cells, tissue systems, and organs, morphology, evolutionary trends, adaptive strategies, and bases for assumed phylogenetic relationships of fossil as well as living forms. Two one-day weekend field trips.

PB 403 Systematic Botany 4.
Prerequisite: PB 200, PB 250, BIO 183, Junior standing.
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.

PB 405 Wetland Flora 3.
Prerequisite: PB 200 or PB 250 or PB 321 or PB 421.
Plant morphological terminology and identifications of wetland plants; discussion of wetland flora, plant communities, functions and values of North Carolina wetland types; several one-day weekend field trips required.

PB 413 Plant Anatomy 2.
Prerequisite: PB 200 or PB 250 or PB 321 or PB 421.
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.

PB 414 Cell Biology 3.
Prerequisite: C- or better in BIO 183 and (CH 221 or CH 225).
The chemical and physical bases of cellular structure and function with emphasis on methods and interpretations.

PB 421 Plant Physiology 3.
Prerequisite: BIO 183 or ZO 160, or PB 200 and CH 220 or CH 221 or CH 225.
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.

PB 445 Paleobotany 4.
Prerequisite: BIO 181 or MEA 102.
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.

PB 464 Rare Plants of North Carolina 3.
Prerequisite: One of the following: (PB 200, PB 220, PB 403, or PB 405).
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.

PB 476 Applied Bioinformatics 2.
Prerequisite: BIT 410 or BCH 454 or GN 311.
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.

PB 480 Introduction to Plant Biotechnology 3.
Prerequisite: BCH 454 or BIT 410 or CS 211 or GN 311 or PB/BIO 414 or PB 421.
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.

PB 481 Plant Tissue Culture and Transformation 2.
Prerequisite: BIT 360 or MB 409 or BCH 454 or ZO 480.
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.

PB 492 External Learning Experience 1-6.
Prerequisite: Sophomore standing.
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.

PB 493 SP Problems in BO 1-6.
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.

PB 495 Special Topics in Botany 1-6.
Prerequisite: 8 hrs. of Botany courses.
Individualized study, under faculty supervision, of botanical topics in the student’s area of interest and not covered in existing courses. Development of a new course on a trial basis.

PB 501 Biology of Plant Pathogens 3.
Prerequisite: PP 315, or PP 318, or an introductory course in microbiology.
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.
PB 503 Systematic Botany 4.
Prerequisite: PB 200, PB 250, BIO 183, Junior standing.
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.

PB 513 Plant Anatomy 2.
Prerequisite: PB 200 or PB 250 or PB 321 or PB 421.
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 receive credit for both PB 413 and PB 513.

PB 545 Paleobotany 4.
Prerequisite: PB 400, 403, 413, 544, MEA 423.
Morphologic, taxonomic, geologic and evolutionary relationships of fossil plants; emphasis on vascular plants; discussions of taphonomy, biogeography and palynology. Required field trips.

PB 564 Rare Plants of North Carolina 3.
Prerequisite: One of the following: (PB 200, PB220, PB 403, or PB 405).
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: PB 360 or ZO 260.
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.

PB 570 Plant Functional Ecology 3.
Prerequisite: PB/BIO 360.
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.

PB 575 Introduction to Mycology 4.

PB 580 Introduction to Plant Biotechnology 3.
Prerequisite: BCH 454 or BIT 410 or CS 211 or GN 311 or PB/BIO 414 or PB 421.
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.

PB 595 Special Topics Botany 1-4.

PB 601 Botany Seminar 1.

PB 620 Special Problems in Botany 1-4.
Directed research in some phase of botany other than a thesis problem, but designed to provide experience and training in research. Credits Arranged.

PB 624 Topical Problems 1-4.
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.

PB 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

PB 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's Student.
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.

PB 689 Non-Thesis Masters Continuous Registration - Full Time Registration 3.
Prerequisite: Master's Student.
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.

PB 690 Master's Examination 1-6.
Prerequisite: Master's Student.
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.

PB 693 Master's Supervised Research 1-9.
Prerequisite: Master's Student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's Student.
Thesis Research.

PB 696 Summer Thesis Research 1.
Prerequisite: Master's Student.
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.
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.
PB 704 Plant Nomenclature 1
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.

PB 730 Fungal Genetics and Physiology 3
Prerequisite: BCH 451, PB 575, GN 411 or PP 501.
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.

PB 733 Plant Growth and Development 3
Prerequisite: PB(ZO) 414 or PB 421, organic chemistry.
Advanced course in plant physiology covering plant growth, development, differentiation, senescence and biological control mechanisms.

PB 751 Advanced Plant Physiology I 3
Prerequisite: PB 421.
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.

PB 774 Phycology 3
Prerequisite: BIO 125 or PB 200.
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.

PB 780 Plant Molecular Biology 3
Prerequisite: BCH 451, GN 411.
Molecular analysis of plant growth and development. Molecular techniques and their application to understanding control of gene expression in plants.

PB 795 Special Topics Botany 1-4.

PB 801 Seminar 1.

PB 820 Special Problems 1-4.
Directed research in some phase of botany other than a thesis problem, but designed to provide experience and training in research. Credits Arranged.

PB 824 Topical Problems 1-4.
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.

PB 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral Student.
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.

PB 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral Student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral Student.
Dissertation Research.

PB 896 Summer Dissertation Research 1.
Prerequisite: Doctoral Student.
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.
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.

PCC - Polymer and Color Chemistry Courses

PCC 101 Introduction to Polymer and Color Chemistry 2.
Corequisite: PCC 104.
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.

PCC 104 Introduction to Polymer and Color Chemistry Lab 1.
Corequisite: PCC 101.
An introduction to hands-on laboratory work for the study of basic polymer principles, dye synthesis, forensic analysis and coloration of fibers.

PCC 106 Polymer Chemistry and Environmental Sustainability 3.
Prerequisite: CH 101 or CH 103; Corequisite: CH 221 or CH 225.
Polymers 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 introduced and concepts for establishing sustainable polymers will be discussed.

PCC 203 Introduction to Polymer Chemistry 3.
Prerequisite: CH 101 and (MT 105 or TT 105 or PCC 101).
Organic reaction principles necessary to understand the preparation, properties and chemistry of polymers. Synthesis, applications and behavior of common classes of polymers with emphasis on those materials used in the textile industry. The chemistry and structure of natural and man-made fibers.

PCC 274 Introduction to Forensic Science 3.
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.
PCC 301 Technology of Dyeing and Finishing 3.
Prerequisite: PCC 106 or PCC 203 or TE 200 and Corequisite: PCC 304.
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.

PCC 302 Technology of Textile Wet Processing 4.
Prerequisite: (TT 105 or MT 105 or PCC 101) and TMS 211 and CH 101 and (PY 211 or PY 205).
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.

PCC 304 Technology of Dyeing & Finishing Laboratory 1.
Prerequisite: PCC 106 or PCC 203 or TE 200 and Corequisite: PCC 301.
Laboratory experience involving the preparation, dyeing, printing, and finishing of natural and man-made fibers.

PCC 350 Introduction to Color Science and Its Applications 2.
Prerequisite: PCC 301 and either PY 208 or PY 212; Corequisite: PCC 354.
Basic principles and applications of color science. Physical, physiological and psychophysical aspects of color, color perception, color specification, color measurement and color control.

PCC 354 Intro to Color Science Laboratory 1.
Prerequisite: PCC 301 and either PY 208 or PY 212; Corequisite: PCC 350.
An introduction to hands-on laboratory work for the color measurement and perception of colored materials.

Prerequisite: Junior standing.
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.

PCC 402 Introduction to the Theory and Practice of Fiber Formation 3.
Prerequisite: TE 200 and (CH 201 or CH 203) and (PY 208 or PY 212) and (MA 231 or MA 241).
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.

PCC 410 Textile Preparation and Finishing Chemistry 3.
Prerequisite: PCC 301.
Topics in textile wet processing. Chemical mechanisms and unit operations in fabric preparation and finishing.

PCC 412 Textile Chemical Analysis 2.
Prerequisite: PCC 301 and (CH 331 or CH 433 or TE 303); Corequisite: PCC 414.
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 quantiative and characterization purposes.

PCC 414 Textile Chemistry Analysis Lab 1.
Prerequisite: PCC 301 and (CH 331 or CH 433 or TE 303); Corequisite: PCC 412.
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 quantitative and characterization purposes.

PCC 420 Textile Dyeing and Printing 3.
Prerequisite: PCC 301.
Topics in coloration of textile fibers; chemical and physical mechanisms in textile dyeing and printing.

Prerequisite: TE 303 or CH 331 or CH 433.
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.

PCC 461 Chemistry of Polymeric Materials 3.
Prerequisite: (CH 220 and TE 200) or CH 223 or CH 227; Corequisite: PCC 464.
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.

PCC 462 Characterization and Physical Properties of Polymers 3.
Prerequisite: PCC 461.
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.

PCC 464 Chemistry of Polymeric Materials Laboratory 1.
Prerequisite: (CH 220 and TE 200) or CH 223 or CH 227; Corequisite: PCC 461.
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 using step-growth and chain-growth polymerization techniques. The properties of the resultant polymers are studied.
PCC 466 Polymer Chemistry Laboratory 3.
Prerequisite: (CH 331 or TE 303 or CH 433) and Senior Standing.
Synthesis and characterization of polymers; thermodynamics of rubber elasticity and gelation; spectroscopic, thermal and scattering techniques for polymer processing. The analysis of polymers into fibers and films.

PCC 471 The Chemistry of Synthetic and Natural Bipolymers 3.
Prerequisite: CH 220 or 221 or 225.
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.

PCC 474 Forensic Chemistry Laboratory 3.
Prerequisite: (CH 220 or CH 223 or CH 227) and TMS 211.
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.

PCC 490 Undergraduate Research in Polymer and Color Chemistry 1-6.
Prerequisite: PCC 301 and PCC 461/CH 461 and (TE 303 or CH 331 or CH 433).. 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.

PCC 491 Seminar in Polymer and Color Chemistry 1.
Prerequisite: Senior standing.
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 majors.

PCC 492 Special Topics in Polymer and Color Chemistry 3.
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.

PER - Foreign Language - Persian Courses

PER 101 Elementary Persian I 3.
Elementary Persian 101 is a beginning course for students who have little or no prior knowledge of the language. It is designed to give the students an introduction to the phonology, morphology, and script of Persian which will develop, by the end of the semester, into outcome skills including the ability to read aloud and comprehend written texts from dictation, and carry on conversations at elementary levels. A textbook with grammar explanations in English is supplemented with tapes and videos of authentic language and culture used in situational communication.

PER 102 Elementary Persian II 3.
Prerequisite: Elementary Persian 101 (PER 101) or instructor's permission..
Elementary Persian 102 is the second-semester continuation of Persian 101. It continues and develops the students' familiarity with and command of the written and spoken forms of the language by actively involving them in communicative activities at the first-year level. A textbook with grammar explanations in English is supplemented with tapes and videos of authentic language and culture used in situational communication.

PER 201 Intermediate Persian I 3.
Prerequisite: Elementary Persian 102, or instructor's permission.
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 and sophisticated communicational contexts. An intermediate textbook with grammar explanations in English is supplemented with tapes and videos of authentic language and culture used in situational communication.

PER 202 Intermediate Persian II 3.
Prerequisite: Elementary Persian (PER 201) or instructor's permission.
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.

PES - Physical Education - Sports Courses

PEC - Physical Education - Coaching Courses

PEF - Physical Education - Fitness Courses

PEH - Physical Education - Health Courses

PEHL - Physical Education/Healthy Living Courses

PEHL 295 Physical Education/Healthy Living Special Topics 1-2.
Special topics course offering for the general education Physical/Healthy Living category.

PEO - Physical Education - Other Courses

PHI - Philosophy Courses

PHI 205 Introduction to Philosophy 3.
Credit is not allowed for both PHI 205 and PHI 210..
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.

PHI 210 Representation, Reason and Reality 3.
Credit is not allowed for both PHI 210 and PHI 205.
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.
PHI 214 Issues in Business Ethics 3.
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.

PHI 221 Contemporary Moral Issues 3.
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.

PHI 250 Thinking Logically 3.
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.

PHI 298 Special Topics in Philosophy 3.
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.
Western philosophy of the ancient world, with special emphasis on Plato and Aristotle.

PHI 301 Early Modern Philosophy 3.
Western philosophy of the 17th and 18th centuries, including such philosophers as Descartes, Hobbes, Leibniz, Locke, Berkeley, Hume, and Kant.

PHI 302 19th Century Philosophy 3.
Western philosophy of the 19th century, including such philosophers as Kant, Hegel, Schopenhauer, Kierkegaard, Marx, and Nietzsche.

PHI 305 Philosophy of Religion 3.
The existence and nature of God, including such topics as traditional proofs of God, skeptical challenges to religious belief, miracles, the problem of evil, faith and reason, and religious experience.

PHI 309 Contemporary Political Philosophy 3.  
Prerequisite: One PHI course.
Current theories about basic concepts in political philosophy, such as liberty, equality, justice, natural rights, and democracy, with special attention to disputes concerning the nature of a just social order.

PHI 310 Existentialism 3.
Philosophy of Existentialism, including such thinkers as Kierkegaard, Nietzsche, Doestoevsky, Sartre, Heidegger, and Camus.

PHI 312 Philosophy of Law 3.
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.

PHI 313 Ethical Problems in the Law 3.
Prerequisite: PHI 221, or 375.
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.

PHI 325 Bio-Medical Ethics 3.
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.

PHI 330 Metaphysics 3.  
Prerequisite: One PHI course.
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.

PHI 331 Philosophy of Language 3.  
Prerequisite: One PHI course.
Introduction to traditional and modern accounts of the relations between language and reality, the nature of truth, problems of intentionality and propositional attitudes.

PHI 332 Philosophy of Psychology 3.  
Prerequisite: One PHI course or one PSY course.
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.

PHI 333 Knowledge and Skepticism 3. 
Prerequisite: One PHI course.
Analysis of such central concepts as knowledge, belief, and truth, and the investigation of the principles by which claims to knowledge may be justified.

PHI 340 Philosophy of Science 3.
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.

PHI 375 Ethics 3.
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.

PHI 376 History of Ethics 3.  
Prerequisite: One PHI course.
Topics in the history of ethics. Philosophers to be studied may include Plato, Aristotle, Aquinas, Butler, Hume, Kant, Sidgwick and Nietzsche.

PHI 401 Kant's Critique of Pure Reason 3.  
Prerequisite: 6 credits in PHI. Credit is not allowed for both PHI 401 and PHI 501.
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.

PHI 420 Global Justice 3.  
Prerequisite: One PHI course. Credit is not allowed for both PHI 420 and PHI 520.
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.
PHI 425 Introduction to Cognitive Science 3.
Prerequisite: One upper-level PHI, PSY, CSC or Linguistics course.
Credit is not allowed for PHI 425 and PHI/PSY 525.
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.

PHI 440 The Scientific Method 3.
Prerequisite: One PHI course. Credit is not allowed for both PHI 440 and PHI 540.
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.

PHI 447 Philosophy, Evolution and Human Nature 3.
Prerequisite: One 300 level or higher course in Philosophy, Biology, Psychology or Anthropology. Credit is not allowed for PHI 447 and PHI 547.
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.

PHI 475 Ethical Theory 3.
Prerequisite: PHI 375 or PHI 376. Credit is not allowed for both PHI 475 and PHI 575.
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.

PHI 494 Research and Writing in Ethics 1.
Prerequisite: PHI 250 or LOG/MA 201 or LOG/MA 335 and one other PHI course. Corequisite: One of (PHI 275,298,306,309,310, 311, 313,325,375, 376, 420, 422, 475, or 498).
A substantial paper in ethics, assigned by the instructor of the corequisite; enrollment subject to departmental approval; may be repeated for credit.

PHI 495 Research and Writing in History of Philosophy 1.
Prerequisite: PHI 250, LOG 201 or 335 and one other PHI course. Corequisite: One of PHI 298, 300, 301, 302, 303, 310, 401 or 498.
A substantial paper in history of philosophy, assigned by the instructor of the corequisite; enrollment subject to departmental approval; may be repeated for credit.

PHI 496 Research and Writing in Contemporary Philosophy 1.
Prerequisite: PHI 250, LOG 201 or 335 and one other PHI course. Corequisite: One of PHI 298, 305, 306, 330, 331, 332, 333, 340, 425, 440, 445, 447 or 498.
A substantial paper in contemporary philosophy, assigned by the instructor of the corequisite; enrollment subject to departmental approval; may be repeated for credit.

PHI 497 Research and Writing in Logic, Representation and Reasoning 1.
Prerequisite: LOG 201 or 335, and one other PHI course, not PHI 250, Corequisite: One of LOG 335, 435/535, 437, PHI 298, 330, 331, 332, 333, 340, 425/525, 440/540, 445/545, 447.
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.

PHI 498 Special Topics in Philosophy 1-6.
Prerequisite: Six credits in PHI courses.
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.

PHI 501 Kant's Critique of Pure Reason 3.
Prerequisite: Graduate Standing. Credit is not allowed for both PHI 501 and PHI 401.
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.

PHI 520 Global Justice 3.
Prerequisite: Graduate standing. Credit is not allowed for both PHI 520 and PHI 420.
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. Students cannot receive credit for both PHI 420 and PHI 520.

PHI 540 Introduction To Cognitive Science 3.
Prerequisite: Graduate standing. Credit is not allowed for PHI 525 and PHI/PSY 425.
Philosophical foundations and empirical fundamentals of cognitive science, an interdisciplinary approach to human cognition. 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.

PHI 547 Philosophy, Evolution and Human Nature 3.
Prerequisite: Graduate standing. Credit is not allowed for both PHI 547 and PHI 447.
Students cannot receive credit for both PHI 447 and PHI 547. Graduate Standing Required.
Core philosophical issues in the evolutionary study of human cognition: the role of adaptationism; the value of psychological vs. behavioral approaches; the phenotypic gambit; the evolution of mortality and altruism; the nature of cultural evolution; innateness, genetic determinism and development; and case studies of evolutionary explanation of human behavior and psychology. Students cannot receive credit for both PHI 447 and PHI 547. Graduate standing required.
PHI 575 Ethical Theory 3.
Prerequisite: Graduate Standing. Credit is not allowed for both PHI 575 and PHI 475.
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. Students cannot receive credit for both PHI 475 and PHI 575.

PHI 598 Special Topics in Philosophy 3.


Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

PHI 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.
Thesis Research.

PHI 696 Summer Thesis Research 1.
Prerequisite: Graduate standing.

PHI 698 Special Topics in Philosophy 3.
Prerequisite: Graduate standing.

PHY 421, BCH 451, a year of physics.

PHY 503 General Physiology I 3.
Prerequisite: Senior standing or Graduate standing, the following courses are recommended: ZO 421, BCH 451, a year of physics.
Discussion of general principles of homeostasis, emphasizing importance of integrative action. Following systems studied: muscular, cardiovascular and nervous systems.

PHY 504 General Physiology II 3.
Prerequisite: PHY (ZO) 503.
Discussion of general principles of homeostasis, emphasizing importance of integrative action. Following systems studied: alimentary, renal, respiratory and endocrine systems.

PHY 524 Comparative Endocrinology 3.
Prerequisite: BIO 421 or PO 405.
Basic concepts of endocrinology, including functions of major endocrine glands involved in processes of growth, metabolism and reproduction.

PHY 552 Advanced Reproductive Physiology and Biotechnology 3.
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 will not be given for both ANS 452 and ANS(PHY) 552.

PHY 595 Special Topics in Physiology 1-3.

PHY 601 Physiology Seminar 1.
Prerequisite: Graduate standing.

PHY 602 Seminar In Biology Of Reproduction 2.
Prerequisite: ANS(PHY) 702.
Current topics in animal reproduction presented by reproductive physiologists from various Research Triangle institutions. Student presentations of research projects or library projects in area of animal reproduction.

PHY 610 Special Topics In Physiology 1-4.
Prerequisite: Graduate standing.

PHY 620 Special Problems In Physiology 1-3.
Prerequisite: Graduate standing.
Credits Arranged.

PHY 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

PHY 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

PHY 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

PHY 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

PHY 696 Summer Thesis Research 1.
Prerequisite: Graduate standing.

PHY 702 Reproductive Physiology of Mammals 3.
Prerequisite: ZO 421.
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.
PHY 764 Advances in Gastrointestinal Pathophysiology 3.
Prerequisite: PHY 503, PHY 504.
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.

PHY 780 Mammalian Endocrinology 3.
Prerequisite: BCH 451, ZO 421.
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.

PHY 785 Special Topics in Physiology 1-4.
Prerequisite: Graduate standing.

PHY 801 Physiology Seminar 1.
Prerequisite: Graduate standing.

PHY 802 Seminar In Biology Of Reproduction 2.
Prerequisite: ANS(PHY) 702.
Current topics in animal reproduction presented by reproductive physiologists from various Research Triangle institutions. Student presentations of research projects or library projects in area of animal reproduction.

PHY 803 Special Topics In Physiology 1-4.
Prerequisite: Graduate standing.

PHY 820 Special Problems In Physiology 1-3.
Prerequisite: Graduate standing.
Credits Arranged.

PHY 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

PHY 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation Research.

PHY 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

PO - Poultry Science Courses

PO 100 Principles of Livestock and Poultry Production 3.
General Information on production practices for poultry, beef cattle, dairy cattle, sheep, goats, horses, pigs, and aquaculture. The student will learn general terminology, reproductive systems, nutrition, management, animal selection, animal welfare, marketing, and meats. There is no lab for this course. Offered via distance education. The prerequisite is a high school diploma or equivalent.

PO 111 Poultry Production 3.
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.

PO 150 Poultry Management 3.
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.

PO 152 Poultry Commercial Applications 3.
Modern poultry industry vertical integration of industry structure, breeding stock management, pest control, ventilation and environmental control, sanitation and biosecurity, waste management, processing, and financing a poultry operation.

PO 162 Livestock and Poultry Disease Management 3.
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.

PO 201 Poultry Science and Production 3.
Fundamental principles of broiler, turkey and egg production including poultry physiology, breeding, incubation, housing, nutrition, disease control, management and marketing.

PO 201A Poultry Science and Production 3.
Fundamental principles of broiler, turkey and egg production including poultry physiology, breeding, incubation, housing, nutrition, disease control, management and marketing.

PO 202 Poultry Science and Production Laboratory 1.
Corequisite: PO 201.
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.

PO 202A Poultry Science and Production Laboratory 1.
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.
PO 290 Poultry Seminar 1.
Prerequisite: Sophomore standing.
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.

PO 322 Muscle Foods and Eggs 3.
Prerequisite: ZO 160, BIO 181 or BIO 183.
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: PO 201.
To provide students with experience handling live poultry as well as working with an understanding about USDA grades and evaluation of poultry meat, meat products, and eggs. Develop an understanding of product specifications.

PO 350 Introduction to HACCP 3.
Introductory course on the Hazard Analysis and Critical Control Points System (HACCP) which is designed to decrease hazards in foods. An International HACCP Alliance approved curriculum which covers prerequisite programs. A step by step approach for developing and implementing a HACCP plan for USDA regulated food processing plants. Offered only as a world wide web course through the Office of Instructional Telecommunications.

PO 404 Avian Anatomy and Physiology 4.
Prerequisite: PO 201.
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 environmental influences on physiological systems. Credit not given for PO 404 and 504.

PO 406 Physiological Aspects of Poultry Management 3.
Prerequisite: PO 201, Corequisite: PO 407.
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.

PO 407 Physiological Aspects of Poultry Management Laboratory 1.
Prerequisite: PO 201, Corequisite: PO 406.
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.

PO 410 Production and Management of Game Birds in Confinement 3.
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.
Junior standing or above.
This course is designed to increase the awareness of the issues and vulnerabilities of the US 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.

PO 415 Comparative Nutrition 3.
Prerequisite: ANS 225 or ANS 230 or CH 220 or CH 223 or CH 227.
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.

PO 421 Commercial Egg Production 2.
Prerequisite: PO 201.
Principles and current practices of commercial egg production.

PO 422 Incubation and Hatchery Management 2.
Prerequisite: PO 201.
Principles and current practices of hatching egg production, incubation, and hatchery management, beginning with the placement of broiler breeder chicks on the breeder farm and ending with the placement of chicks at the brooding facility.

PO 424 Poultry Meat Production 3.
Prerequisite: PO 201.
Principles and current practices of vertically integrated broiler and turkey production; encompassing management, nutrition, poultry health, environmental, and related areas.

PO 425 Feed Manufacturing Technology 3.
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 433 Poultry Processing and Products 3.
Prerequisite: PO 201.
Poultry processing, further processing, and resulting products as affected by basic muscle composition and function during the conversion 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.

PO 435 Poultry Incubation & Breeding 4.
Prerequisite: PO 201.
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 those 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.

PO 492 External Learning Experience 1-6.
Prerequisite: Sophomore standing.
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.

PO 493 Special Problems in Poultry Science 1-6.
Prerequisite: Sophomore standing.
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.

PO 495 Special Topics in Poultry Science 1-3.
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

PO 504 Avian Anatomy and Physiology 4.
Prerequisite: PO 201.
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 environmental influences on physiological systems. Credit not given for PO 404 and 504.

PO 506 Physiological Aspects of Poultry Management 3.
Prerequisite: PO 201.
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.

PO 510 Poultry Product Safety: An On-Farm Model 3.

PO 515 Advanced Comparative Nutrition 3.
An in-depth presentation of core nutrition principles stressing the role nutrient availability plays in digestive and metabolic adaptations of a variety of animal species. Consideration will be given to translational biomedical nutrition issues that apply to both human and animal health. Students are expected to develop a term paper suitable for submission in a peer-reviewed scientific journal that reviews the latest information in metabolic or digestive adaptations of a specific species as related to nutritional processes. Credit will not be allowed for both ANS/NTR/PO 415 comparative Nutrition and NTR/PO 515 Advanced Comparative Nutrition.

PO 524 Comparative Endocrinology 3.
Prerequisite: BIO 421 or PO 405.
Basic concepts of endocrinology, including functions of major endocrine glands involved in processes of growth, metabolism and reproduction.

PO 533 Poultry Processing and Products 3.
Prerequisite: PO 201.
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.

PO 566 Animal Cell Culture Techniques 2.
Prerequisite: BIT 360 or BIT 810 equivalent.
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, second part.

PO 580 Feed and Ingredient Quality Assurance 3.
Prerequisite: NTR(FM) 525.
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.

PO 590 Special Problems in Poultry Science 3.

PO 601 Seminar 1.
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.

PO 620 Special Problems 1-6.
Prerequisite: Graduate standing.
Specific problems of study assigned in various phases of poultry science.
PO 685 Master’s Supervised Teaching 1-3.
Prerequisite: Master’s student.
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.

PO 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master’s student.
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.

PO 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master’s student.
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.

PO 690 Master’s Examination 1-6.
Prerequisite: Master’s student.
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.

PO 693 Master’s Supervised Research 1-9.
Prerequisite: Master’s student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

PO 695 Master’s Thesis Research 1-9.
Prerequisite: Master’s student.
Thesis Research.

PO 696 Summer Thesis Research 1.
Prerequisite: Master’s student.
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.

PO 699 Master’s Thesis Preparation 1-9.
Prerequisite: Master’s student.
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.

PO 757 Comparative Immunology 3.
Prerequisite: MB 751 or MB 441 or BIO 414.
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.

PO 775 Mineral Metabolism 3.
Prerequisite: ANS(NTR,PO) 415, BCH 451 and ZO 421.
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.

PO 801 Graduate Seminar In Poultry Science 1.
Prerequisite: Master’s student.
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.

PO 820 Special Problems In Poultry Science 1-6.
Prerequisite: Graduate standing.
Specific problems of study assigned in various phases of poultry science.

PO 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

PO 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

PO 893 Doctoral Supervised Research 1-9.
Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation Research.

PO 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

PP - Plant Pathology Courses

PP 144 Weeds & Diseases of Ornamentals 3.
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.

PP 150 Introduction to Plant Molecular Biology 3.
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 (SCI/IBLS) and other pre-college, transitional and early-college programs. Students must have no more than 30 credit hours. Department approval required.
PP 154 Turf Weed and Disease Management 3.
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.

PP 155 Diseases of Ornamentals and Turfgrasses 3.
Causes, development, identification and management of diseases of greenhouses and landscape ornamentals and turfgrasses. WARFIELD.

PP 222 Kingdom of Fungi 3.
Prerequisite: Any 100-level course in Biology or 200-level course in Plant Biology.
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.

PP 241 The Worm's Tale: Parasites In Our Midst 3.
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.

PP 315 Principles of Plant Pathology 4.
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.

PP 318 Forest Pathology 3.
Prerequisite: PB 200.
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.

PP 450 Challenges in Plant Resource Protection 3.
Prerequisite: CS 414 or ENT 425 or PP 315.
This course provides applied training to students in the scientific and regulatory aspects of plant protection using real-world studies, scenarios, and addressing important contemporary issues for safeguarding American agriculture. Students will gain hands-on problem solving abilities regarding the diagnosis, containment, and mitigation of introduced plant pests and pathogens.

PP 460 Fundamentals of (Pest) Risk Analysis 1.
This course provides students with a historical perspective as well as real-time exposure to working professionals involved in the development of risk analysis documents for plant protection. The course uses real world scenarios and addresses contemporary issues facing scientists and regulators tasked with safeguarding American agriculture. Students will gain hands-on problem solving abilities regarding the identification and mitigation of plant pathogens, insects, and noxious weeds that can be introduced into the USA through international trade in agricultural commodities.

PP 470 Advanced Turfgrass Pest Management 2.
Prerequisite: C- or better in CS 200.
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.

PP 492 External Learning Experience 1-6.
Prerequisite: Sophomore standing.
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.

PP 493 Special Problems in Plant Pathology 1-6.
Prerequisite: Sophomore standing.
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.

PP 495 Special Topics in Plant Pathology 1-3.
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

PP 500 Plant Disease: Principles, Diagnosis and Management 4.
Prerequisite: B.S. degree in Plant Sciences.
A one-semester survey of plant pathology. Principles of plant pathology for diagnosis and control of plant diseases, principally for county agents and non-plant pathology graduate students.

PP 501 Biology of Plant Pathogens 3.
Prerequisite: PP 315, or PP 318, or an introductory course in microbiology.
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.
PP 502 Plant Disease: Methods & Diagnosis 2.
Prerequisite: PP 315.
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.

PP 506 Epidemiology and Plant Disease Control 3.
Prerequisite: PP 315 or PP 318.
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.

PP 530 Agriculture, Ethics and the Environment 3.
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.

PP 540 Tropical Plant Pathology 2.
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 Rice 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.

PP 575 Introduction to Mycology 4.

PP 590 Special Topics 1-3.
PP 601 Seminar 1.
Discussion of assigned phytopathological topics.

PP 615 Advanced Special Topics in Plant Pathology 1-3.
Prerequisite: PP 501, 502, Corequisite: ST 511.
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

PP 620 Special Problems 1-6.
Investigation of special problems in plant pathology not related to thesis problem. Investigations may consist of original research and/or literature survey.

PP 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

PP 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

PP 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

PP 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

PP 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.


Prerequisite: Graduate standing.
Original research in plant pathology.

PP 707 Plant Microbe Interactions 3.
Prerequisite: PP 501.
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.

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 Ecology of Soil Ecosystems 3.
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.

An interdisciplinary course primarily focusing on the interactions between soil organisms and their environment, and the ecological consequences of these diverse complex interactions. A broad range of topics, including soil biodiversity, plant-microbial interactions, trophic interactions, energy flow and nutrient cycling, and microbial controls over plant and ecosystem responses to natural and anthropogenic perturbation (e.g., tillage or global change components) are addressed.

PP 728 Soilborne Plant Pathogens 3.
Prerequisite: PP 501, 502.

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.

PP 730 Fungal Genetics and Physiology 3.
Prerequisite: BCH 451, BO 775, GN 411 or PP 501.

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.

PP 790 Special Topics 1-3.

PP 795 Advanced Special Topics 1.

PP 801 Seminar in Plant Pathology 1.
Discussion of assigned phytopathological topics.

PP 810 Special Topics 1-3.

PP 815 Advanced Special Topics 1-3.

PP 820 Special Problems in Plant Pathology 1-6.
Investigation of special problems in plant pathology not related to thesis problem. Investigations may consist of original research and/or literature survey.

PP 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

PP 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation Research.

PP 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

PRK - Park Scholars Courses

PRK 102 Topics in Scholarship, Leadership, and Service II 0.
Prerequisite: PRK 101, restricted to Park Scholars.
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.

PRK 202 Topics in Scholarship, Leadership, and Service IV 0.
Prerequisite: PRK 201, restricted to Park Scholars.
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.

PRK 302 Topics in Scholarship, Leadership, and Service VI 0.
Prerequisite: PRK 301, restricted to Park Scholars.
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.

PRK 402 Topics in Scholarship, Leadership and Service VIII 0.
Prerequisite: PRK 401, restricted to Park Scholars.
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.

PRT - Parks, Recreation, and Tourism Management Courses

PRT 150 Parks, Recreation and Tourism Management Orientation 1.
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.
PRT 152 Introduction to Parks, Recreation and Tourism 3.
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.

PRT 156 Professional Golf Management Orientation 3.
Prerequisite: PGM Majors.
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.

PRT 200 Leisure Behavior, Health and Wellness 3.
Leisure as a lifelong resource for human satisfaction and fulfillment; its potential for physical, mental, social and emotional growth and emotional growth and development of the individual. Leisure opportunity areas presented and evaluated.

PRT 210 Golf Management I 1.
Prerequisite: PRT 156.
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.

PRT 211 Golf Management II 1.
Prerequisite: PGM Majors, PRT/PEG 210.
Advanced concepts, techniques, and practices of teaching golf; golf club design and repair.

PRT 212 Golf Instructor Development 2.
Prerequisite: PRT 156 and PRT 210.
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.

PRT 214 Introduction to Adventure Education 3.
History and philosophy, social psychology of adventure, theories of adventure, benefits, risk-taking behavior, current needs and issues, research and evaluation, and model programs. Field trip required. Students are responsible for their own transportation for field trip.

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.

PRT 220 Commercial Recreation and Tourism Management 3.
Prerequisite: PRT 152.
Commercial recreation and the tourism industry, including its origin, present characteristics, behavioral foundations and societal impacts. Emphasis on recreation administration in the commercial sector.

PRT 238 Diversity and Inclusion in Recreation and Sport 3.
Prerequisite: PRT 152.
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.

PRT 250 Management of Park and Recreation Facilities 3.
Prerequisite: PRT 152.
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.

PRT 266 Introduction to Sport Management 3.
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.

PRT 277 Psychological & Cultural Dimensions of Sport 3.
Prerequisite: Sport Management or PRT Majors, PRT 266.
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.

PRT 286 Writing and Speaking in Sports Organizations 3.
Prerequisite: Sport Management or PRT Majors, PRT 266.
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.

PRT 292 External Learning Experience 1-3.
Prerequisite: PRT 152 and Sophomore Standing.
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.

PRT 293 Independent Study in Parks, Recreation, & Tourism Management 1-6.
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.
PRT 294 Independent Study in Parks, Recreation, & Tourism Management 1-6.
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.

PRT 295 Special Topics in Parks, Recreation, and Tourism Management 1-3.
Special topics in the Department of Parks, Recreation, and Tourism Management at the 200 level for offering of courses on an experimental basis.

PRT 311 Golf Course Turf Grass Management 3.
Prerequisite: PGM Majors, Sophomore standing, PRT 211.
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.

PRT 312 Golf Management III 1.
Prerequisite: PGM Majors, PRT 311.
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.

PRT 315 Organization and Administration of Adventure Programs 3.
Prerequisite: PRT 152.
Overview of the organizational and administration of adventure programs and services, professional standards, programming, management, staffing, budgeting, public relations, liability and risk management.

PRT 320 Convention and Visitor Services 3.
Prerequisite: PRT 152.
An examination of the programmatic issues of providing visitor services for conventions, meetings, group tours and special events. The focus is on the planning and delivery of visitor service programs designed to enhance visitor experiences in a community.

PRT 350 Outdoor Recreation Management 3.
Prerequisite: PRT 152.
Concepts and methods of outdoor recreation planning and management explored with emphasis on the public sector. Current issues relative to recreation provision identified and debated.

PRT 351 Outdoor Consortium 3.
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 week-long field experience that may conflict with other scheduled courses. Field experience held in conjunction with four other universities in the Great Smoky Mountains National Park. A fee will be assessed for the trip.

PRT 358 The Recreation Program 3.
Prerequisite: PRT 152.
Theoretical and applied approaches to the recreation program planning process. Basic elements of programming using a variety of recreational settings and diversity of practical experience.

PRT 359 Leadership and Supervision in Recreation 3.
Prerequisite: PRT 250.
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.

PRT 366 Sport Programming 3.
Prerequisite: Sport Management and PRT Majors, PRT 266.
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.

PRT 375 Internship Orientation 1.
Prerequisite: PRT 152.
Preparation for recreation and park internship. Resume writing, interviewing skills, cover letters and internship search techniques and resources.

PRT 376 Sport Administration 3.
P: PRT 266 and Sports Management students only.
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.

PRT 380 Analysis and Evaluation in Parks, Recreation 3.
Prerequisite: 300-level Statistics course, PRT 359.
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 systematic evaluation designs. Activities leading to the analysis and development of performance reports to assess and improve managerial operational efficiency are covered.

PRT 406 Sports Law 3.
Prerequisite: Junior standing.
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 well as key state and federal statutory legislation such as civil rights and antitrust.

PRT 407 Services, Facilities and Event Marketing 3.
Prerequisite: PRT 358.
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.

PRT 410 Food and Beverage Management 3.
Prerequisite: PGM Majors, Junior standing, PRT 312.
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.
PRT 411 Club Management 3.  
**Prerequisite:** Junior standing, PRT 152.  
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.

PRT 412 Golf Course Architecture 3.  
**Prerequisite:** PRT 211.  
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.

PRT 413 Golf Management IV 1.  
**Prerequisite:** PGM Majors, PRT 312, Senior standing.  
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.

PRT 414 PGA Apprentice Program Completion 0.  
**Prerequisite:** PGM Majors.  
Checkpoint mechanism to register the successful completion of the Professional Golfers’ Association Apprentice requirement.

PRT 419 Sustainable Tourism 3.  
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.

PRT 420 Resort Planning and Management 3.  
**Prerequisite:** PRT 152.  
Theory and practical applications of planning, accommodations management, food and beverage operations, recreation programs and management in the resort industry.

PRT 430 Tourism, Poverty, and Health 3.  
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 posed 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.

PRT 442 Recreation and Park Interpretive Services 3.  
**Prerequisite:** Junior standing.  
The principles and practices of environmental and historical interpretation. Personal (attended) and non-personal (unattended) interpretive communication techniques. Comprehensive planning and implementation of interpretive programs, and equipment and facilities used in environmental and historical interpretation. One overnight field trip required.

PRT 449 Human Dimensions of Natural Resources in Australia/New Zealand 3.  
**Corequisite:** PRT 450.  
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.

PRT 450 Sustaining Natural Resources in Australia/New Zealand 3.  
**Corequisite:** PRT 449.  
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.

PRT 451 Principles of Recreation Planning and Facility Development 3.  
**Prerequisite:** PRT 358.  
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.

PRT 454 Parks and Recreation Finance and Administration 3.  
**Prerequisite:** PRT 359.  
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.

PRT 458 Special Events Planning 3.  
**Prerequisite:** PRT 358.  
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.
PRT 466 Sport Finance and Economics 3.
Prerequisite: Sport Management and PRT Majors, PRT 266, ACC 210, and (ARE 201 or EC 201 or EC 205).
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.

PRT 475 Recreation and Park Internship 8.
Prerequisite: PRT 350, PRT 358, PRT 359, PRT 375, PRT 380, 100 hours of approved work experience.
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.

PRT 476 Sport Marketing 3.
Prerequisite: PRT 486, Sport Management or PRT Majors, PRT 266.
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.

PRT 477 Park, Recreation and Tourism Management 3.
Prerequisite: Senior standing.
Integration of knowledge, theory and methods from coursework and experience; development and presentation of comprehensive operational and management problems and plans. Designed to encourage students to function as professionals and to relate areas of specialty to the broader Parks, Recreation and Tourism Management profession. Must be taken during student's last semester of coursework.

PRT 486 Senior Seminar in Sports Management 3.
Prerequisite: Sport Management Majors, Senior standing, PRT 476.
Issues affecting sport management at a national and global level. Interactive effect of strategies and decisions in each cognate area in sport management. Professional ethics and the notion of rights and responsibilities will be examined in the context of sport marketing, finance, communications, risk management and other management functions inherent in the sport enterprise. Students will also examine various theories of ethics and concepts of morality and develop a personal philosophy for social responsibility and management values.

PRT 491 Special Topics in Recreation 1-3.
Investigation and analysis of a problem associated with recreation resources.

PRT 493 Independent Study in Parks, Recreation, and Tourism Management 1-6.
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.

PRT 494 Independent Study in Parks, Recreation, and Tourism Management 1-6.
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.

PRT 500 Conceptual Foundations of Recreation 3.
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.

PRT 501 Research Methods In Recreation 3.
Restricted to: Graduate-level Statistics.
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.

PRT 503 Advanced Fiscal Management for Parks, Recreation, Tourism and Sport Organizations 3.
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.

PRT 504 Data Management and Applications in Parks, Recreation, Tourism and Sport Management 3.
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 students and others by consent of the instructor. This course will be offered online in an accelerated seven-week format.

PRT 505 GIS and Spatial Analysis in PRTS 3.
Prerequisite: ST 311.
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.
PRT 506 Organizational Behavior and Leadership in Parks, Recreation, Tourism and Sport 3.
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.

PRT 507 Strategic Marketing Management in Parks, Recreation, Tourism and Sport Organizations 3.
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 consent of the instructor. This course will be offered online in an accelerated seven-week format.

PRT 508 Risk Management for Parks, Recreation, Tourism and Sport Organizations 3.
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.

PRT 509 Program Evaluation for Parks, Recreation, Tourism and Sport Organizations 3.
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.

PRT 510 Active Recreation and Community Health 3.
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.

PRT 520 Concepts in Travel and Tourism 3.
Prerequisite: Graduate standing.
This course provides an in-depth knowledge of the conceptual foundation of tourism by introducing students to selected theories, methods, techniques, current issues, practices, and principles that govern tourism behavior. This course is restricted to students with graduate standing. This course will be offered online in an accelerated seven-week format.

PRT 531 Introduction to Geographic Information Science 3.
Prerequisite: Graduate standing or PBS status, proficiency with WindowsNT,98, or 2000 and in web browsing(Netscape or Explorer) to the level described in the NCSU Computing essentials+CD is required. Application of Geographic Information Systems (via the PRT 462 companion course) and the research issues that surround the use and current limitations of this technology. Successful students will have mastered the general framework for GIS modeling and will be prepared for further graduate study in spatial analysis. Credit will not be given for both PRT 462 and NR/PRT 531.

PRT 532 Principles of Geographic Information Science 3.
Prerequisite: NR/PRT 531 or PA 541 or ECI 630/496E or SSC 495G.
Exploration of theoretical underpinnings of Geographic Information Systems(GIS); focus on spatial concepts, analysis and modeling with computing and programming experiences using a GIS software; required major project, computer homework assignments and independent learning with on-line course modules.

PRT 533 Application Issues In Geographic Information Systems 3.
Prerequisite: NR/PRT 532.
Operation and management issues related to GIS use in natural resource organizations. Issues in proposing and implementing GIS through case study analyses and experimental project planning including social and legal impacts, cost and benefit assessments, institutional constraints to implementation, benchmarks, proposal development, education concerns, and planning for technological advances.

PRT 535 Computer Cartography 2.
Prerequisite: PRT 462 or GIS 410 or NR/PRT 531 or GIS 510.
Principles of cartographic design and how to apply them to produce high-quality Geographic Information System based maps. Successful students will acquire an understanding of map design and experience in applying this with ArcView GIS. Students produce project maps in both print and web media. Offered only through the Internet.

PRT 550 Outdoor Recreation Behavior 3.
Prerequisite: PRT 501.
An understanding of outdoor recreation behavior in natural resource-oriented areas such as state and national parks and national forests. Nature of resource-based recreation experience, influencing factors and implications of this behavior for park management.

PRT 555 Environmental Impacts of Recreation and Tourism 3.
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.

PRT 595 Special Topics In Recreation Resources 1-3.
Prerequisite: Graduate standing.
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.

PRT 601 Seminar In Recreation Research 1.
Prerequisite: PRT 501.
Research studies, scientific articles and progress reports on research effects presented and critically evaluated. Each student pursuing a graduate degree expected to take this offering twice for one hour of credit each time.
PRT 610 Special Topics In Recreation Resources 1-3.
Prerequisite: Graduate standing.
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.

PRT 620 Recreation Resources Problems 1-4.
Prerequisite: Advanced Undergraduate standing or Graduate standing.
Assigned 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.

PRT 650 Professional Electronic Portfolio for Parks, Recreation and Tourism Management 1.
Prerequisite: Graduate Standing and PRT 500 and PRT 504 and PRT 505 and PRT 506 and PRT 508 and PRT 503 and PRT 507.
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.

PRT 660 Professional Practicum 3.
Provides prospective park, recreation, sport or tourism professionals with a 200-hour learning experience in a selected agency or organization, under the joint guidance of a qualified manager and a university supervisor. Requires completion of a project or analytical report for the agency.

PRT 665 Professional Project 3.
Prerequisite: 12 credits of PRT graduate courses.
Directed study in a specialized phase of parks, recreation, sport or tourism management such as supervision, evaluation or administration.

PRT 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

PRT 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

PRT 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

PRT 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

PRT 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis Research.

PRT 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

PRT 700 Advanced Theories of Leisure 3.
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.

PRT 705 Qualitative Approaches to Recreation Research 3.
Prerequisite: Doctoral student.
This course provides an introduction to post-positivist and interpretive paradigms as well as the management of qualitative data used in recreation-related research. The interpretive approach and the relationship between methods and research questions are examined along with an assessment of qualitative approaches and applied techniques for data management. Procedures for data analysis and interpretation, the role of the "self" in conducting research, and the issues and ethics that arise in using qualitative approaches are discussed.

PRT 795 Special Topics in Recreation Resources 1-3.

PRT 801 Seminar In Recreation Research 1.
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.

PRT 810 Special Topics In Recreation Resources 1-3.
Prerequisite: Graduate standing.
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.

PRT 820 Recreation Resources Problems 1-4.
Prerequisite: Advanced Undergraduate standing or Graduate standing.
Assigned 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.
PRT 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

PRT 890 Doctoral Preliminary Exam 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

PRT 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

PS - Political Science Courses

PS 101 Internet Research 1.
Tools and techniques for conducting Internet research and electronic literature reviews. Documentation and ethics of using and citing information sources.

PS 102 Data Analysis 1.
Statistical analysis of governmental and survey data. Introduction to data sets and collecting, computerizing and analyzing political and social data.

PS 103 Designing Political Web Pages 1.
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.

PS 201 American Politics and Government 3.
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.

PS 202 State and Local Government 3.
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.

PS 203 Introduction to Nonprofits 3.
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.

PS 204 Problems of American Democracy 3.
Political problems in America from the perspective of political theory. Democracy, economics and politics, racial and sexual equality, civil disobedience, and individual freedom.

PS 205 Law and Justice 3.
Role of law from practical, political and theoretical perspective; linkages between law and justice in addressing social problems, such as gun control; drug legalization; civil disobedience; gender equality; and property rights; the impact of media on public perceptions of law and justice.

PS 231 Introduction to International Relations 3.
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.

PS 236 Issues in Global Politics 3.
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.

PS 241 Introduction to Comparative Politics 3.
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.

PS 298 Special Topics in Political Science 1-6.
Experimental course at the freshman and sophomore levels.

PS 301 The Presidency and Congress 3.
Prerequisite: PS 201.
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.

PS 302 Campaigns and Elections in the US Political System 3.
Prerequisite: PS 201.
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.

PS 303 Race in U.S. Politics 3.
Prerequisite: Sophomore standing.
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.
PS 305 The Justice System in the American Political Process 3.
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.

PS 306 Gender and Politics in the United States 3.
Prerequisite: PS 201.
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.

PS 307 Introduction to Criminal Law in the United States 3.
Prerequisites: PS 201, PS 306.
Introduction to the criminal law, its history, and its significance in the U.S. legal system. The course examines the development and application of criminal law, including the roles of law enforcement, the courts, and the criminal justice system. Students will explore issues such as police power, search and seizure, and the due process clause of the U.S. Constitution.

PS 308 Supreme Court and Public Policy 3.
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.

PS 309 Equality and Justice in United States Law 3.
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; immigration law; criminal justice practices.

PS 310 Public Policy 3.
Introduction to public policy formulation and analysis, including agenda-setting strategies, problems of legitimation, the appropriations process, implementation, evaluation, resolution, and termination.

PS 312 Introduction to Public Administration 3.
Administration in city, state and national governments: effectiveness and responsiveness, involvement in policy areas, and issues of ethics and responsibilities.

PS 313 Criminal Justice Policy 3.
Prerequisite: PS 201.
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.

PS 314 Science, Technology and Public Policy 3.
Societal impacts of science and technology. Structures and processes for formulation, implementation, evaluation of United States science and technology policy. Political implications of selected issues in science and technology policy studies.

PS 320 U.S. Environmental Law and Politics 3.
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.

PS 331 U.S. Foreign Policy 3.
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 policy-making process.

PS 335 International Law 3.
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.

PS 336 Global Environmental Politics 3.
International politics, laws, and policies pertaining to global environmental problems in the realms of population, pollution, climate change, biological diversity, forests, oceans, and fisheries.

PS 339 Politics of the World Economy 3.
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.

PS 341 European Politics 3.
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.

PS 342 Politics of China and Japan 3.
Politics, public policy, and foreign affairs of China and Japan.

PS 343 Government and Politics in South Asia 3.
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.

PS 345 Governments and Politics in the Middle East 3.
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.

PS 361 Introduction to Political Theory 3.
Nature and purpose of politics, as treated by such writers as Plato, Aristotle, St. Augustine, Machiavelli, Locke, Rousseau, Mill, Marx, and Nietzsche.

PS 362 American Political Thought 3.
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.

PS 371 Research Methodology of Political Science 3.
Prerequisite: ST 311 or (ST 301 and ST 302).
Research methods in social science and quantitative analysis in political science and public policy including research design, data collection, statistical analysis and computer applications.

PS 391 Internship in Political Science 1-6.
Internship in a governmental agency, interest group, or like organization involves seminar or formal report.

PS 398 Special Topics in Political Science 3.
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.
PS 401 American Parties and Interest Groups 3.
American parties and interest groups as instruments for mobilizing electorates, shifting public opinion and setting political priorities. The role of parties and interest groups in operating and financing elections. Strategies, tactics and problems of parties and interest groups influencing elected officials, bureaucrats and the policy process.

PS 406 American State Politics 3.
Comparative study of the politics and policies of the fifty American states. Socioeconomic and political variations and state response to intergovernmental domestic programs. Analysis of state policy in economic development, environment, health, housing, education, transportation, criminal justice and regulation.

PS 408 Urban Politics 3.
Examination of politics in small towns, cities, counties, and urban regions including political development of cities, groups in urban politics, governmental institutions, local government officials, citizen participation, suburban development, metropolitan reform, and intergovernmental relations.

PS 409 Black Political Participation in America 3.
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.

PS 411 Public Opinion and the Media in American Politics 3.
Prerequisite: PS 201.
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.

PS 413 Criminal Justice Field Work 4.
Prerequisite: Acceptance in Criminal Justice Option; Senior standing; SOC 306 and PS 311.
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.

PS 415 Administration of Justice 3.
Junior standing or above.
Politics and administration in the American system of justice. Credit will not be given for both PS 415 and PA 515.

PS 418 Gender Law and Policies 3.
Prerequisite: 3 hours of Political Science.
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.

PS 431 The United Nations and Global Order 3.
Prerequisite: PS 231 or PS 236 or PS 335.
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.

PS 432 Violence, Terrorism, and Public Policy 3.
Prerequisite: SOC 300 or PS 371.
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.

PS 433 Global Problems and Policies 3.
Prerequisite: PS 231 or PS 236 or PS 241.
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.

PS 434 Ethnic Conflict and Political Violence 3.
In this course, students will examine the phenomenon of ethnic conflict in the modern world. Why is ethnicity such a potent source of conflict? How important is “ethnicity” as opposed to politics, economic, or other factors in generating ethnic conflict? Is ethnic conflict inevitable? Why is it more prominent in some places than others? What can states, international organizations, and peoples of the world do to prevent or ameliorate interethnic strife? We will examine these questions through a mix of theoretical readings and in-depth case studies of sectarian violence, terrorism, state failure and collapse, riots, and racial tensions, and etc.

Prerequisite: PS 331.
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.

PS 438 Seminar in Latin American & Caribbean Politics 3.
Prerequisite: Six hours of Political Science including PS 231.
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.

PS 445 Comparative Systems of Law and Justice 3.
Junior standing or above.
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.

PS 462 Seminar in Political Theory 3.
Prerequisite: PS 361 or Consent of Instructor.
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.

PS 463 Public Choice and Political Institutions 3.
Prerequisite: Junior standing or Senior standing, Political Science Majors, 12 hours of Political Science Courses.
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.
PS 533 Global Problems and Policy 3.
Prerequisite: Advanced Undergraduate standing including 12 hours of PS program, Graduate standing or PBS status.
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.

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.

PS 536 Global Environmental Law and Policy 3.
Prerequisite: Graduate standing or PBS status.
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.

PS 539 International Political Economy 3.
Prerequisite: Advanced Undergraduate standing, Graduate standing or PBS status.
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.

PS 540 Seminar In Comparative Politics 3.
Prerequisite: One course in comparative politics and one course in PS methodology.
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.

PS 541 Political Islam 3.
Prerequisite: Graduate standing.
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.

PS 542 European Politics 3.
Prerequisite: Nine hours of PS program, Graduate standing or PBS status.
Analysis of political institutions and processes in selected European states and the European community and major social, economic and political issues confronting European societies.
PS 543 Latin American nd Caribbean Politics 3.
Prerequisite: Advanced Undergraduate standing including 12 hours of Political Science or PBS status.
Comparative political development in Latin America and the Caribbean. Emphasis on democratization and implications for US foreign policy.

PS 545 Comparative Systems Of Law and Justice 3.
Prerequisite: Graduate standing.
Legal culture and administration of justice in various countries and in the U.S. Emphasis on impact of legal ideology on nature of crime, political justice, police administration, corrections and judicial processes. Credit for both PS 445 and PS 545 is not allowed.

PS 571 Research Methods and Analysis 3.
Prerequisite: Advanced Undergraduate standing including 12 hours of PS program, Graduate standing or PBS status.
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.

PS 585 Constitutional and Legal Principles for Police Supervisors 3.
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.

PS 590 Special Topics 1-3.

PS 598 Special Topics In Political Science 1-6.
Prerequisite: Six hours of PS program.
Detailed investigation of a topic. Topic and mode of study determined by student and a faculty member.

PS 610 Special Topics 1-6.
Prerequisite: Six hours of PS program.
Detailed investigation of a topic. Topic and mode of study determined by student and a faculty member.

PSE - Paper Science Engineering Courses

PSE 201 Pulping and Papermaking Technology 3.
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 coating discussed.

PSE 211 Pulp and Paper Internship 1.
Prerequisite: PSE 201.
Experience in the pulp and paper industry. Problem solving in an industrial setting to gain insight of pulp and paper technology. Written report required.

Prerequisite: PSE 201.
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.

PSE 220 From Papyrus to Plasma Screens: Paper and Society 2.
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.

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 Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

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 Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

PSE 295 Special Topics in Paper Science & Engineering 1-3.
Special Topics in Paper Science & Engineering at the 200 level for offering courses on an experimental basis.

PSE 322 Wet End and Polymer Chemistry 4.
Prerequisite: PSE 212 and (CH 221 or CH 225) and (CH 222 or CH 226).
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.

PSE 332 Wood and Pulping Chemistry 3.
Prerequisite: CH 221/225 and CH 222/226 and CH 223/227 and CH 224/228.
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.

PSE 335 Principles of Green Chemistry 4.
Prerequisite: Grade of C or better in CH 101/102, CH 201/202 (or equivalent general chemistry series), and CH 221/222 (or equivalent).
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; alternative feedstocks; enzymatic catalysis; ionic liquids; re-engineering of chemical processes; chemical synthesis.

PSE 355 Pulp and Paper Unit Processes I 3.
Prerequisite: CHE 205.
Selected topics in chemical engineering as applied in the pulp and paper industry. Emphasis on computational practice.
PSE 360 Pulp and Paper Processes II. 3.
Prerequisite: PSE 201, PSE 355 or CHE 311.
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 calculation and computer simulation tools.

PSE 371 Pulping Process Analysis 3.
Prerequisite: PSE 201.
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.

PSE 415 Paper Industry Strategic Project Analysis 3.
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.

PSE 416 Process Design and Analysis 3.
Prerequisite: PSE 417.
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 360.
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 process modifications of complex manufacturing systems.

PSE 425 Bioenergy & Biomaterials Engineering 3.
Prerequisite: For PSE Majors: (MAE 301 or CHE 316) and PSE 360; For CHE Majors: CHE 312 and CHE 316; For BAE Majors: MAE 301 and BAE 402.
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: Senior standing in PSE.
Study of fundamental knowledge on the structure and properties of fibers and fibrous products, and the related physical and physiochemical mechanisms. Product design exercises will apply the fundamental understanding to specific end use requirements.

Prerequisite: PSE 212, PSE 322, PSE 371.
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.

PSE 475 Process Control in Pulp and Paper 3.
Prerequisite: Senior standing in PSE.
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.

PSE 476 Environmental Life Cycle Analysis 3.
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.

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 Courses" be completed by the student and faculty member prior to registration by the department.

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 Courses" be completed by the student and faculty member prior to registration by the department.

PSY - Psychology Courses

PSY 200 Introduction to Psychology 3.
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.

PSY 201 Controversial Issues in Psychology 3.
Prerequisite: Freshman standing.
Students will explore contemporary controversial issues within several areas of psychology (biological, human development, cognitive processes, mental health, psychological treatment, and social psychology) and encounter the diverse approaches used by psychologists and other scientists. Students will have the opportunity to refine and use their critical thinking skills as they inquire into basic psychological concepts relevant to issues they help select and will practice confronting differing opinions responsibly and respectfully to fully contribute to and gainfully receive from the university community.
PSY 220 Orientation to Psychology 1.
Orientation for new or potential Psychology majors. Analysis of expectations and demands of the psychology degree programs. Exploration of the challenges and opportunities presented by various post-baccalaureate educational and career options.

PSY 230 Introduction to Psychological Research 3.
Prerequisite: PSY 200.
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.

PSY 240 Introduction to Behavioral Research I 3.
Prerequisite: PSY or HRD Majors, PSY 200, Corequisite: PSY (ST) 241. Introduction to quantitative methods in psychology, including measurement, experimental control, validity, and fundamentals of research design. Discussion of distributions and statistical inference.

PSY 241 Introduction to Behavioral Research I Lab 1.
Prerequisite: PSY or HRD Majors, PSY 200, Corequisite: PSY (ST) 240. Students design, analyze and report a variety of simple experiments.

PSY 242 Introduction to Behavioral Research II 3.
Prerequisite: PSY or HRD Majors, PSY (ST) 240, Corequisite: PSY (ST) 243. 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.

PSY 243 Introduction to Behavioral Research II Lab 2.
Prerequisite: PSY or HRD Majors, PSY (ST) 240, Corequisite: PSY (ST) 242. Design and analysis of a major research project.

PSY 307 Industrial and Organizational Psychology 3.
Prerequisite: PSY 200 or PSY 201. 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.

PSY 311 Social Psychology 3.
Prerequisite: PSY 200 or PSY 201. 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.

PSY 312 Applied Psychology 3.
Prerequisite: PSY 200 or PSY 201. 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.

PSY 313 Positive Psychology 3.
Prerequisite: PSY 200.
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).

PSY 340 Ergonomics 3.
Prerequisite: PSY 200 or PSY 201.
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.

PSY 345 Psychology and the African American Experience 3.
Prerequisite: PSY 200 or PSY 201. 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.

PSY 360 Community Psychology Principles and Practice 3.
Prerequisite: PSY 200. 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.

PSY 370 Personality 3.
Prerequisite: PSY 200.
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.

PSY 376 Developmental Psychology 3.
Prerequisite: PSY 200 or PSY 201 or EDP 304. Behavioral development during the life span, including study of current theories and project work with persons at various stages of the life cycle.

PSY 400 Perception 3.
Prerequisite: PSY 200 or PSY 201, Junior/Senior.
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.
PSY 406 Psychology of Gender 3.
Prerequisite: PSY 200, PSY 201 or HSS 200.
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 cannot be given for both PSY 406 and PSY 506.

PSY 410 Learning and Motivation 3.
Prerequisite: PSY 200, Junior standing.
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.

PSY 411 The Psychology of Interdependence and Race 3.
Prerequisite: PSY 311.
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 interpersonal relationships - Interdependence Theory - this course will provide students with an understanding of the various structures of interpersonal relationships in order to explore how and why the presence of race (and other diversity categories) influence the ways in which people try to interact with each other within those interpersonal structures.

PSY 416 Psychology of Emotion 3.
Prerequisite: PSY 200.
Introduction to the classic and contemporary theories of emotion, with strong emphasis on how data provide evidence to test theory. Biological, social, and cultural foundations are explored.

PSY 420 Cognitive Processes 3.
Prerequisite: PSY 200, Junior standing.
Introduction to research and theory in cognition, including such topics as memory, acquisition and use of language, reading, problem-solving, reasoning, and concepts.

PSY 425 Introduction to Cognitive Science 3.
Prerequisite: One upper-level course in either PHI, PSY, CSC or Linguistics. Credit is not allowed for both PSY 425 and PHI/PSY 525.
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.

PSY 430 Biological Psychology 3.
Prerequisite: PSY 200 and (BIO 105/106 or BIO 181).
Biological mechanisms of behavior, including elementary neuroanatomy and neurophysiology, sensory and motor processes, and their application to motivation, learning, and psychological processes.

PSY 431 Health Psychology 3.
Prerequisite: PSY 200 and (PSY 230 or PSY 240/242 OR equivalent research methods course).
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.

PSY 436 Introduction to Psychological Measurement 3.
Prerequisite: PSY 240-241.
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.

PSY 470 Abnormal Psychology 3.
Prerequisite: PSY 200 or 304 or EDP 304.

PSY 475 Child Psychology 3.
Prerequisite: PSY 200 or 304 or EDP 304; PSY 376.
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.

PSY 476 Psychology of Adolescent Development 3.
Prerequisite: PSY 200 or EDP 304.
Theories, principles, and issues of human psychological development emphasizing adolescence. Cognitive, social, and physical changes; their interaction. Implications for teaching and parenting adolescents.

PSY 481 Special Topics in Psychology 3.
Prerequisite: PSY 200.
Exploration in depth of advanced areas and topics of current interest in psychology.

PSY 495 Community-Based Applied Psychology 4.
Prerequisite: PSY 200 and PSY 230.
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. $15 liability insurance fee required.

PSY 497 Senior Seminar in Psychology 2.
Prerequisite: HRD or PSY Majors, Senior standing.
Readings and discussions in depth of a special topic, which integrates several fields covered in the undergraduate psychology or HRD major.
PSY 498 Psychology Honors Seminar 3.
Prerequisite: HRD and PSY honors students.
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.

PSY 499 Individual Study in Psychology 1-6.
Corequisite: PSY 495 for HRD majors during their work semester.
Individual research project (literature review, experiment, survey, field study) open to any undergraduate, under the direction of a Psychology Department faculty member.

PSY 500 Visual Perception 3.
Prerequisite: Graduate standing.
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.

PSY 502 Physiological Psychology 3.
Prerequisite: Twelve hours of PSY including PSY 200, 400, 410.
Physiological foundations of behavior, basic vertebrate neuroanatomy and neurophysiology.

PSY 504 Evolutionary Psychology 3.
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.

PSY 506 Psychology of Gender 3.
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. Credit for both PSY 406 and PSY 506 is not allowed.

PSY 508 Cognitive Processes 3.
Prerequisite: Graduate standing or PBS status.
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.

PSY 510 Advanced Problems In Psychology 1-3.
Prerequisite: Graduate standing.
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.

PSY 511 Advanced Social Psychology 3.
Prerequisite: Graduate standing or PBS status.
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.

PSY 525 Introduction To Cognitive Science 3.
Prerequisite: Graduate standing. Credit is not allowed for both PSY 525 and PHI/PSY 425.
Philosophical foundations and empirical fundamentals of cognitive science, an interdisciplinary approach to human cognition. 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.

PSY 535 Tests and Measurements 3.
Prerequisite: Six hours of PSY program.
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.

PSY 540 Human Factors In Systems Design 3.
Prerequisite: IE 452 or PSY 340. Corequisite: ST 507 or 515.
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.

PSY 541 Overview of Human Factors Psychology 3.
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.

PSY 542 Retirement Psychology 3.
Prerequisite: Six hours PSY program.
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.

PSY 558 Psychology and the African Experience 3.
Prerequisite: Six hours PSY program.
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.

PSY 575 Special Topics in Psychology in the Public Interest 1-6.
P: 6 credit hours in GRAD PSY.
Exploration of advanced specialized topics in Psychology in the Public Interest Program, 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.
PSY 582 Adolescent Development 3.
Prerequisite: 6 hours in PSY.
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.

PSY 584 Advanced Developmental Psychology 3.
Prerequisite: Nine hrs. of PSY, including PSY 376, PSY 475 or PSY 476. 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.

PSY 591 History and Systems Of Psychology 1-3.
Prerequisite: PSY 200,400,410,420, Consent of Instructor or Graduate standing.
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.

PSY 641 Psychological Clinic Practicum 1-12.
Prerequisite: Twelve hrs. in grad. PSY, which must include clinical skill courses PSY 722 and PSY 723.
Clinical participation in interviewing, counseling, psycho-therapy and administration of psychological tests. Practicum to be concerned with adults and children.

PSY 651 Internship In Psychology 1-6.
Prerequisite: Approval of advisory committee.
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 semester or half time for an academic year or equivalent time.

PSY 680 Directed Study Psychology 1-6.
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.

PSY 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

PSY 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis Research.

PSY 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

PSY 704 Learning and Motivation 3.
Prerequisite: Graduate standing or PBS status.
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.

PSY 705 Affect and Cognition 3.
Prerequisite: Six Hours of Graduate Level PSY.
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.

PSY 710 Special Topics In Psychology 1-3.
Prerequisite: Graduate standing.
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.

PSY 714 Social Psychology: Small Groups Research 3.
Prerequisite: PSY 511.
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.

PSY 721 Area Seminar In School Psychology 1-6.
Prerequisite: Graduate standing or PBS status.
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.

PSY 722 Individual Intelligence Measurement 4.
Prerequisite: PSY 535 and consent of school psychology coordinator.
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.

PSY 723 Personality Measurement 3.
Prerequisite: PSY 722.
Theory and practicum in individual personality testing of children and adults with emphasis on projective techniques, other personality measures, report writing and case studies.
PSY 724 Psychological Intervention I 3.
Prerequisite: PSY 723.
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.

PSY 725 Psychological Intervention II 3.
Prerequisite: PSY 724.
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.

PSY 727 Psychological Consultation 3.
Prerequisite: Nine hrs. grad. PSY or ED.
Introduction to psychological consultation with emphasis on school setting. Presentation of various consultation models and theoretical bases. Development of skills in practice of consultation.

PSY 740 Engineering Psychology of Human-computer Interaction 3.
Prerequisite: IE/PSY 540 or CSC 554.
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.

PSY 743 Ergonomic Performance Assessment 3.
Prerequisite: PSY 200, ST 507 and 508.
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.

PSY 745 Human Performance Modeling 3.
Prerequisite: ST 507 or 515 or equivalent; IE (PSY) 540, CSC 554 or IE (PSY) 744.

PSY 750 Area Seminar In Human Resources Development 1-6.
The following topics dealt with: (1) human resources development as an area of inquiry, (2) methods of inquiry, (3) contemporary issues, (4) ethical questions, (5) relationship to other areas within psychology.

PSY 751 Human Resource Planning 3.
Prerequisite: Graduate standing or PBS status, Corequisite: ST 507.
Review of the literature, methods and research issues in the field of human resource 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.

PSY 752 Action Research In Psychology 3.
Prerequisite: ST 511, Corequisite: ST 508.
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.

PSY 755 Cross-Cultural Research and Development 3.
Prerequisite: ST 507, Graduate standing, Corequisite: ST 508.
Review of the literature, methods and issues in cross-cultural research and development. Cross-cultural programs evaluation and policy studies in health, education, technology transfer, international cooperation and communications. For graduate students in science and technology with plans to work in international settings.

PSY 756 Consumer Research 3.
Prerequisite: ST 507, Graduate standing or PBS status, Corequisite: ST 508.
Review of the literature, methods and research issues pertaining to consumer behavior, Consumer demographics, psychographics, attitudes, persuasion, intentions, decision processes, consumption, saving, innovation and related topics. Research methods including experiments, surveys, focus groups and case studies.

PSY 757 Innovation and Technology 3.
Prerequisite: 3 hrs. grad. ST or research methods.
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.

PSY 760 Psychometrics 3.
Prerequisite: Six hours of graduate statistics, including linear regression. Theoretical and statistical approaches to understanding psychological measurement. Topics include detailed coverage of reliability, validity, and factor analysis.

PSY 761 Advanced Psychometrics: Item Response Theory 3.
Prerequisite: PSY 760.
Item Response Theory approaches to advanced test construction and scoring; the investigation of test bias via item response theory methods.

PSY 762 Quasi-Experimental Evaluation Design 3.
Prerequisite: ST 507.
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: PSY 750.
An introduction to the systems approach and general systems theory. (1) Concepts and terminology of general systems theory, (2) techniques currently used to access system requirements and (3) methods of analyzing system performance. Emphasis on application of systems techniques to the design and implementation of human resource development programs.

PSY 764 Survey of Industrial/Organizational Psychology 3.
Prerequisite: PSY 535.
Issues surrounding the person, organization and job. Employee motivation and work attitudes, work analysis and design, recruitment, selection, training, and performance appraisal of employees, and organizational leadership and group/team processes. Emphasis on scientist-practitioner model throughout the course.

PSY 765 Vocational Psychology 3.
Prerequisite: ST 507, PSY 761.
The study of the individual's vocational behavior and development through the years of choice and adjustment. An up-to-date review and synthesis of research and theory in the field of vocational psychology. Empirical studies and theoretical statements in the field appraised and evaluated to determine what behavioral laws apply to vocational phenomena.

PSY 766 Personnel Selection Research 3.
P: Six hrs. of grad. ST, PSY 760.
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.

PSY 767 Training Research 3.
Prerequisite: Six hrs. of grad. PSY and six hrs. of grad. ST.
A survey of conceptual and research literature on training. Topics include needs assessments, learning, transfer, maintenance, criterial 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.

PSY 768 Organizational Psychology 3.
Prerequisite: Nine hrs. of PSY.
A study of the application of behavioral science, particularly psychology and social psychology, to organizational and management problems.

PSY 769 Work Motivation 3.
Prerequisite: PSY 768.
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.

PSY 770 Organization Development and Change 3.
Prerequisite: PSY 768.
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.

PSY 785 Methodological Issues In Developmental Psychology 3.
Prerequisite: PSY 584 and 3 hrs. of grad. statistics.
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.

PSY 786 Cognitive Development 3.
Prerequisite: PSY 584.
Examination of research and theory in cognitive development. Primary focus on childhood, but implications for the entire lifespan addressed. Application of cognitive developmental principles in creating interventions and educational programs also discussed.

PSY 787 Social Development 3.
P: Psychology Graduate Status or Permission of Instructor.
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.

PSY 788 Adulthood and Aging: Cognitive and Intellectual Change 3.
Prerequisite: PSY 584 or PSY 508.
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.

PSY 789 Socio-Emotional Processes In Adulthood and Aging 3.
Prerequisite: PSY 584.
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.

PSY 792 Psychology Of Families and Parenting 3.
Prerequisite: Nine hrs. grad. PSY or ED.
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.

PSY 795 Stress and Coping 3.
Prerequisite: Two grad. PSY courses.
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.

PSY 800 Introduction To Graduate Study In Psychology 1.
Restricted to students with Graduate standing in PSY.
PSY 809 Psychology Colloquium 1.
PSY 820 Special Topics in Psychology 1-3.
Prerequisite: 6 hrs. of PSY. Corequisite: 3 hrs. of ST.
Course provides opportunity for exploration in depth of advanced areas and topics of current interest.

PSY 841 School Psychology Practicum 1-6.
Prerequisite: Twelve hrs. in grad. PSY, which must include clinical skill courses PSY 722 and PSY 723.
Clinical participation in interviewing, counseling, psycho-therapy and administration of psychological tests. Practicum to be concerned with adults and children.

PSY 846 Practicum in Industrial/Organizational Psychology 3.
Prerequisite: PSY 764.
Procedures and techniques used by Industrial and Organizational Psychologists in the field. Students write work proposals, conduct interventions in field, and codument results. Review one or more I/O procedure step-by-step.

PSY 851 Internship In Psychology 1-6.
Prerequisite: Master's degree in PSY and approval of advisory committee.
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 semester or half time for an academic year or equivalent time.

PSY 880 Directed Study In Psychology 1-6.
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.

PSY 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

PSY 890 Doctoral Preliminary Exam 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation Research.

PSY 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

PY - Physics Courses
PY 123 Stellar and Galactic Astronomy 3.
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.

PY 124 Solar System Astronomy 3.
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).

PY 125 Astronomy Laboratory 1.
Corequisite: PY 123 or 124.
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.

PY 126 Computer-based Astronomy Laboratory 1.
Corequisite: PY 123 or PY 124.
Ten computer-based laboratory exercises in astronomy. Celestial coordinates, motions of celestial objects, and bright stars and constellations. Simulated observing of planets, stars, and galaxies, with data reduction and analysis.

PY 131 Conceptual Physics 4.

PY 133 Conceptual Physics: Optics 4.
Fundamentals of optics from a conceptual rather than a mathematical viewpoint. Applications of optics ranging from everyday phenomena to modern optical devices; from rainbows to lasers. Numerous demonstrations and discovery-based laboratory. Properties of light, color, optical devices, light in the atmosphere, vision in animals and man, light in modern physics, light in the cosmos.

PY 201 University Physics I 4.
Corequisite: MA 141. Credit is not allowed for both PY 201 and PY 205 or PY 211.
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.

PY 202 University Physics II 4.
Prerequisite: PY 201, MA 141. Corequisite: MA 241. Credit is not allowed for both PY 202 and PY 208 or PY 211.
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.

PY 203 University Physics III 4.
Prerequisite: PY 202, MA 241, Corequisite: MA 242.
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.
PY 205 Physics for Engineers and Scientists I 3.
Prerequisite: MA 141 with a grade of C- or better or MA 241PL. 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.
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.

PY 206 Physics for Engineers and Scientists I Laboratory 1.
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.
Laboratory course to accompany the PY 205 lecture course. A calculus-based study of mechanics, sound and heat.

PY 208 Physics for Engineers and Scientists II 3.
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.
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.

PY 209 Physics for Engineers and Scientists II Laboratory 1.
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.
Laboratory course to accompany the PY 208 lecture course. A calculus-based study of electricity, magnetism, optics and modern physics.

PY 211 College Physics I 4.
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 Calculus exam. Credit is not allowed for both PY 211 and PY 201 or PY 212.
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.

PY 212 College Physics II 4.
Prerequisite: PY 211 or PY 205. Credit is not allowed for both PY 212 and PY 202 or PY 208.
Second semester of a two-semester introductory sequence in non-calculus physics, with laboratory. Electricity, magnetism, light, and modern physics. Credit not allowed for more than one of PY 212, PY 202, and PY 208.

PY 251 Introduction to Scientific Computing 3.
Prerequisite: PY 202 or PY 208.
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.

PY 252 Instrumental and Data Analysis for Physics 2.
Prerequisite: PY 202 or PY 208.
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 (oscilloscope, 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/grounding, soldering).

PY 299 Special Problems in Physics 1-3.
Study in experimental or analytical topics in classical and modern physics.

PY 301 Introduction to Quantum Mechanics 3.
Prerequisite: C- or better in PY 203 or PY 407.
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.

PY 328 Stellar and Galactic Astrophysics 3.
Prerequisite: PY 202 or PY 208.
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.

PY 341 Relativity, Gravitation and Cosmology 3.
Prerequisite: C- or better in PY 203 or PY 407.
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: Schwarzschild 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.

PY 401 Quantum Physics I 3.
Prerequisite: Grade of C- or better in PY 411 and grade of C- or better in PY 203.
An introduction to the basic principles of quantum physics with an emphasis on selected applications to atoms, molecules, solids, nuclei and elementary particles.

PY 402 Quantum Physics II 3.
Prerequisite: C- or better in PY 401.
An introduction to the basic principles of quantum physics with an emphasis on selected applications to atoms, molecules, solids, nuclei and elementary particles.

PY 407 Introduction to Modern Physics 3.
Prerequisite: MA 242, PY 208.
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.
PY 411 Mechanics I 3.
Prerequisite: C- or better in PY 203 or C- or better in PY 407 Co-requisite: MA 341.
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.

PY 412 Mechanics II 3.
Prerequisite: C- or better in PY 411.
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.

PY 413 Thermal Physics 3.
Prerequisite: PY 203 or 407, MA 341.
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.

PY 414 Electromagnetism I 3.
Prerequisite: C- or better in PY 203 or C- or better in PY 407, and MA 341.
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.

PY 415 Electromagnetism II 3.
Prerequisite: C- or better in PY 414.

PY 452 Advanced Physics Laboratory 3.
Prerequisite: Senior standing, Physics Majors.
Introduction to laboratory electronics and instrumentation. Experiments in mechanics; electromagnetism; electronics; optics; and atomic, nuclear, plasma and solid state physics. Senior Physics students only.

PY 463 Fluid Physics 3.
Prerequisite: MA 341 and PY 208.
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.

PY 499 Independent Research in Physics 1-6.
Study and research in physics. Topics for experimental or theoretical investigation.

PY 501 Quantum Physics I 3.
Prerequisite: C- or better in PY 411.
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.

PY 502 Quantum Physics II 3.
Prerequisite: C- or better in PY 401.
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.

PY 506 Nuclear and Subatomic Physics 3.
Prerequisite: PY 203 or 407; PY 412.
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.

PY 507 Elementary Particle Physics 3.
Prerequisite: PY 401 and PY 506.
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.

PY 509 General Relativity 3.
P: MA 401 and MA 405 and PY 412 and PY 415; R: Graduate Standing.
This course provides in-depth knowledge of general relativity covering: Einstein's equation, Schwarzschild metric, Kerr metric, Friedman-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 geodesic affect and the frame dragging effect measured in Gravity Probe B experiment.

PY 511 Mechanics I 3.
Prerequisite: C- or better in PY 203 or C- or better in PY 407, and MA 341.
First semester of two-semester sequence in particle and continuum mechanics at intermediate level. 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. Credit for both PY 411 and PY 511 is not allowed.

PY 512 Mechanics II 3.
Prerequisite: PY 511.
Second semester of two-semester sequence in particle and continuum mechanics at intermediate level. 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. Credit for both PY 412 and PY 512 is not allowed.

PY 514 Electromagnetism I 3.
Prerequisite: PY 203 or PY 208, MA 341.
First semester of 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. Credit for both PY 412 and PY 514 is not allowed.

PY 515 Electromagnetism II 3.
Prerequisite: PY 514.
Continuation of PY 514. Electromagnetic induction, magnetic fields in matter, Maxwell's equations, wave guides, radiation. Credit for both PY 415 and PY 515 is not allowed.
PY 516 Physical Optics 3.
Prerequisite: PY 415.
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.

PY 517 Atomic and Molecular Physics 3.
Prerequisite: PY 401, 412.
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.

PY 519 Biological Physics 3.
Prerequisite: PY 413 or Graduate Standing.
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.

PY 525 Computational Physics 3.
Prerequisite: CSC 112 or equivalent; Corequisite: of PY 401.
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.

PY 528 Introduction to Plasma Physics and Fusion Energy 3.
Prerequisite: MA 401 and PY 208.
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.

PY 543 Astrophysics 3.
Prerequisite: PY 203 or 407; PY 411.
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.

PY 552 Introduction To the Structure Of Solids 3.
Prerequisite: C- or better in PY 401.
Basic considerations of crystalline solids, metals, conductors and semiconductors.

PY 561 Electronics For Physicists 3.
Prerequisite: Graduate standing.
Analog and digital electronics laboratory course serving as introduction to use of modern instrumentation required for experimental research in physics. Bipolar and field effect transistors, operational amplifiers, oscillators, power supplies, analog-digital and digital-analog conversion and digital logic circuits.

PY 570 Polymer Physics 3.
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.

PY 581 Matter & Interactions for Teachers I 3.
First semester (mechanics) of a two-semester sequence intended to broaden and deepen high school physics teachers their knowledge of introductory-level physics from a contemporary point of view. Includes an introduction to computational physics. Departmental permission required: normally restricted to in-service high school physics teachers.

PY 582 Matter & Interactions for Teachers II 3.
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. Departmental permission required: normally restricted to in-service high school physics teachers. PY 581 prerequisite may be waived with strong background in physics and mathematics.

PY 590 Special Topics In Physics 1-3.
Investigations in physics under staff guidance. May consist of literature reviews, experimental or theoretical projects or special topics lectures. Credits Arranged.

PY 599 Special Topics in Physics 1-3.
Investigations in physics under staff guidance. May consist of literature reviews, experimental or theoretical projects or special topics lectures. Credits arranged.

PY 601 Seminar 1.
Reports on topics of current interest in physics. Several sections offered so that students with common research interests may be grouped together.

PY 610 Special Topics I 1-3.
Investigations in physics under staff guidance. May consist of literature reviews, experimental or theoretical projects or special topics lectures. Credits Arranged.

PY 615 Advanced Special Topics In Physics 1-3.
Advanced study in astrophysics, atomic and molecular physics, condensed matter physics, nuclear physics or plasma physics. Emphasis on new and rapidly developing research areas.

PY 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

PY 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.
PY 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master’s student.
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.

PY 693 Master’s Supervised Research 1-9.
Prerequisite: Master’s student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

PY 695 Master’s Thesis Research 1-9.
Prerequisite: Master’s student.
Thesis Research.

PY 696 Summer Thesis Research 1.
Prerequisite: Master’s student.
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.

PY 699 Master’s Thesis Preparation 1-9.
Prerequisite: Master’s student.
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.
Prerequisite: MA 512, PY 782.
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.

PY 712 Advanced Quantum Mechanics II 3.
Prerequisite: PY 711.
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.

PY 721 Statistical Physics I 3.
Prerequisite: PY 401, PY 413.
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.

PY 722 Statistical Physics II 3.
Prerequisite: PY 721.
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.

PY 727 Semiconductor Thin Film Technology 3.
Prerequisite: ECE 404.
Techniques and processes encountered in growth and characterization of epitaxial semiconductor thin films. Interactions of gases at solid interfaces and gas phase dynamics related to epitaxial processes. Example of growth techniques are: solution growth, molecular beam epitaxy and chemical vapor deposition. Film characterization includes electrical, structural, optical, and chemical techniques. Issues involved in epitaxial growth such as: lattice match, critical layer thickness, heterostructures, superlattices and quantum wells.

PY 753 Introduction To the Structure Of Solids II 3.
Prerequisite: PY 552.
The properties of semiconductors, superconductors, magnets, ferroelectrics and crystalline defects and dislocations.

PY 754 Properties of Surfaces and Interfaces 3.
Prerequisite: PY(ECE) 552.
Properties of surfaces and interfaces of materials. Relation between electronic properties and atomic structure. (A) Surfaces: thermodynamics, experimental techniques, structure and reconstruction.

PY 755 Dielectric Films and their Interfaces 3.
Prerequisite: PY 552.
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.

PY 781 Quantum Mechanics I 3.
Prerequisite: MA 512; PY 411 or 414; Graduate standing.
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.

PY 782 Quantum Mechanics II 3.
Prerequisite: MA 512; PY 411 or 414; Graduate standing.
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.

PY 783 Advanced Classical Mechanics I 3.
Prerequisite: MA 512, PY 412, PY 414; Graduate standing.
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.
PY 785 Advanced Electricity and Magnetism I 3.
Prerequisite: PY 415; Graduate standing.
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.

PY 786 Advanced Electricity and Magnetism II 3.
Prerequisite: PY 415; Graduate standing.
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.

PY 801 Seminar 1.
Reports on topics of current interest in physics. Several sections offered so that students with common research interests may be grouped together.

PY 810 Special Topics In Physics 1-3.
Investigations in physics under staff guidance. May consist of literature reviews, experimental or theoretical projects or special topics lectures. Credits Arranged.

PY 815 Advanced Special Topics In Physics 1-3.
Advanced study in astrophysics, atomic and molecular physics, condensed matter physics, nuclear physics or plasma physics. Emphasis on new and rapidly developing research areas.

PY 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

PY 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation Research.

PY 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

REL - Religious Studies Courses

REL 200 Introduction to the Study of Religion 3.
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.

REL 210 Religious Traditions of the World 3.
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.

REL 230 South Asian Religious Traditions 3.
Hindu, Buddhist, Jain, Sikh, Islamic, Christian, Jewish, and Zoroastrian religious traditions in comparative perspective. Religious and cultural history through literature, film, and art of India, Pakistan, Bangladesh, Sri Lanka, Nepal, and Afghanistan. Doctrine, practice, teaching tales, and issues of change and conflict in South Asia and in the diaspora, especially the USA.

REL 298 Special Topics in Religious Studies 3.
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 Religion and Society 3.
Prerequisite: 3 cr. in SOC, 200 level.
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.

REL 311 Introduction to the Old Testament 3.
Study of Old Testament books, examining their content, background and development. Comparisons of the biblical material with other Ancient Near Eastern literature. Assessment of contributions from archeology and literary studies to clarifying the text.

REL 312 Introduction to the New Testament 3.
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.

REL 314 Introduction to Intertestamental Literature 3.
Intertestamental literature in the context of Jewish history, institutions and beliefs of the Intertestamental Period (ca. 300 B.C.-ca. 100 A.D.).

REL 317 Christianity 3.
Development of Christianity from its origins to the present; events, persons, ideas, beliefs and practices which were most significant in this development.

REL 320 Religion in American History 3.
Prerequisite: 3 hours of History or Sophomore standing.
Representative people, movements and thought in the major religions within the context of American society and culture.

REL 323 Religious Cults, Sects, and Minority Faiths in America 3.
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.
REL 327 Issues in Contemporary Religion 3.
Responses of contemporary Western religious thinkers to critiques of religion and to challenges posed by the 20th century including the Nazi Holocaust, social injustice (liberation theologies - black, feminist, Third World), ecological crisis, threat of nuclear warfare, and conflicts between religions.

REL 331 The Hindu Tradition 3.
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.

REL 332 The Buddhist Traditions 3.
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.

REL 333 Chinese Religions 3.
Survey of Chinese religions from prehistoric times to present. Confucianism, Daoism, primary Buddhist schools in China, spirit possession, divination and popular religious worship.

REL 334 Japanese Religions 3.
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.

REL 340 Islam 3.
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.

REL 350 Introduction to Judaism 3.
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.

REL 383 Religion, Globalism, and Justice 3.
Prerequisite: One course in religion, philosophy, history, political science, anthropology or sociology.
Issues and problems in religion and societies since 1945. Historical, theoretical, sociological, and cultural approaches to globalism and religion. Inquiry into the role of ethical reasoning in religious debates on the problem of globalization.

REL 402 Early Christianity to the Time of Eusebius 3.
Prerequisite: One of: REL 312, REL 317, or HI 207.
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 Christian movements; anti-heretical writings; orthodox institutions of authority.

REL 407 Islamic History to 1798 3.
Prerequisite: 3 hrs. of History.
Credit will not be given for both HI 407 and HI 507. 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.

REL 408 Islam in the Modern World 3.
Prerequisite: 3 hours of history or religious studies.
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.

REL 412 Advanced Readings in the Christian Gospels 3.
Prerequisite: REL 312 or REL 317.
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.

REL 413 The Life and Letters of the Apostle Paul 3.
Prerequisite: REL 312 or REL 317.
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.

REL 423 Religion and Politics in America 3.
Prerequisite: one 300-level course in religion, philosophy, or history. 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.

REL 471 Darwinism and Christianity 3.
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.
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 evolutionary world.

REL 472 Women and Religion 3.
Prerequisite: one course in religious studies or women’s and gender studies.
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.
REL 473 Religion, Gender, and Reproductive Technologies 3.
Credit is not allowed for both REL 473 and REL 573.
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.

REL 482 Religion and Conflict 3.
Prerequisite: A 300 or above level Religion course.

REL 489 Interpretations of Religion 3.
Prerequisite: One course in religion, philosophy, anthropology, history, or sociology.

REL 491 Advanced Readings in Theological and Religious Literature 3.
Prerequisite: 300-level course in Religion.
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.

REL 496 Seminar in Religious Studies 3.
Prerequisite: 300-level course in Religion.
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.

REL 498 Special Topics in Religious Studies 1-6.
Prerequisite: 6 hours REL.
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.

REL 571 Darwinism and Christianity 3.
Prerequisite: Graduate standing. Credit is not allowed for both REL 571 and REL 471.
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 evolutionary world.

REL 573 Religion, Gender, and Reproductive Technologies 3.
Prerequisite: Graduate Standing. Credit is not allowed for both REL 573 and REL 473.
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.

REL 582 Religion and Conflict 3.
Credit is not allowed for both REL 582 and 482. Graduate Standing Required.

SMT - Sustainable Materials and Technology Courses

SMT 200 Introduction to Sustainability and Technology 1.
Co-requisite: WPS/SMT 201.
This laboratory is to be taken concurrently with SMT 201 - Sustainable Materials for Green Housing. This laboratory will delve deeper into concepts discussed in class. It will include an introduction into data collection and analysis, industrial ethics, and field trips to biomaterials-based industries. For SMT students only or with permission of instructor.

SMT 201 Sustainable Materials for Green Housing 2.
Sustainable Materials for Green Housing.

SMT 202 Anatomy and Properties of Renewable Materials 3.
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.

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.

SMT 210 Sustainable Materials Internship 1.
Prerequisite: Completion of summer practicum.
Experience in the forest products or related industries with a departmentally selected employer.

SMT 230 Sustainability, Global Trade and Forest Products 2.
This course is designed to give the participants an exposure to understanding the effects of global trade on sustainability issues. The course will include a focus on global issues leading to a sound environment, in addition to a healthy economic base, stable employment, adequate purchasing power, and maintenance of social and cultural integrity. Various sustainable forest products industries in the US and other countries will be used as example to explain the various concepts throughout this course.
SMT 231 Sustainable Manufacturing 2.
The overall goal of the class is to make the students more informed and aware consumers of various products and how they are produced. The class will connect the economic and energy impacts of various manufacturing sectors with the environmental impacts, e.g., carbon, water, and pollutants. The concept of embodied energy, water use, and land impacts will be used will be used to examine these manufacturing sectors. The concept of Life Cycle Analysis will be introduced and used to evaluate the use and trade-offs for different manufacturing techniques. The opportunities and trade-offs for reuse and recycling materials at the “end of life” will also be explored for the various products and their respective manufacturing industries.

SMT 232 Recycle to Create a Sustainable Environment 2.
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.

SMT 293 Independent Study in Sustainable Materials & Technology 1-6.
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 Enrolled in Non-Standard Courses” be completed by the student and faculty member prior to registration by the department.

SMT 294 Independent Study in Sustainable Materials & Technology 1-6.
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 Enrolled in Non-Standard Courses” be completed by the student and faculty member prior to registration by the department.

SMT 295 Special Topics in Sustainable Materials and Technology 1-3.
Special Topics in Wood Products at the 200 level for offering of courses on an experimental basis.

SMT 301 Chemistry of Sustainable Materials 4.
Prerequisite: CH 101 and CH 102 and CH 220.
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.

SMT 302 Processing of Biomaterials 4.
Prerequisite: SMT 202 or SMT 203.
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.

SMT 310 Introduction to Industrial Ecology 3.
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.

SMT 344 Sustainable Composites and Biopolymers 3.
Prerequisite: SMT 301 and Senior standing in SMT.
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.

SMT 346 Sustainable Materials Business Marketing 3.
Prerequisite: SMT 202 or SMT 203.

SMT 493 Independent Study in Sustainable Materials & Technology
Prerequisite: SMT 301 and Senior standing in SMT.
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-Standard Courses” be completed by the student and faculty member prior to registration by the department.
SMT 494 Independent Study in Sustainable Materials & Technology
1-6.
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-Standard Courses" be completed by the student and faculty member prior to registration by the department.

SOC - Sociology Courses

SOC 202 Principles of Sociology 3.
Introduction to sociology. Analyses of key processes and institutions including interaction, inequality, organization, socialization, and social change. Includes core sociological concepts, methods, theories.

SOC 203 Current Social Problems 3.
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.

SOC 204A Current Social Problems 3.
AGI Students Only.
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.

SOC 204 Sociology of Family 3.
Contemporary American family structures and processes and their development. Focus on socialization, mate selection, marital adjustment and dissolution. Includes core sociological theories, concepts and methods.

SOC 205 Jobs and Work 3.
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.

SOC 206 Social Deviance 3.
Social processes in the creation and maintenance of deviant populations: classification, objectification of social meanings, functions of subcultures and social outcomes of the deviance-ascription process. Includes core sociological concepts, methods, theories.

SOC 220 Cultural Geography 3.
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.

SOC 241 Sociology of Agriculture and Rural Society 3.
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.

SOC 241A Sociology of Agriculture and Rural Society 3.
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.

SOC 261 Technology in Society and Culture 3.
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.

SOC 295 Special Topics in Sociology 1-3.
Offered as needed to present 200-level subject materials not normally available in regular course offerings or for new courses on a trial basis.

SOC 300 Social Research Methods 4.
Prerequisite: SOC 202, Corequisite: ST 311.
Basic methods of social research, research design, sampling, data collection, measurement, and analysis; the relationship between theory and research. Laboratory exercises on computer applications.

SOC 301 Human Behavior 3.
Prerequisite: 3 cr. in SOC, 200 level.
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 intragroup and intergroup relations.

SOC 304 Women and Men in Society 3.
Prerequisite: 3 cr. in SOC, 200 level.

SOC 305 Racial and Ethnic Relations 3.
Prerequisite: 3 cr. in SOC, 200 level.
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.

SOC 306 Criminology 3.
Prerequisite: 3 cr. in SOC, 200 level.
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.
SOC 309 Religion and Society 3.
Prerequisite: 3 cr. in SOC, 200 level.
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.

SOC 310 Managers, Work, and Organizations 3.
Prerequisite: Any 200-level SOC. SOC 205 recommended.
Sociological analysis of managers, who they are, and what they do. How recent changes in the U.S. economy have altered managers’ work. How managers influence and adapt to the organizational environment. Relationship of management and labor in the production process.

SOC 311 Community Relationships 3.
Prerequisite: 3 cr. in SOC, 200 level.
Institutions, organizations and agencies found in modern communities; social problems and conditions with which they deal; their interrelationships and trends toward comprehensive planning.

SOC 342 International Development 3.
Prerequisite: 3 cr. in SOC, 200 level.
Sociological explanations of the causes of development and underdevelopment and origins of the present world system with emphasis on lesser developed countries. Recent global changes in the world situation including the increasing internationalization and interdependence of all countries.

SOC 350 Food and Society 3.
Prerequisite: 3 credits of a 200-level Sociology.
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.

SOC 351 Population and Planning 3.
Prerequisite: 3 credits in SOC at the 200 level.

SOC 381 Sociology of Medicine 3.
Prerequisite: 200 level Sociology.
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.

SOC 395 Special Topics in Sociology 1-3.
Prerequisite: 3 credits of a 200-level Sociology.
Offered as needed to present 300-level subject materials not normally available in regular course offerings or for new courses on a trial basis.

SOC 400 Theories of Social Structure 3.
Prerequisite: 3 cr. in SOC, 200 level.
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.

SOC 401 Theories of Social Interaction 3.
Prerequisite: 3 cr. in SOC, 200 level.
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.

SOC 402 Urban Sociology 3.
Prerequisite: SOC 300.
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.

SOC 404 Families and Work 3.
Prerequisite: SOC 200 level, SOC 300.
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.

SOC 407 Sociology of Sexualities 3.
Prerequisite: 3 hours SOC 200 level, 300 level.
Exploration of sexuality in a social context. Relationship between sexuality, gender and power in the U.S. Historical trends in behaviors and identities: social movements and sexual issues; current behavioral trends. Some issues covered; identity, social construction, sexual meanings.

SOC 410 Sociology of Organizations 3.
Prerequisite: 3 cr. in SOC, 200 level, SOC 300.
Application of sociological theories to study of organizational structures and processes. Special attention to control and coordination, relations with other organizations, and decision making.

SOC 413 Criminal Justice Field Work 4.
Prerequisite: SOC 306 and PS 305, Senior standing in Criminal Justice option.
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.

SOC 414 Social Class 3.
Prerequisite: SOC 300.
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.

SOC 418 Sociology of Education 3.
Prerequisite: SOC 300.
SOC 425 Juvenile Delinquency 3.
Prerequisite: 3 cr. in SOC 200-level; SOC 300.

SOC 427 Sociology of Law 3.
Prerequisite: 3 cr. in SOC 200-level; SOC 300.
Sociological concepts, theories and research of law as social control. Social forces behind the creation, maintenance and application of law in American Society.

SOC 428 Formal Institutions of Social Control 3.
Prerequisite: 3 hours SOC 200 level; SOC 300.
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.

SOC 429 Quantitative Data Analysis in Sociology 3.
Prerequisite: SOC 300 or ST 311 or equivalent.
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.

SOC 430 Community and Crime 3.
Prerequisite: 3 credits in SOC 200 level; SOC 300.
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.

SOC 432 Violence, Terrorism, and Public Policy 3.
Prerequisite: SOC 300 or PS 371.
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.

SOC 440 Social Change 3.
Prerequisite: 3 cr. in SOC, 200 level; SOC 300.
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.

SOC 445 Inequality, Ideology, and Social Justice 3.
Prerequisite: 3 hours of 200-level SOC and SOC 300.
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.

SOC 450 Environmental Sociology 3.
Prerequisite: 3 hours SOC 200 level, SOC 300.
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.

SOC 457 Corporate Power in America 3.
Prerequisite: (SOC 202 or SOC 203) and SOC 300.
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.

SOC 465 Social Aspects of Mental Health 3.
Prerequisite: SOC 300.
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.

SOC 492 External Learning Experience 1-6.
Prerequisite: Sophomore standing.
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.

SOC 493 Special Problems in Sociology 1-6.
Prerequisite: Sophomore standing.
A learning experience in agriculture and life sciences within an academic framework that utilizes campus facilities and resources. Arrangements must be initiated by student and approved by a faculty advisor and departmental teaching coordinator.

SOC 495 Special Topics in Sociology 1-3.
Offered as needed to present materials not normally available in regular course offerings or for new courses on a trial basis.

SOC 498 Independent Study in Sociology 1-6.
Prerequisite: Six hours SOC above the 200 level.
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 in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

SOC 508 Social Organization 3.
Prerequisite: SOC 400 or SOC 701.
Introduction to study of social structure. Focus on inequality, work, organizations, the economy, the state. Classic writings and their impacts.
SOC 509 Population Problems 3.
Prerequisite: SOC 202.
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.

SOC 513 Community Organization and Development 3.
Prerequisite: SOC 202.
Community organization viewed as a process of bringing about desirable changes in community life. Study of community needs and resources. Stress on democratic processes in community action and principles of organization, along with techniques and procedures. Analysis of roles of lay and professional workers.

SOC 514 Developing Societies 3.
Prerequisite: Six hrs. SOC or ANT or Graduate standing or PBS status.
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 themes in current development schemes. Proposal and discussion of untested strategies for the future. Examination of these problems in their national and international contexts.

SOC 533 The Community 3.
Prerequisite: Six hrs. SOC.
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.

SOC 591 Special Topics In Sociology 1-6.
An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.

SOC 601 Seminar 1-3.
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. Credits Arranged.

SOC 610 Special Topics In Sociology 1-6.
An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.

SOC 642 Practicum In Sociology 1-6.
Prerequisite: Graduate standing in the Master of Sociology program and nine hrs. of SOC at the 500-600 level.
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 problems facing the organization/agency.

SOC 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

SOC 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

SOC 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis Research.

SOC 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

SOC 701 Classical Sociological Theory 3.
Prerequisite: Six hrs. SOC and Graduate standing or PBS status.
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.

SOC 702 Contemporary Sociological Theory 3.
Prerequisite: SOC 701.
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.

SOC 703 Theory Construction 3.
Prerequisite: SOC 701.
Providing students with a capability to develop theoretical frames of reference within which to devise and implement research activities. Acquainting students with philosophical and disciplinary bases of theory, establishing relationship between theory and research and enabling objective evaluation of theoretical positions encountered in the literature.

SOC 704 Feminist Thought in the Social Sciences 3.
Prerequisite: SOC 701 and SOC 702.
This course is designed to provide an overview of feminist thought in the social sciences. We evaluate theoretical writings on social structure, social processes, the development of consciousness about gender inequality. We include both discussion of distortions within mainstream theory and the recent development of alternative theory using the standpoint of women as a point of departure. We begin with general theoretical issues and move quickly to the complexity of matrices of domination with U.S. and global contexts.

SOC 707 Quantitative Sociological Analysis 3.
Prerequisite: ST 507.
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.
SOC 708 Advanced Sociological Analysis 3.
Prerequisite: SOC 711, ST 507 or ST 711.
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.

SOC 710 Teaching Sociology 3.
Prerequisite: Admission to sociology graduate program.
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.

SOC 711 Research Methods In Sociology I 3.
Prerequisite: SOC 300, ST 311.
Issues in philosophy of science, causation, relationship of theory and research. Qualitative, experimental and survey design methodologies.

SOC 712 Advanced Survey Research Methods 3.
Prerequisite: SOC 711 and SOC 707.
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 operationalize behavioral and social constructs and to test hypotheses.

SOC 713 Applied Research 3.
Prerequisite: SOC 202.
Studies research process with emphasis upon its application to action problems. Stress upon development of research design to meet action research needs.

SOC 715 Qualitative Sociological Methods and Analysis 3.
Prerequisite: Graduate standing.
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 rhetorical and feminist epistemological debates.

SOC 721 Deviant Behavior 3.
Prerequisite: Six hrs. SOC or ANT or Graduate standing or PBS status.
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.

SOC 722 Social Control 3.
Prerequisite: Six hrs. SOC above 200 level or Graduate standing or PBS status.
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.

SOC 723 Research On Crime and Deviance 3.
Prerequisite: SOC 721.
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.

SOC 727 Comparative Societies 3.
Prerequisite: Six hrs. SOC.
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.

SOC 731 Survey Of Family Sociology 3.
Prerequisite: SOC 202.
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.

SOC 732 Contemporary Family Theory and Research 3.
Prerequisite: SOC 731.
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.

SOC 733 Social Stratification 3.
Prerequisite: Six hrs. SOC.
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.

SOC 737 Sociology Of Gender 3.
Prerequisite: Graduate student, SOC 736 OR 731.
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 relationships.

SOC 740 Race and Ethnic Inequality 3.
Prerequisite: Six hours of Sociology.
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.

SOC 749 Social Psychology Of Inequality 3.
Prerequisite: SOC 746 or 508.
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 to reproduction of inequality in everyday life.
SOC 742 Social-Psychological Processes In Health and Illness 3.
Prerequisite: SOC 505.
Contemporary issues in the sociology of health and illness from a social psychological perspective. The social meaning of illness, social group differences in health, social causes of distress, morbidity and mortality, and measurement of health and illness.

SOC 743 Psychiatric Sociology and Mental Health 3.
Prerequisite: SOC 505.
Major issues in mental health. Epidemiology, causes, course, consequences, correlates, treatment, institutions, and services for mental illness.

SOC 746 Sociological Social Psychology 3.
Prerequisite: SOC 401.
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.

SOC 747 Social Psychology 3.
Prerequisite: Six hrs. SOC.
The presentation of the major ideas of social psychology in context of the theoretical orientations from which they have emerged. Examination of nature and role of theory in social psychology. The social psychologies of various theorists then examined in terms of their particular approaches including the Gestalt, Field, Role, Psychoanalytic and Reinforcement orientations and combinations of these.

SOC 752 Work and Industry 3.
Prerequisite: SOC 400 or SOC 508 or SOC 701.
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.

SOC 753 Inequality in Work and the Economy 3.
Prerequisite: SOC 701.
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.

SOC 754 Economic Sociology 3.
Prerequisite: SOC 701.
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.

SOC 756 Sociological Analysis Of Agricultural Development 3.
Prerequisite: Six hrs. SOC or Graduate standing.
Systematic sociological analysis of agricultural development and change, emphasizing less-developed countries. Review of classical and contemporary theoretical perspectives. Specific topics: land tenure and agricultural development; peasants and peasant societies; peasant revolt and revolution; women and development.

SOC 758 Rural Sociology 3.
Prerequisite: Six hours of Sociology.
Rural conditions and trends including environmental resources; human and social resources; institutions and change; theory, research and rural development policy.

SOC 791 Special Topics In Sociology 1-6.
An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.

SOC 801 Seminar 1-3.
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. Credits Arranged.

SOC 810 Special Topics In Sociology 1-6.
An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.

SOC 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

SOC 890 Doctoral Preliminary Exam 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation Research.

SOC 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

SSC - Soil Science Courses

SSC 103 Introductory Topics in Crop, Soil and Turfgrass Sciences 1.
Introduction to the scope, purpose, and objectives of a university education with an emphasis on areas related to Crop, Soil and Turfgrass Sciences. Students will explore university, college and departmental resources, academic policies and procedures, opportunities for minors, career opportunities, and current trends and issues in our related disciplines. Students cannot receive credit for both CS 103 and ALS 103. Freshman Only; PAA, PAB, PAC, PAE, PCB, SST, TFG.

SSC 112 Principles of Soil Science 4.
Fundamental soil physical and chemical properties and principles. Major lecture topics: soil description, formation, soil water and the hydrologic cycle, and soil fertility and fertilizers. Laboratory exercises in identifying soil horizons, determining soil texture, identifying nutrient deficiency symptoms in plants and interpreting soil fertility test reports. BROOME.
SSC 151 Fertilizers and Soil Fertility
Principles of managing plant nutrients in soils for crop, turfgrass and other plant production; nutrient requirements; deficiency symptoms, nutrient availability in soils; soil acidity and liming; fertilizer materials; organic fertilizers; and environmental effects of fertilizers. BROOME.

SSC 185 Land and Life
Soil is a fundamental natural resource that sustains life on earth. Detailed information is provided about soils at local, community, regional, national, and global scales; and their importance to world food security and human health, agricultural production, environmental quality, and sustainable ecosystems. Students will gain practical knowledge about soils, their use and management, and their critical role in supporting life. Understanding basic soil properties, their interactions, and how they are influenced or impacted by human activity is essential to everyday life and to being a well-informed citizen.

SSC 200 Soil Science
Prerequisite: CH 101 or CH 100.
Fundamentals of soils including origin, composition and classification; their physical, chemical, and biological properties; significance of these properties to soil-plant relationships and soil management.

SSC 201 Soil Science Laboratory
Corequisite: SSC 200.
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.

SSC 332 Environmental Soil Microbiology
Prerequisite: BIO 181 and SSC 200.
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.

SSC 341 Soil Fertility and Fertilizers
Prerequisite: SSC 200.
Principles of managing plant nutrition for crop production, fertilizer materials, crop fertilization, soil fertility maintenance and management practices for optimizing fertilizer use; soil and plant tissue testing as diagnostic tools in nutrient management.

SSC 342 Soil Fertility Laboratory
Corequisite: SSC 341.
Soil sampling and analyses for acidity and nutrient content. Calculating lime and fertilizer recommendations and calibrating fertilizer spreaders. Discussion of fertilizer materials and calculation of least cost blends. Computer programs to confirm recommendations and least cost blends. Field trip to a fertilizer distributor and to a fertilizer user.

SSC 361 Role of Soils in Environmental Management
Prerequisite: SSC 200.
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.

SSC 427 Biological Approaches to Sustainable Soil Systems
Prerequisite: SSC 200 or equivalent, BIO 181 or 183, and CH 101.
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.

SSC 428 Service-Learning in Urban Agriculture Systems
Prerequisite: SSC 200 or equivalent, BIO 181 or 183, and CH 101.
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.

SSC 440 Geographic Information Systems (GIS) in Soil Science and Agriculture
Prerequisite: SSC 200.
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.

SSC 442 Soil and Environmental Biogeochemistry
Prerequisite: SSC 200 and (CH 101, or CH 201, or CH 220, or CH 221).
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.

SSC 452 Soil Classification
Prerequisite: SSC 200.
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.

SSC 455 Soils, Environmental Quality and Global Challenges
Prerequisite: SSC 200 or ES 100 or Instructor permission.
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 analyze the roles of soils in each issue.
SSC 461 Soil Physical Properties and Plant Growth 3.
Prerequisite: SSC 200.
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.

SSC 462 Soil-Crop Management Systems 3.
Prerequisite: CS 213, CS 414, SSC 342, SSC 452; senior standing.
Units 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.

SSC 470 Wetland Soils 3.
Prerequisite: SSC 200, SSC 452 recommended.
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.

SSC 490 Senior Seminar in Crop Science and Soil Science 1.
Prerequisite: Senior standing in Agronomy, Plant and Soil Sciences, or Turfgrass Science.
Review and discussion of current topics in crop science, soil science, agronomy and natural resource management. Preparation and presentation of scientific information in written and oral format. Senior standing in Agronomy, Plant and Soil Sciences, or Turfgrass Science.

SSC 492 External Learning Experience 1-6.
Prerequisite: Sophomore standing.
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 the prospective employers must be initiated by student and approved by faculty adviser. The prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

SSC 493 Special Problems in Soil Science 1-6.
Prerequisite: Sophomore standing.
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 faculty adviser. The prospective employer, the departmental teaching coordinator prior to the experience.

SSC 495 Special Topics in Soil Science 1-6.
Prerequisite: SSC 200.
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

SSC 511 Soil Physics 4.
Prerequisite: SSC 200, PY 212.
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.

SSC 521 Soil Chemistry 3.
Prerequisite: SSC 200, one yr. of general inorganic chemistry.
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.

SSC 532 Soil Microbiology 4.
Prerequisite: MB 351; CH 220.
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: SSC 200.
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.

SSC 541 Soil Fertility 3.
Prerequisite: SSC 341.
Soil conditions affecting plant growth and the chemistry of soil and fertilizer interrelationships. Factors affecting the availability of nutrients. Methods of measuring nutrient availability.

SSC 545 Remote Sensing Applications in Soil Science and Agriculture 3.
Prerequisite: SSC 200, PY 212.
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.

SSC 551 Soil Morphology, Genesis and Classification 3.
Prerequisite: SSC 200.

SSC 562 Environmental Applications Of Soil Science 3.
Prerequisite: SSC 200.
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 through soils.

SSC 570 Wetland Soils 3.
Prerequisite: SSC 200, SSC 452 recommended.
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.
SSC 573 Introduction to Surface Hydrologic/Water Quality Modeling
3.  
Prerequisite: BAE 471, SSC 200.  
Concepts in basic hydrologic, erosion and chemical transport used in modeling. Evaluation of typical hydrologic/water quality models on watershed systems. Usage of state-of-the-art models in project examples.

SSC 590 Special Problems 1-3.  
Prerequisite: SSC 200.  
Special problems in various phases of soils. Emphasis placed on review of recent and current research. Credits Arranged.

SSC 601 Seminar 1.  
Prerequisite: Graduate standing in SSC.  
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.

SSC 609 Colloquium In Soil Science 1-3.  
Prerequisite: Graduate standing in SSC.  
Seminar-type discussions and lectures on specialized and advanced topics in soil science. Credits Arranged.

SSC 620 Special Problems 1-6.  
Prerequisite: SSC 200.  
Special problems in various phases of soils. Emphasis placed on review of recent and current research. Credits Arranged.

SSC 685 Master's Supervised Teaching 1-3.  
Prerequisite: Master's student.  
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.

SSC 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.  
Prerequisite: Master's student.  
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.

SSC 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.  
Prerequisite: Master's student.  
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.

SSC 690 Master's Exam 1-6.  
Prerequisite: Master's student.  
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.

SSC 693 Master's Supervised Research 1-9.  
Prerequisite: Master's student.  
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

SSC 695 Master's Thesis Research 1-9.  
Prerequisite: Master's student.  
Thesis Research.

SSC 696 Summer Thesis Research 1.  
Prerequisite: Master's student.  
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.  
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.

SSC 701 Tropical Soils: Characteristics and Management 3.  
Corequisite: Six credits in SSC.  
Characteristics of the tropical environment. Distribution and classification of tropical soils. Soil-plant relationships in the tropics. Soil management systems with emphasis on shifting cultivation, flooded rice production, subsistence farming and tropical pasture management.

SSC 720 Soil and Plant Analysis 3.  
Prerequisite: PY 212; CH 315; at least three soils courses including SSC 341.  
Theory and advanced principles of utilization of chemical instruments to aid research on the heterogeneous systems of soils and plants.

SSC 722 Advanced Soil Chemistry 3.  
Prerequisite: SSC 521, CH 730.  
Critical review of application of chemical thermodynamics and kinetics to understand soil systems, solution equilibria, precipitation and dissolution, complexation, reduction-oxidation, surface-solute interactions and chemical transport. Application of chemical speciation models.

SSC 725 Pesticide Chemistry 1.  
Prerequisite: (CH 201 or CH 203) and (CH 221 or CH 225).  
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.

SSC 727 Pesticide Behavior and Fate In the Environment 2.  
Prerequisite: CS(HS,SSC,TOX) 725, SSC 200.  
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.

SSC 753 Soil Mineralogy 3.  
Prerequisite: SSC 200, SSC 341.  
Composition, structure, classification, identification, origin, occurrence and significance of soil minerals with emphasis on primary weatherable silicates, layer silicate clays and sesquioxides.

SSC 771 Theory Of Drainage--Saturated Flow 3.  
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 steady-state and transient flow equations to determine their applicability to drainage problems. Consideration of analogs and models of particular drainage problems.
SSC 790 Special Topics 1-3.
SSC 801 Seminar 1.
SSC 809 Colloquium In Soil Science 1-3.
Prerequisite: Graduate standing in SSC.
Seminar-type discussions and lectures on specialized and advanced topics in soil science. Credits Arranged.
SSC 820 Special Problems 1-3.
Prerequisite: SSC 200.
Special problems in various phases of soils. Emphasis placed on review of recent and current research. Credits Arranged.
SSC 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.
SSC 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.
Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.
Prerequisite: Doctoral student.
Dissertation research.
SSC 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

SSGE - Social Sciences Courses
SSGE 295 Social Sciences Special Topics 3.
Special topics course offering for the general education Social Sciences category.

SSGK - Social Sciences and Global Knowledge Courses
SSGK 295 Social Sciences and Global Knowledge Special Topics 3.
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.

SSUS - Social Sciences and U.S. Diversity Courses
SSUS 295 Social Sciences and U.S. Diversity Special Topics 3.
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.

ST - Statistics Courses
ST 101 Statistics by Example 3.
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.
ST 240 Introduction to Behavioral Research I 3.
Prerequisite: PSY and HRD Majors, PSY 200, Corequisite: PSY (ST) 241.
Introduction to quantitative methods in psychology, including measurement, experimental control, validity, and fundamentals of research design. Discussion of distributions and statistical inference.
ST 241 Introduction to Behavioral Research I Lab 1.
Prerequisite: PSY 200, PSY and HRD Majors, Corequisite: PSY (ST) 240.
Students design, analyze and report a variety of simple experiments.
ST 242 Introduction to Behavioral Research II 3.
Prerequisite: PSY or HRD Majors, PSY (ST) 240, Corequisite: PSY (ST) 243.
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.
ST 243 Introduction to Behavioral Research II Lab 2.
Prerequisite: PSY or HRD Majors, PSY (ST) 240, Corequisite: PSY (ST) 242.
Design and analysis of a major research project.
ST 295 Special Topics ST 1-3.
ST 301 Statistical Methods I 3.
Prerequisite: MA 141 and either COS 100 or E 115.
ST 302 Statistical Methods II 3.
Prerequisite: ST 301.
Confidence intervals and hypothesis testing with graphics in multiple samples and/or variables cases: tests for means/proportions of two independent groups, analysis of variance for completely randomized design, contingency table analysis, correlation, single and multiple linear regression; design of experiments with randomized blocks, factorial design and analysis of covariance. Computer use emphasized.
ST 305 Statistical Methods 4.
Prerequisite: MA 141 and either COS 100 or E 115.

ST 311 Introduction to Statistics 3.
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.

ST 312 Introduction to Statistics II 3.
Prerequisite: ST 311.
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: MA 114.
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.

ST 351 Data Analysis for Economists 3.
Prerequisite: BUS/ST 350.
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.

ST 361 Introduction to Statistics for Engineers 3.
Prerequisite: College algebra.
Statistical techniques useful to engineers and physical scientists. Includes elementary probability, frequency distributions, sampling variation, estimation of means and standard deviations, basic design of experiments, confidence intervals, significance tests, elementary least squares curve fitting. Credit not allowed for both ST 361 and ST 370 or ST 380.

ST 370 Probability and Statistics for Engineers 3.
Prerequisite: MA 241.
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 surface fitting (regression analysis). The principles of experimental design and statistical process control introduced. Credit not allowed for both ST 370 and ST 361 or ST 380.

ST 371 Introduction to Probability and Distribution Theory 3.
Prerequisite: MA 241, Corequisite: MA 242.
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.

ST 372 Introduction to Statistical Inference and Regression 3.
Prerequisite: ST 371.
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.

ST 380 Probability and Statistics for the Physical Sciences 3.
Prerequisite: MA 241.
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 surface fitting (regression analysis). Credit not allowed for both ST 380 and ST 361 or ST 370.

ST 401 Experiences in Data Analysis 4.
Prerequisite: Permission of Instructor and either ST 311 or ST 305.
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.

ST 412 Long-Term Actuarial Models 3.
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.
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.

ST 413 Short-Term Actuarial Models 3.
Prerequisite: MA 241 or MA 231, and one of MA 421, ST 301, ST 305, ST 370, ST 371, ST 380, ST 421.
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 242.
First of a two-semester sequence of mathematical statistics, primarily for undergraduate majors and graduate minors in Statistics. Introduction to probability, univariate and multivariate probability distributions and their properties, distributions of functions of random variables, random samples and sampling distributions.

ST 422 Introduction to Mathematical Statistics II 3.
Prerequisite: ST 421.
Second of a two-semester sequence of mathematical statistics, primarily for undergraduate majors and graduate minors 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.
ST 430 Introduction to Regression Analysis 3.
Prerequisite: (ST 302 or ST 305) and (MA 305 or MA 405).
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.

ST 431 Introduction to Experimental Design 3.
Prerequisite: ST 302 or ST 305.
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.

ST 432 Introduction to Survey Sampling 3.
Prerequisite: ST 302 or ST 305.
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.

ST 435 Statistical Methods for Quality and Productivity Improvement 3.
Prerequisite: ST 302 or ST 305.
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.

ST 445 Introduction to Statistical Computing and Data Management 3.
Corequisite: ST 302 or ST 305.
Use of computers to manage, process and analyze data. Concepts of research; data management; JCL and utility programs; use of statistical program package for data analyses and graph production; and writing statistical programs to perform simulation experiments. Major paper required.

ST 495 Special Topics in Statistics 1-6.
Offered as needed to present material not normally available in regular departmental course offerings, or for offering new courses on a trial basis.

ST 498 Independent Study In Statistics 1-6.
Prerequisite: Six hours of ST.
Detailed investigation of topics of particular interest to advanced undergraduates under faculty direction. 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.

ST 501 Fundamentals of Statistical Inference I 3.
Prerequisite: MA 242 or equivalent.
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 521 and ST 501.

ST 502 Fundamentals of Statistical Inference II 3.
Prerequisite: ST 501.
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 522 and ST 502.

ST 503 Fundamentals of Linear Models and Regression 3.
P: ST 501; C: ST 502.

ST 505 Applied Nonparametric Statistics 3.
Prerequisite: ST 372 or ST 511.
Statistical methods requiring relatively mild assumptions about the form of the population distribution. Hypothesis testing, point and interval estimation and multiple comparison procedures for a variety of statistical problems.

ST 506 Sampling Animal Populations 3.
Prerequisite: ST 512.
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.

ST 507 Statistics For The Behavioral Sciences I 3.
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.

ST 508 Statistics For The Behavioral Sciences II 3.
Prerequisite: ST 507.
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.

ST 511 Experimental Statistics For Biological Sciences I 3.
Prerequisite: ST 311 or Graduate standing.
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.

ST 512 Experimental Statistics For Biological Sciences II 3.
Prerequisite: ST 511.
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.

ST 513 Statistics For Management I 3.
Prerequisite: Graduate standing.
Analysis of data to represent facts, guide decisions and test opinions in managing systems and processes. Graphical and numerical data analysis for descriptive and predictive decisions. Scatter plot smoothing and regression analysis. Basic statistical inference. Integrated use of computer.
ST 514 Statistics For Management and Social Sciences II 3.
Prerequisite: ST 507.
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.

ST 515 Experimental Statistics for Engineers I 3.
Prerequisite: ST 361 or Graduate standing.
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.

ST 516 Experimental Statistics For Engineers II 3.
Prerequisite: ST 515.
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.

ST 519 Teaching and Learning of Statistical Thinking 3.
Prerequisite: ST 507 or ST 511.
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.

ST 520 Statistical Principles of Clinical Trials and Epidemiology 3.
Prerequisite: ST 511, Corequisite: ST 512.

ST 521 Statistical Theory I 3.
Corequisite: MA 425 or MA 511 and MA 405.
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.

ST 522 Statistical Theory II 3.
Prerequisite: MA 511 or MA 425 and ST 521.
General framework for statistical inference. Point estimators: biased and unbiased, minimum variance unbiased, least 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.

ST 524 Statistics In Plant Science 3.
Prerequisite: ST 512.
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.

ST 535 Statistical Process Control 3.
Prerequisite: ST 515, Students must have access to an MS-DOS PC.

ST 536 Off-Line Quality Control 3.
Prerequisite: ST 421 or ST 515.
Off-line quality control methods for graduate students with a calculus-level first course in engineering statistics. About one third of lectures presentation of material from area of sampling inspection with emphasis upon using PCs for computations. Remainder of course presentation of material from design of experiments especially important in industrial applications: factorial experiments, orthogonal arrays, Plackett-Burman plans, Box-Behnken designs, response surfaces, design optimality, variability analysis.

ST 546 Probability and Stochastic Processes I 3.
Prerequisite: MA 421 and MA 425 or MA 511.
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.

ST 552 Linear Models and Variance Components 3.
Prerequisite: MA 405, ST 521, Corequisite: ST 522.

ST 555 Statistical Programming I 3.
An introduction to the data-handling techniques that are required to apply statistical methods including the importing, validating, and exporting of data files; manipulating, subsetting, and grouping data; merging and appending data sets; and basic reports including tables and graphics. Students learn SAS, the industry standard for statistical practice, and the R language commonly used in upper level statistics courses. Regular access to computer for homework and class exercises is required. Credit for both ST 445 and ST 555 is not allowed.
ST 556 Statistical Programming II 3.
P: ST 555 or Base SAS Certification.
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.

ST 557 Using Technology to Teach Statistics 3.
P: ST 508 or ST 512.
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 I help them structure learning activities around these technologies. Students will also learn to identify key elements in technologies that support pedagogical goals.

ST 561 Intermediate Econometrics 3.
Prerequisite: ECG 700 and ST 514.
Formalization of economic hypotheses into testable relationships and application of appropriate statistical techniques. Major attention to procedures applicable for single equation stochastic models expressing microeconomic and macroeconomic relationships. Statistical considerations relevant in working with time series and cross-sectional data in economic investigations. Survey of simultaneous equation models and the available estimation techniques.

ST 590 Special Topics 1-3.

ST 601 Seminar 1.

ST 610 Topics in Stat 1-99.
Special topics in Statistics.

ST 620 Special Problems 1-3.
Development of techniques for specialized cases, particularly in connection with thesis and practical consulting problems.

ST 625 Advanced Special Problems 1-3.
Prerequisite: ST 512, ST 552.
Any new advance in the field of statistics which can be presented in lecture series as unique opportunities arise.

ST 630 Independent Study 1-3.

ST 635 Readings 1-3.

ST 641 Statistical Consulting 1.
Prerequisite: ST 512 and ST 522.
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 and discuss consulting experiences.

ST 685 Master’s Supervised Teaching 1-3.
Prerequisite: Master’s student.
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.

ST 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master’s student.
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.

ST 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master’s student.
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.

ST 690 Master’s Examination 1-6.
Prerequisite: Master’s student.
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.

ST 693 Master’s Supervised Research 1-9.
Prerequisite: Master’s student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

ST 695 Master’s Thesis Research 1-9.
Prerequisite: Master’s student.
Thesis Research.

ST 696 Summer Thesis Research 1.
Prerequisite: Master’s student.
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.

ST 699 Master’s Thesis Preparation 1-9.
Prerequisite: Master’s student.
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.

ST 706 Nonlinear Programming 3.
Prerequisite: OR(IE,MA) 505 and MA 425.
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 attention directed toward current research and recent developments in the field.

ST 708 Applied Least Squares 3.
Prerequisite: ST 512.
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.

ST 711 Design Of Experiments 3.
Prerequisite: ST 512.
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 422, ST 512.
ST 721 Genetic Data Analysis 3.
Prerequisite: ST 430 and GN 411.

ST 730 Applied Time Series Analysis 3.
Prerequisite: ST 512.
An introduction to use of statistical methods for analyzing and forecasting data observed over time. Trigonometric 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.

ST 731 Applied Multivariate Statistical Analysis 3.
Prerequisite: ST 512.
An introduction to use of multivariate statistical methods in analysis of data collected in experiments and surveys. Topics covered include multivariate analysis of variance, discriminant analysis, canonical correlation analysis and principal components analysis. Emphasis upon use of a computer to perform multivariate statistical analysis calculations.

ST 732 Applied Longitudinal Data Analysis 3.
Prerequisite: ST 512.

ST 733 Applied Spatial Statistics 3.
Prerequisite: ST 512.
Graphical and quantitative description of spatial data. Kriging, block kriging and co-kriging. Common variogram models. Analysis of mean-nonstationary data by median polish and universal kriging. Spatial autoregressive models, estimation and testing. Spatial sampling procedures. Use of existing software with emphasis on analysis of real data from the environmental, geological and agricultural sciences.

ST 740 Bayesian Inference and Analysis 3.
Prerequisite: ST 522.
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).

ST 744 Categorical Data Analysis 3.
Prerequisite: ST 512 and ST 522.
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.

ST 745 Analysis of Survival Data 3.
Prerequisite: ST 522.
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.

ST 746 Introduction To Stochastic Processes 3.
Prerequisite: MA 405 and MA(ST) 546 or ST 521.
Markov chains and Markov processes, Poisson process, birth and death processes, queuing theory, renewal theory, stationary processes, Brownian motion.

ST 747 Probability and Stochastic Processes II 3.
Prerequisite: MA(ST) 546.
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.

ST 748 Stochastic Differential Equations 3.
Prerequisite: MA(ST) 747.

ST 750 Introduction to Econometric Methods 3.
Prerequisite: ST 421; Corequisite: ST 422.
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.

ST 751 Econometric Methods 3.
Prerequisite: ST 421, ST 422.
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.
ST 752 Time Series Econometrics 3.
Prerequisite: ECGs(ST) 751.
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; vector autoregressive (VAR) models. Linear models for nonstationary data: deterministic and stochastic trends; cointegration. Methods for capturing volatility of financial time series such as autoregressive conditional heteroscedasticity (ARCH) models. Generalized Method of Moments estimation of nonlinear dynamic models.

ST 753 Microeconometrics 3.
Prerequisite: ECG 751.
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. Panel data models: balanced and unbalanced panels; fixed and random effects; dynamic panel data models; limited dependent variables and panel data analysis.

ST 755 Advanced Analysis Of Variance and Variance Components 3.
Prerequisite: ST 512, ST 552.
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.

ST 756 Computational Molecular Evolution 3.
Prerequisite: GN 411 and ST 511.

ST 757 Statistics for Molecular Quantitative Genetics 3.
Prerequisite: ST 512 and GN 703 or ST 721.
Genetic mapping data. Linkage map reconstruction, quantitative genetical models. Statistical methods and computer programs for mapping quantitative trait loci and estimating genetic architecture of quantitative traits.

ST 758 Computation for Statistical Research 3.
Prerequisite: ST 522 and ST 552.
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.

ST 762 Nonlinear Statistical Models for Univariate and Multivariate Response 3.
Prerequisite: ST 512, ST 552.
Inference for general nonlinear parametric statistical models for univariate and multivariate continuous and discrete response, including generalized linear models, nonlinear models with nonconstant variance, and generalised estimating equation procedures for multivariate response, including repeated measurement data. Linear and quadratic estimating equations, models for covariance structure, effects of model misspecification and robustness. Survey of major theoretical results and implementation using standard statistical software.

ST 771 Biostatistics I 3.
Prerequisite: Advanced calculus, reasonable background in biology.
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 offsetshoots), 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 or 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.

ST 772 Biostatistics II 3.
Prerequisite: BMA 771, elementary probability theory.
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.

ST 773 Stochastic Modeling 3.
Prerequisite: BMA 772 or ST (MA) 746.

ST 779 Advanced Probability 3.
Prerequisite: MA 425 and ST 521.
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 512 and ST 522.

Prerequisite: ST 512 and ST 522.
Theory and methods of time series analysis from frequency point of view. Harmonic analysis, complex demodulation and spectrum estimation. Frequency domain structure of stationary time series and space-time processes. Sampling distributions of commonly used statistics.
ST 784 Multivariate Analysis 3.
Prerequisite: ST 522.

ST 790 Advanced Special Topics 1-3.
ST 793 Advanced Statistical Inference 3.
Prerequisite: ST 522.
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.

ST 801 Seminar 1.
ST 810 Advanced Topics in Statistics 1-3.
ST 820 Special Problems 1-3.
Development of techniques for specialized cases, particularly in connection with thesis and practical consulting problems.

ST 825 Advanced Special Problems 1-3.
Prerequisite: ST 512, ST 552.
Any new advance in the field of statistics which can be presented in lecture series as unique opportunities arise.

ST 830 Independent Study 1-3.
ST 835 Readings 1-3.
ST 841 Statistical Consulting 1.
Prerequisite: ST 512 and ST 522.
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 and discuss consulting experiences.

ST 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

ST 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation Research.

ST 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

STS - Science, Technology and Society Courses

STS 210 Women and Gender in Science and Technology 3.
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.

STS 214 Introduction to Science, Technology, and Society 3.
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.

STS 257 Technology in the Arts 3.
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.

STS 301 Science and Civilization 3.
Prerequisite: Sophomore standing.
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.

STS 302 Contemporary Science, Technology and Human Values 3.
Prerequisite: Sophomore standing.
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.

STS 304 Ethical Dimensions of Progress 3.
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.

STS 322 Technological Catastrophes 3.
Prerequisite: Sophomore standing.
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.
STS 323 World Population and Food Prospects 3.
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.

STS 325 Bio-Medical Ethics 3.
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.

STS 326 Technology Assessment 3.
Impacts of technologies as they are applied in society. Description and forecasting of effects, interactions, and potential irreversibilities.

STS 402 Peace and War in the Nuclear Age 3.
An interdisciplinary examination of contemporary wars and international conflict, arms, races, nuclear strategy and defense policy, arms control, theories and strategies of peace.

Prerequisite: STS 214, STS or STB Majors.
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.

STS 405 Technology and American Culture 3.
An interdisciplinary study of the role of technology in American culture which examines the ideological, political, social, economic, and institutional contexts of technological change from the 1760's to the present, and explores the cultural impacts of new technological systems.

STS 471 Darwinism and Christianity 3.
Prerequisite: One course in religious studies, biological sciences, philosophy of science, or history of science.
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 evolutionary world.

STS 484 Cross Cultural Technology Transfer 3.
Technology transfer into cultures with different values and traditions. Special attention to the role of local and international organizations and to gender and environmental concerns. Case studies: crop science, water, energy, forest resources, banking, information technology.

Prerequisite: Junior standing.
Examination of a significant issue, method, or historical episode in the area of science, technology, and society.

STS 491 Independent Study in Science, Technology, and Society 3.
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" be completed by the student and faculty member prior to registration by the department.

STS 571 Darwinism and Christianity 3.
Prerequisite: Graduate standing.
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 evolutionary world.

SVM - Specialized Veterinary Medicine Courses

SVM 510 Animal Production Topics 1-3.
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 and relevant population health issues.

SVM 579 Advanced Specialty Training 1-3.
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.

SVM 595 Special Topics 1-3.

SVM 601 Seminar - Poultry Medicine 1-3.

SVM 602 Seminar - Small Animal Surgery 1-3.

SVM 610 Special Topics 1-3.

SVM 615 Advanced Animal Production Topics 1-3.
Prerequisite: SVM 510.
Students will be provided with experience in 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.

SVM 635 Advanced Reading 1-3.

SVM 650 Internship - SVM 1-3.

SVM 685 Supervise Teaching 1-3.

SVM 686 Other Teaching 1-3.

SVM 693 Supervised Research 1-3.

SW - Social Work Courses

SW 201 Community Social Services 4.
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.
SW 260 Introduction to Gerontology: An Interdisciplinary Field of Practice 3.
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.

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.

P: ST 311; R: Social Work Majors/Minors.
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.

Prerequisite: SW 290.
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 201.
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.

SW 312 Multicultural Social Work 3.
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.

SW 320 Social Work Practice I 4.
Corequisite: Social Work Majors, and a prerequisite or corequisite of SW 310.
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 strength-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.

SW 405 Social Work Practice II 4.
Prerequisite: Social Work Majors, SW 320, Corequisite: SW 480/SW 408.
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.

SW 408 Social Work Practice III 3.
Prerequisite: Social Work Majors, SW 320, Corequisite: SW 405, SW 480.
Course prepares students for practice with 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.

SW 412 Social Work in Schools 3.
Prerequisite: Nine credits in Social Work courses, including SW 320.
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.
SW 413 African American Families: History, Tradition, and Community 3.
Prerequisite: Sophomore standing.
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.

SW 415 Child Welfare 3.
Prerequisite: SW 201.
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 310.
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.

SW 417 Direct Practice with Older Adults 3.
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.

Prerequisite: Students are Participants in the NC Child Welfare Education Collaborative Program.
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 occasional field trips to community agencies.

SW 420 The Legal Aspects of Social Work 3.
Prerequisite: Social Work Majors and Social Work Minors.
Legal environment of the social work profession. Relationships among legal processes, the delivery of social work services and client problems.

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.

SW 480 Preparation for Field Work 1.
Prerequisite: Social Work Majors, SW 320, Corequisite: SW 405, SW 408.
Introduction to aspects of field placement process and necessary skills for a successful internship. Application, interview, ethical practice, documentation, supervision and learning contract.

SW 490 Field Work in Social Services 12.
Prerequisite: Social Work Majors, SW 405, SW 408, SW 480.
Supervised placement in a social service organization; demonstration of CSWE core competencies and professional practice behaviors. Weekly integrative seminar. Intern liability insurance required. Students are expected to provide their own transportation to the internship site.

SW 495 Special Topics in Social Work 3.
Detailed investigation of a topic in social work. Topic and mode of study determined by faculty member.

Prerequisite: Junior standing or Senior standing, Social Work Majors or Social Work Minor, Nine credits in social work courses.
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 member prior to registration by the department.

SW 500 Advanced Standing Seminar 4.
Corequisite: SW 505.
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.

SW 501 Social Work Policy, Services and Programs 3.
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.

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.

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.

Prerequisite: ST 311.
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.
P: SW 505 & SW 510.
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.

SW 515 Child Welfare 3.
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. Credit is not allowed for both SW 415 and SW 515.

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. Credit is not allowed for both SW 416 and SW 516.

SW 517 Direct Practice with Older Adults 3.
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.

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 occasional field trips to community agencies. Required for members of the NC Child Welfare Education Collaborative Program.

SW 520 SW Generalist Practice I 3.
C: SW 505 and SW 651.
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.

SW 521 SW Generalist Practice II 3.
P: SW 505 & SW 520; C: SW 652.
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.

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.

SW 550 Advanced Social Work Practice with Families 3.
Prerequisite: SW 652, Corequisite: SW 654.
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.

SW 551 Social Work Practice with Children and Adolescents 3.
Prerequisite: SW 521 and SW 652.
Focuses on assessment and intervention strategies for clinical practice with children and adolescents. Explores issues common to these client groups.

SW 557 SW Program Development and Grant Writing 3.
Prerequisite: SW 561 & SW 653; Corequisite: SW 654.
Provides a comprehensive introduction to program development and grant writing in social work. Examines the major steps in the process including problem identification, needs assessment, program planning, and resource identification and development. 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 the MSW program.

SW 560 Advanced Policy Practice with Organizations and Communities 3.
Prerequisite: SW 501 & SW 521.
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.

SW 561 Social Work Administration and Supervision 3.
Prerequisite: SW 521 & SW 652.
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.
SW 571 Community Mental Health 3.
Prerequisite: SW 691.
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 653.
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 students to interact and blend perspectives from both direct practice and community partnership concentration options.

SW 581 Advanced Social Work Practice with Individuals 3.
Prerequisite: SW 521 and SW 652.
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 external and/or internal stressors. Interventions with diverse populations risk. Restricted to students who have completed all foundation courses in the MSW program.

SW 582 Advanced Social Work Practices with Groups 3.
Prerequisite: SW 521 and SW 652; Corequisite: SW 583.
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 interventions in assessing their impact on individual and social change. Restricted to students who have completed all foundation courses in the MSW program.

SW 583 Advanced Social Work Practice with Family Systems 3.
Prerequisite: SW 521 and SW 652; Corequisite: SW 584.
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.

SW 590 Social Work Capstone 2.
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 curricular content and demonstrating readiness to practice as an MSW level professional social worker. Restricted to students who have completed the first semester in the Advanced Year of the MSW Program.

SW 595 Special Topics in Social Work 3.
Prerequisite: Graduate standing.
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.

SW 630 Independent Study in Social Work 1-6.
Prerequisite: Master of Social Work, SW 510.
An independent study addressing an area of social work practice or social welfare.

SW 651 Social Work Field Internship I 5.
C: SW 505 & SW 520.
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.

SW 652 Social Work Field Internship II 5.
Prerequisite: SW 520 and SW 651, Corequisite: SW 521.
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.

SW 653 Advanced Social Work Field Internship I 5.
C: SW 512 or 557 or 561 or 581 or 582.
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.

SW 654 Advanced Social Work Field Internship II 5.
Prerequisite: SW 653; Corequisite: SW 560 or SW 561 or SW 583 or SW 590.
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.

T - Textiles Courses

T 101 Introduction to the College of Textiles 1.
Introduction topics related to the College of Textiles, the textile industry, 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.

T 102 Introduction to Product Evolution 2.
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.

T 200 Introduction to Textiles 3.
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.

T 491 Honors Seminar in Textiles 1.
Prerequisite: By invitation into Honors Program in Textiles.
A seminar on current university and industrial research in the field of textiles.
T 493 Industrial Internship in Textiles 3.
Prerequisite: Textile core courses.
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.

Prerequisite: GPA of 2.75 or better and JR standing.
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 different countries to work
together using various communication tools. Students shall arrange
international contacts and provide a written proposal of the project to the
undergraduate administrator or course coordinator prior to registration.

T 497 Independent Research in Textile Engineering, Chemistry and
Materials Science I 3.
Prerequisite: Junior standing in TECS; 2.8 GPA.
Independent research in Textile Engineering, Chemistry and Materials
Science topics through experimental, theoretical and literature studies.
Written and oral reports required.

T 498 Independent Research in Textile Engineering, Chemistry and
Materials Science II 1-3.
Prerequisite: T 497.
Independent research in Textile Engineering, Chemistry and Materials
Science topics through experimental, theoretical and literature studies.
Written and oral reports required.

TAM - Textile and Apparel Management
Courses

TAM 589 Special Studies In Textile Management and Technology
1-4.
Prerequisite: Senior standing.
New or special course on developments in textile management and
technology. Specific topics and prerequisites vary.

TC - Textile Chemistry Courses

TC 502 Textile Wet Processing 4.
Introduction to the technology of textile wet processing. Topics include
preparation, coloration, and finishing of textile substrates, color science
and color measurement. Emphasis on basic science and equipment of
textile wet processing. Not for TC graduate students.

TC 530 The Chemistry Of Textile Auxiliaries 3.
Prerequisite: One yr. of organic chemistry.
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.

TC 561 Organic Chemistry Of Polymers 3.
Prerequisite: TC 461 and CH 231 or CH 431.
Principles of step reaction and addition polymerizations;
copolymerization; emulsion polymerization; ionic polymerization;
characterization of polymers; molecular structure and properties.

TC 565 Polymer Applications and Technology 3.
Prerequisite: One yr. of organic chemistry, TC 461.
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.

TC 589 Special Studies In Textile Engineering and Science 1-4.
Prerequisite: Senior standing or Graduate standing.
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.

TC 601 Seminar 1.
Discussion of scientific articles and presentations; review and discussion
of student papers and research problems.

TC 630 Independent Study 3.

TC 685 Master’s Supervised Teaching 1-3.
Prerequisite: Master’s student.
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.

TC 688 Non-Thesis Masters Continuous Registration - Half Time
Registration 1.
Prerequisite: Master’s student.
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.

TC 689 Non-Thesis Master Continuous Registration - Full Time
Registration 3.
Prerequisite: Master’s student.
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.

TC 690 Master’s Examination 1-6.
Prerequisite: Master’s student.
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.

TC 693 Master’s Supervised Research 1-9.
Prerequisite: Master’s student.
Instruction in research and research under the mentorship of a member
of the Graduate Faculty.

TC 695 Master’s Thesis Research 1-9.
Prerequisite: Master’s student.
Thesis Research.

TC 696 Summer Thesis Research 1.
Prerequisite: Master’s student.
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.
TC 699 Master’s Thesis Preparation 1-9.
Prerequisite: Master’s student.
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.

TC 704 Fiber Formation—Theory and Practice 3.
Prerequisite: MA 341, PY 208.
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.

TC 705 Theory Of Dyeing 3.
Prerequisite: CH 433.

TC 706 Color Science 3.
Prerequisite: Senior standing or Graduate standing in TC, Corequisite: TC 707.
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.

TC 707 Color Laboratory 1.
Prerequisite: Senior standing or Graduate standing in TC, Corequisite: TC 706.
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.

TC 720 Chemistry Of Dyes and Color 3.
Prerequisite: (CH 221 or CH 225) and (CH 223 or CH 227).
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.

TC 721 Dye Synthesis Laboratory 3.
Prerequisite: TC 720.
Laboratory work in preparation and analysis of synthetic dyes of a large number of types. Personal instruction in techniques and processes for preparation and purification of intermediates and dyes.

TC 771 Polymer Microstructures, Conformations and Properties 3.
Prerequisite: CH 220.
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.

TC 791 Special Topics In Textile Science 1-4.
Prerequisite: Senior standing or Graduate standing.
Intensive treatments of selected topics in textile, polymer and fiber science.

TC 792 Special Topics In Fiber Science 1-3.
Study of selected topics of particular interest in various advanced phases of fiber science.

TC 896 Summer Dissert Res 1.
TDE 261 Digital Media Education 3.
Prerequisite: TDE 205.
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.

TDE 331 Technology Through Engineering and Design II 3.
Prerequisite: TDE 131 and Corequisite: GC 350.
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 permission.

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.

TDE 359 Electronics Technology 3.
Prerequisite: Junior standing.
Direct current, alternating current, and semiconductors. Measurement and circuit behavior. Experimentation with application circuits.

Prerequisite: TDE 131 and GC 120.
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.

TDE 385 Robotics Education 1.
Corequisite: TDE 386.
This course is an introduction to design and invention system control mechanisms and robot sensors. Students will classify foundational technical developments in autonomous, computer, and radio-control teleoperations. Students will explore the history and evolution of robots and automation and their social, economic, industrial, and educational impacts.

TDE 386 Robotics Education Lab 3.
Corequisite: TDE 385.
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.

TDE 407 Field Work in Technology Education 1-6.
Supervised off-campus field experience in Technology Education that relates on-the-job experiences in the field to the technical competencies which are the content of the curriculum. May be repeated for a maximum of 6 credits.

TDE 452 Lab Planning in Technology Education 3.
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.

Prerequisite: Technology Education Majors, Admittance to teacher education candidacy.
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.

TDE 457 Student Teaching in Technology Education 1-8.
Skills and techniques involved in teaching technology education through practice in a public school setting.

TDE 481 Research & Development in Technology Education 3.
Prerequisite: TDE 331, TDE 385, and TDE 386.
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.

TDE 490 Special Problems in Technology Education 1-6.
Prerequisite: Junior standing.
Supervised, independent investigation in a defined area of interest in Technology Education.

TDE 495 Senior Seminar in Technology Education 3.
Prerequisite: Junior standing.
An in-depth investigation of a topic or a set of problems and/or issues in Technology Education.

TDE 498 Independent Study in Technology Education 1-3.
Prerequisite: Junior standing.
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 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.

TE - Textile Engineering Courses

TE 105 Textile Engineering: Materials and Systems 2.
Corequisite: CH 101.
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.

TE 110 Computer-Based Modeling for Engineers 3.
Prerequisite: E 115, Corequisite: MA 141.
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.
TE 200 Introduction to Polymer Science and Engineering 3.
Prerequisite: Grade of C or better CH 101.
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.

TE 201 Textile Engineering Science 4.
Prerequisite: Grade of C or better in MA 241, PY 205; and Corequisite: TE/ISE 110.
Structure, physical and mechanical properties of fibers; structure of assemblies. Structure/property relations. Laboratory exercises in characterization of fiber properties.

TE 205 Analog and Digital Circuits 4.
Prerequisite: C- or better in TE 110, PY 208, Corequisite: MA 341.
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.

TE 301 Engineering Textile Structures I: Linear Assemblies 3.
Prerequisite: (MAE 206 or CE 214) and MA 242.
Engineering analysis of textile structures, especially yarns. Unit processes of production, handling and packaging. Production sequences, intermachine effects, machine design and their consequences on the textile product.

TE 302 Textile Manufacturing Processes and Systems II 4.
Prerequisite: TE 301 and C- or better in TE/ISE 110.

TE 303 Thermodynamics for Textile Engineers 3.
Prerequisite: MA 242, PY 208.
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 applied examples and problems will be heavily utilized.

TE 401 Textile Engineering Design I 4.
Prerequisite: TE 302.
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.

TE 402 Textile Engineering Design II 4.
Prerequisite: TE 401.
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.

TE 404 Textile Engineering Quality Improvement 3.
Prerequisite: ST 370 and C- or better in TE/ISE 110.
Defining and quantifying quality of textile products; quality improvement using statistical process control (SPC) and design of experiment (DOE) techniques.

TE 424 Textile Engineering Quality Improvement Laboratory 1.
Corequisite: TE 404.
Application of process improvement methods to textile systems using statistical software. Laboratory supplements lecture material presented in TE 404.

Prerequisite: (MA 341 and TE 205) or CHE 312.
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: C- or better in TE/ISE 110 and JR standing.
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.

TE 463 Polymer Engineering 3.
Prerequisite: MSE 201 or BME 203; and Corequisite: TE 303, MAE 301, or MSE 301.
Chemical and physical properties of polymers and fibers; thermodynamics of crystallization, time dependent phenomena, fracture mechanics and rheology. Advanced topics in extrusion.

TE 466 Polymeric Biomaterials Engineering 3.
Prerequisite: PY 208 and (TE 200 or CH 220 or CH 221 or CH 225) and (MAE 206 or CE 214).
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.

TE 467 Mechanics of Tissues & Implants Requirements 3.
Prerequisite: (ZO 160 or BIO 183) and (MAE 314 or CE 313).
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.

TE 492 Special Topics in Textile Engineering 1-3.
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.

TE 505 Textile Systems and Control 3.
Prerequisite: TE 305, CSC 114.
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.
TE 533 Lean Six Sigma Quality 3.
Prerequisite: ST 361 and ST 371, or equivalent.
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.

TE 540 Textile Information Systems Design 3.
Prerequisite: Introductory Programming Course.
The course will focus on using rapid application development (RAD) tools to design and implement database-based driven applications in a client/server architecture. This includes the SQL database query language, utilizing VB.Net as the RAD environment to build decision support systems and how to integrate these tools together to design and build information systems. Credit will not be given for both TE 440 and TE 540.

TE 550 Clothing Comfort and Personal Protection Science 3.
R: Graduate Standing or Permission of Instructor.
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.

TE 551 Human Physiology for Clothing and Wearables 3.
R: Graduate Standing or Permission of Instructor.
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.

TE 565 Textile Composites 3.
Prerequisite: MA 341, MAE 206.
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.

TE 566 Polymeric Biomaterials Engineering 3.
Prerequisite: PY 208 and (TE 200 or CH 220 or CH 221 or CH 225) and (MAE 206 or CE 214).
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. Credit for TE 466 and TE 566 is not allowed.

TE 570 Polymer Physics 3.
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.

TE 589 Special Studies In Textile Engineering and Science 1-4.
Prerequisite: Senior standing or Graduate standing.
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.

TE 601 Seminar 1.

TE 630 Independent Study 3.

TE 676 Special Projects 1-3.

TE 685 Master’s Supervised Teaching 1-3.
Prerequisite: Master’s student.
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.

TE 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master’s student.
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.

TE 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master’s student.
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.

TE 690 Master’s Examination 1-6.
Prerequisite: Master’s student.
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.

TE 693 Master’s Supervised Research 1-9.
Prerequisite: Master’s student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

TE 695 Master’s Thesis Research 1-9.
Prerequisite: Master’s student.
Thesis Research.

TE 696 Summer Thesis Research 1.
Prerequisite: Master’s student.
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.

TE 699 Master’s Thesis Preparation 1-9.
Prerequisite: Master’s student.
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.
TED - Technology Education Courses

TED 530 Foundations for Teaching Technology 3.
Prerequisite: Graduate standing.
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.
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.

TED 534 Instructional Design in Technical and Technology Education 3.
Prerequisite: Graduate standing.
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 applications in technical and technology education classrooms.

TED 536 Scientific and Technical Visualization: Theory and Practice 3.
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 to assist individuals in the exploration of scientific and technical concepts. Particular focus on how to integrate scientific/technical graphics into the instructional settings.

TED 551 Technology Education: A Discipline 3.
Prerequisite: Graduate standing or PBS status.
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.

TED 552 Curricula for Emerging Technologies 3.
Prerequisite: Graduate standing or PBS status.
Analyze advanced technologies and develop instructional programs for technology education curricula in secondary schools. Topics include technologies in production, transportation and communication.

TED 555 Developing and Implementing Technology Education 3.
Prerequisite: Graduate standing or PBS status.
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.

TED 556 Laboratory Management and Safety in TED 3.
Prerequisite: Graduate standing.
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.

TED 558 Teaching Creative Problem Solving 3.
Prerequisite: Graduate standing or PBS status.
Provides teachers with the opportunity to study the research associated with creativity and apply these theories to implement a creative problem solving program.

TED 601 Practicum in Technology Education 1-6.
Prerequisite: Graduate standing or PBS status.
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.

TED 602 Practicum in TED 1-3.

TED 610 Special Topics in Technology Education 1-3.
Prerequisite: Graduate standing or PBS status.
Individual or group of special topics in professional education. The faculty member determines the topic and mode of study after discussion with students.

TED 621 Special Problems in Technology Education 1-3.
Prerequisite: Graduate standing or PBS status.
Guided independent or group or current problems in technology education.

TED 641 Internship in Technology Education 3.
Prerequisite: Graduate standing or PBS status.
Classroom teachers will document products of learning to include: content pedagogy, student development, multiple instructional strategies, motivation and management, professional growth and community involvement.

TED 646 Field-based Research in Technology Education 3.
Prerequisite: Graduate standing or PBS status.
Employ methods of field-based research to examine and improve instructional effectiveness and student achievement.

TED 655 Internship in Graphic Communications Education 3.
Prerequisite: TED 530 or EOE 751 with Consent of Instructor.
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.

TED 668 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.
**TED 689 Non-Thesis Master Continuous Registration - Full Time Registration** 1-6.
*Prerequisite: Master's student.*
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.

**TED 690 Master's Examination** 1-6.
*Prerequisite: Master's student.*
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.

**TED 692 Research Project in Technology Education** 1-6.
*Prerequisite: ELP 732.*
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.

**TED 693 Master's Supervised Research** 1-9.
*Prerequisite: Master's student.*
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

**TED 695 Master's Thesis Research** 1-9.
Thesis research.

**TED 696 Summer Thesis Res 1.**

**TED 709 Seminar in Technology Education** 1-3.
*Prerequisite: Graduate standing or PBS status.*
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.

**TED 751 Technology Education: A Discipline** 3.
*Prerequisite: Graduate standing or PBS status.*
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 research and identifies areas of needed research.

**TED 752 Curricula for Emerging Technologies** 3.
*Prerequisite: Graduate standing or PBS status.*
Analyze advanced technologies and develop instructional programs for technology education curricula in secondary schools. Topics include technologies in production, transportation and communication.

**TED 755 Developing and Implementing Technology Education** 3.
*Prerequisite: Graduate standing or PBS status.*
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.

**TED 756 Planning of Change in TED** 3.
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 aptly use behavioral tools to achieve success.

**TED 757 Leadership Development in TED** 3.
*Prerequisite: Graduate standing or PBS status.*
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.

**TED 758 Teaching Creative Problem Solving** 3.
*Prerequisite: Graduate standing or PBS status.*
Provides teachers with the opportunity to study the research associated with creativity and apply these theories to implement a creative problem solving program.

**TED 801 Practicum in Technology Education** 1-6.
*Prerequisite: Graduate standing or PBS status.*
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.

**TED 810 Special Topics in Technology Education** 1-3.
*Prerequisite: Graduate standing or PBS status.*
Individual or group of special topics in professional education. The faculty member determines the topic and mode of study after discussion with students.

**TED 821 Special Problems in Technology Education** 1-3.
*Prerequisite: Graduate standing or PBS status.*
Guided independent or group or current problems in technology education.

*Prerequisite: Master's student.*
Dissertation research.

*Prerequisite: Graduate standing or PBS status.*
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.

**THE - Theatre Courses**

**THE 103 Introduction to the Theater** 3.
Artistic, technical, historical, and literary areas of theater, including acting, directing, design, stagecraft, lighting, costuming, makeup, and criticism.

**THE 203 Theory and Practice of Acting** 3.
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.

**THE 223 Stagecraft** 3.
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.

**THE 233 Introduction to Stage Lighting** 3.
Fundamentals and uses of stage lighting equipment and stage lighting design. Practical application of design media and shop facilities. Participation in production activity for University Theater presentations.
THE 234 Makeup Design for the Stage 3.
The process of design and application of makeup for the stage including techniques for character and age makeup, making and applying facial hair and other specialized techniques. Taught from the play script to production with emphasis on historical research, play analysis, and applications techniques. The course includes hands-on experience with makeup. May not be taken concurrently with ARS 236 or ARS 333. May not be taken concurrently with ARS 236 or ARS 333.

THE 236 Text to Stage 3.
Study of script preparation beginning with the directors' and designers' collaborative efforts through rehearsal process, to the production itself and ending with the final evaluation. Directors' methods and designer processes in theory and practice. Attendance at one rehearsal and two productions is required. May not be taken concurrently with ARS 233 or 333. May not be taken concurrently with ARS 233 or ARS 333.

THE 293 Theater Practicum 1-6.
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.

THE 294 Independent Study in Theater 1-3.
Individualized study in Theater under the supervision of faculty in the discipline. Mode of study, evaluation criteria, and credit hours to be determined in consultation with the supervising faculty and documented. Course may be taken a maximum of 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.

THE 303 Stage Directing 3.
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.

THE 323 Introduction to Scenic Design 3.
Prerequisite: THE 103 or 223.
Aesthetics, elements, and principles of scenic design. Theories and applications to the physical stage in relation to the script. Practical applications with the use of design media in University Theater productions.

THE 333 Costume Design and Technology 3.
Prerequisite: THE 103 or THE 236.
The process of designing costumes taught from the perspective of both the play's script and the anticipated production with emphasis on historical research, play analysis, rendering technique, and basic construction. Hands-on experience required. May not be taken concurrently with ARS 233 or ARS 236. May not be taken concurrently with ARS 233 or ARS 236.

THE 334 Advanced Acting 3.
Prerequisite: THE 203 or demonstrated competence in acting.
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.

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.

THE 352 Dress, Style, Change 3.
Prerequisite: Junior standing.
Interdisciplinary course focusing on historical and cultural principles of style as related to dress and fashion. Examination of fashion and stylistic trends in cycles of dress.

THE 363 Audition and Interpretation Techniques 3.
Cold-reading scenes broken down to meet challenges of theatrical auditions. Personal technique developed to interpret texts through exercises, monologues, and scenes. Promotion of self-awareness, confidence, and understanding of dramatic literature as reflector of contemporary and historic lives.

THE 398 Special Topics in University Theatre 1-3.
Presentation of material normally not available in regular course offerings, or offerings of a new course on a trial basis.

THE 403 Touring Theatre 3.
Prerequisite: Audition required.
A touring performance experience consisting of text analysis, characterization, role development, and performance of scripts.

THE 433 Period Styles in Acting 3.
Prerequisite: THE 493.
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.

TMS - Textile Materials Science Courses

TMS 211 Introduction to Fiber Science 3.
Prerequisite: MT 105 or TT 105 or PCC 101; Corequisite: MA 131 or MA 141.
Properties of fibers related to type and chemical structure. Fiber classification and identification. Reaction to moisture, stress-strain properties, and methods of measuring physical properties. Relationship between polymer structure, fiber properties and utilization.

TMS 212 Yarn and Fabric Formation and Properties 2.
Prerequisite: TMS 211.
The development of products from textile and fibrous materials is a critical component of new product development in many industries, including textiles, retail, plastics, composites, transporations, 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.

TMS 214 Yarn and Fabric Formation and Properties Lab 1.
Prerequisite: TMS 212.
The development of products from textiles and fibrous materials is a critical component of new product development in many industry. This laboratory course provides hands-on exercises and demonstrations of key textile and fiber-based products are manufactured.
TMS 492 Special Topics in Textile Materials Science 1-3.
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.

TMS 500 Fiber and Polymer Microscopy 3.
Prerequisite: MA 242, PY 208, TC 203.
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.

TMS 521 Filament Yarn Production Processing and Properties 3.
Prerequisite: Graduate standing or PBS status.
Structure, properties and processes for manufacturing and treating continuous filament yarns. Response of fibers to elevated temperatures, twist, false twist and various bulking processes. Yarn structures 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.

TMS 565 Textile Composites 3.
Prerequisite: MA 341, MAE 206.
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.

TMS 589 Special Studies In Textile Engineering and Science 1-4.
Prerequisite: Senior standing or Graduate standing.
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.

TMS 676 Special Projects 1-3.

TMS 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

TMS 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

TMS 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

TMS 690 Master's Exam 1-6.
Prerequisite: Master's student.
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.

TMS 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

TMS 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

TMS 761 Mechanical and Rheological Properties Of Fibrous Material 3.
Prerequisite: MA 301.
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.

TMS 762 Physical Properties Of Fiber Forming Polymers, Fibers and Fibrous Structures 3.
Prerequisite: PY 208.
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.

TMS 763 Characterization Of Structure Of Fiber Forming Polymers 3.
Prerequisite: Graduate standing.
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.

TOX - Toxicology Courses

TOX 121 Pesticides and Their Utilization 3.
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.

TOX 201 Poisons, People and the Environment 3.
Introduction to the fascinating world of chemical poisons including their many and varied effects on people as well as the environment. Learn how and why poisons have played an important role in history, how to critically evaluate the chemical risk information reported in the media, and the underlying principles of "the basic science of poisons.".
TOX 401 Principles of Toxicology 4.
Prerequisite: CH 220 or CH 221 or CH 225; BIO 181 or ZO 160.
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.

TOX 415 Environmental Toxicology and Chemistry 4.
Prerequisite: CH 220 or CH 221 or CH 225; BIO 181 or ZO 160 recommended.
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.

TOX 495 Special Topics in Toxicology 1-3.
Offered as needed to present materials unavailable in regular course offerings or for offering new courses on a trial basis.

TOX 499 Undergraduate Research in Toxicology 1-3.
Prerequisite: Sophomore standing or higher.
Research for students in Toxicology. In lieu of a syllabus, student and professor will prepare a contract which details the research and how the results will be disseminated.

TOX 501 Principles of Toxicology 4.
Prerequisite: (CH 220 or CH 221 or CH 225) and (BIO 181 or ZO 160).
Introduction to basic principles of toxicology, including 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. Students cannot obtain credit for both TOX 401 and TOX 501.

TOX 515 Environmental Toxicology 4.
Prerequisite: Two years of biology.
Evaluation of the nature, distribution and significance of microchemical contamination. Emphasis on current, relevant problems.

TOX 595 Special Topics 1-3.

TOX 601 Toxicology Seminar 1.
Prerequisite: Graduate standing.

TOX 620 Special Problems 1-3.
Prerequisite: Graduate standing.
Topics include responsibility in science, environmental fate of chemicals, developmental toxicology, lab rotations, journal club and wildlife toxicology.

TOX 660 Free Radicals In Toxicology 1.
Prerequisite: BCH 451 and TOX 710.
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.

TOX 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master’s student.
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.

TOX 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master’s student.
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.

TOX 690 Master’s Exam 1-6.
Prerequisite: Master’s student.
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.

TOX 693 Master’s Supervised Research 1-9.
Prerequisite: Master’s student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

TOX 695 Master’s Thesis Research 1-9.
Prerequisite: Master’s student.
Thesis research.

TOX 696 Summer Thesis Research 1.
Prerequisite: Master’s student.
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.

TOX 699 Master’s Thesis Preparation 1-9.
Prerequisite: Master’s student.
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.

TOX 701 Fundamentals of Toxicology 3.
Prerequisite: BCH 451, Senior standing or Graduate standing.
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.

TOX 704 Chemical Risk Assessment 1.
Prerequisite: TOX 701, a ST course.

TOX 705 Immunotoxicology 2.
Prerequisite: TOX 701.
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.

TOX 710 Molecular and Biochemical Toxicology 3.
Prerequisite: BCH 451; TOX 701.
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.
TOX 715 Environmental Toxicology 3.
Prerequisite: Two years of biology.
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.

TOX 725 Pesticide Chemistry 1.
Prerequisite: (CH 201 or CH 203) and (CH 221 or CH 225).
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.

TOX 727 Pesticide Behavior and Fate In the Environment 2.
Prerequisite: GS(HS,SSC,TOX) 725, SSC 200.
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.

TOX 771 Cancer Biology 4.
Prerequisite: CBS 770.
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.

TOX 795 Special Topics in Toxicology 1-3.

TOX 801 Toxicology Seminar 1.
Prerequisite: Graduate standing.

TOX 820 Special Problems In Toxicology 1-3.
Prerequisite: Graduate standing.
Topics include responsibility in science, environmental fate of chemicals, developmental toxicology, lab rotations, Journal Club, and wildlife toxicology.

TOX 860 Free Radicals in Toxicology 1.
Prerequisite: BCH 451 and TOX 710.
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.

TOX 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

TOX 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

**TT - Textile Technology Courses**

**TT 105 Introduction to Textile Technology 3.**
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.

**TT 221 Yarn Production and Properties I 2.**
Prerequisite: TT 105 or MT 105; Corequisite: MA 131 or MA 141.
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.

**TT 252 Formation and Structure of Textile Fabrics 4.**
Prerequisite: TT 221.

**TT 305 Introduction to Nonwoven Products and Processes 3.**
Prerequisite: TMS 211 and (MA 131 or MA 141) and (PY 211 or PY 205); Corequisite: (ST 311 or BUS 350 or ST 361 or ST 370).
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/process interaction. Plant visits whenever possible.

**TT 321 Yarn Production and Properties II 3.**
Prerequisite: TT 221.
Fiber and machine interactions in blending, carding, drawing and spinning. Drafting theories and the influence of fiber and machine variables on irregularity. The role of twist on yarn structure, properties and productivity. Developments and limitations in processing technology.

**TT 327 Yarn Production and Properties 4.**
Prerequisite: TMS 211 and (MA 231 or MA 241); Co-requisite: PY 212.
The processing of natural and man-made, 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.

**TT 331 Performance Evaluation of Textile Materials 4.**
Prerequisite: (ST 311 or BUS 350 or ST 361 or ST 370) and TMS 211 and TT 221 and (PY 211 or PY 205) and (MA 231 or MA 241); Corequisite: TT 252 or (TT 341 and TT 351).
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.
TT 341 Knitted Fabric Technology 3.
Prerequisite: TT 221.

TT 351 Woven Products and Processes 3.
Prerequisite: TT 221 and (PY 212 or PY 208).
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 automobiles, agriculture, construction, etc. and stimulate understanding of their structure, performance requirements, and relevant manufacturing principles including braiding.

TT 371 Woven Textile Design 3.
Prerequisite: TT 252.
Design and production of woven fabrics. Exploration of various basic structures, color and textural effects. Development of design abilities through hand-production methods, including an introduction to Computer-integrated Design systems and an awareness of industrial processes.

TT 372 Knitted Textile Design 3.
Prerequisite: TT 252.

TT 380 Management and Control of Textile and Apparel Systems 3.
Prerequisite: FTM 217; Corequisite: TT 221.
Management approaches, practices and basic economic considerations in the development, production and distribution of industrial and consumer textile and apparel products.

TT 401 Textile Technology Senior Design I 4.
Prerequisite: TT 331, Senior standing.
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.

TT 402 Textile Technology Senior Design II 4.
Prerequisite: TT 401.
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.

TT 405 Advanced Nonwovens Processing 3.
Prerequisite: MA 241, PY 208, TT 305.
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.

TT 406 Bonding Fundamentals in Nonwovens 3.
Prerequisite: TT 405, MAE 308, MAE 310.
Fundamentals of fluid mechanics and heat transfer mechanisms during the bonding of nonwovens. In-depth description of hydroentangling, thermal bonding and needle punching techniques. Modeling methods and laboratory work are assigned.

Prerequisite: ST 361 or ST 370; Corequisite: TT 405.

TT 408 Nonwoven Product Development 3.
Prerequisite: TT 407.

TT 425 Textured Yarn Production and Properties 3.
Prerequisite: TT 331.

TT 431 Quality Management and Control In Textile Manufacturing 3.
Prerequisite: TT 331.
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.

TT 451 Advanced Woven Fabric Design 3.
Prerequisite: (TT 252 or TT 351) and Senior Standing.
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.

TT 470 Jacquard Woven Fabric Design 3.
Prerequisite: TT 252, TT 371.
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.

TT 480 Operations Management Decisions for Textiles 3.
Prerequisite: FTM 380, ACC 210, ST 361, (MA 131 and 132 or MA 141).
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.
TT 481 Design and Technology of Technical Textiles 3.
Prerequisite: TT 305, TT 341 and TT 351.
Performance requirements of various technical textiles. Underlying principles of design, application, manufacture, and evaluation of fibrous structures intended to meet specific end-use requirement.

TT 485 Textile Computer Integrated Enterprise 3.
Prerequisite: TT/FTM 380.
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.

TT 486 Supply Chain Management in the Textile Industry 3.
Prerequisite: TT/FTM 380.
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.

TT 499 Textile Senior Project 4.
Prerequisite: Senior standing.
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 be presented formally at the end of the semester. Course should be taken in the last semester of the Senior year. It cannot be substituted by other project courses.

TT 500 Understanding the Textile Complex 3.
Prerequisite: Graduate standing.
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.

TT 503 Materials, Polymers, and Fibers used in Nonwovens 3.
Prerequisite: MA 141, PY 205, PCC 203.
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.

TT 504 Introduction to Nonwovens Processes and Products 3.
Prerequisite: MA 141; PY 205, Corequisite: TT503.
Fiber web/nonwoven fabrics produced directly from fibers or their precursors. Physical and chemical nature of local bonding and fiber entanglement. Viable process for producing these fabrics. Economic justification for process and production. Product/process interaction. Plant visits whenever possible.

TT 505 Advanced Nonwovens Processing 3.
Prerequisite: TT/NW503, TT/NW504.
An in-depth understanding of the mechanisms and processes used in the production of nonwoven materials. Design and operation of these mechanisms and processes. Process flow, optimization of process parameters, influence of process parameters on product properties.

TT 506 Bonding Principles in Nonwovens 3.
Prerequisite: MAE 308, MAE 310, TT/NW505.
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.

TT 507 Nonwoven Characterization Methods 3.
Prerequisite: ST 361, Corequisite: TT/NW 505.

TT 508 Nonwoven Product Development 3.
Prerequisite: TTNW505, TT/NW507.

TT 520 Yarn Processing Dynamics 3.
Prerequisite: Graduate standing or PBS status.
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.

TT 521 Filament Yarn Production Processing and Properties 3.
Prerequisite: Graduate standing or PBS status.
Structure, properties and processes for manufacturing and treating continuous filament yarns. Response of fibers to elevated temperatures, twist, false twist and various bulking processes. Yarn structures 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.

TT 530 Textile Quality and Process Control 3.
Prerequisite: TT 420, Corequisite: ST 511 or ST 515.
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.

TT 532 Evaluation of Biotextiles 3.
Prerequisite: ZO 160, TC 203, TMS 211, CH 220.
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 an animal trials so as to meet regulatory requirements.

TT 533 Lean Six Sigma Quality 3.
Prerequisite: ST 361 and ST 371, or equivalent.
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.
TT 535 Research Methods and Management 3.
Prerequisite: ST 361, Graduate standing.
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.

TT 549 Warp Knit Engineering and Structural Design 3.
Prerequisite: TT 443

TT 550 Production Mechanics and Properties of Woven Fabrics 3.
Prerequisite: Graduate standing or PBS status.
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 undergraduerte textiles majors.

TT 551 Advance Woven Fabric Design & Structures 3.
Prerequisite: Graduate standing.
Theory and practice of structural design and technology requirements for highly specialized woven fabrics. Emphasis upon resultant physical behavior of different fabrics and their components. Credit not allowed for TT 451 and TT 551.

TT 553 Formation and Structure of Woven and Knitted Fabrics 3.
The interrelation between the mechanics of production and mechanical properties of woven and knitted fabrics; unit operations required to prepare yarns 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).

TT 570 Textile Digital Design and Technology 3.
Prerequisite: Graduate standing.
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: TT 570.
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.

TT 581 Technical Textiles 3.
Prerequisite: TT 520 or TT 521, and TT 550.
Performance requirements of various technical textiles. Underlying principles of design and manufacturing of fibrous structures to meet specific needs in mechanical and other behaviors.

TT 591 Special Studies in Textile Technology 1-4.
Prerequisite: Graduate standing or PBS status.
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.

TT 601 Seminar 1.
Discussion of scientific articles of interest to the textile industry; review and discussion of student papers and research problems.

TT 630 Independent Study in Textile Technology 3.
Prerequisite: Graduate standing or PBS status.
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).

TT 665 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

TT 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

TT 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis Research.

TT 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.
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.

TT 896 Summer Dissert Res 1.
TTM - Textile Technology Management Courses

TTM 501 Textile Enterprise Integration 3.
Prerequisite: Graduate standing, Background in textile manufacturing.
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.

TTM 510 Apparel Technology Management 3.
Prerequisite: Graduate standing or PBS status.
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 manufacturing capacities and elasticities.

TTM 515 Apparel Production 3.
Concepts and practices for the production of apparel items, beginning with development of basic fit blocks and extending through the reation of stylized garments using pattern engineering techniques, supported by computerized pattern development.

Exploration of industry design software for apparel and other sewn products. U4ia visual design software, 3D to 2D pattern generation software, Gerber Accumat 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.

TTM 530 Textile Quality and Process Control 3.
Prerequisite: TT 420, Corequisite: ST 511 or ST 515.
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.

TTM 533 Lean Six Sigma Quality 3.
Prerequisite: ST 361 and ST 371, or equivalent.
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.

TTM 535 Research Methods and Management 3.
Prerequisite: ST 361, Graduate standing.
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.

TTM 561 Strategic Technology Management in the Textile Complex 3.
Prerequisite: Graduate standing or PBS status.
Management approaches and strategies for forecasting, planning, creating, and implementing technology changes in textile industry complex undergoing rapid market place and global competitive changes.

TTM 573 Management of Textile Product Development 3.
Prerequisite: Graduate standing.
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.

TTM 581 Global Textile and Apparel Business Dynamics 3.
Prerequisite: Graduate standing or PBS status.
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.

TTM 582 Global Textile Brand Management and Marketing 3.
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.

TTM 583 Strategic Planning for Textile Firms 3.
Prerequisite: Graduate standing.
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.

TTM 585 Market Research In Textiles 3.
Prerequisite: TAM (EC) 482.
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.

TTM 588 Global Perspectives in Textiles Supply Chain Management 3.
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 perspectives. Students may not take this course more than once for the same global perspective.

Prerequisite: Graduate standing or PBS status.
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.

TTM 601 Seminar 1.
Discussion of scientific articles of interest to the textile industry; review and discussion of student papers and research problems.
TTM 630 Independent Study in Textile Technology Management 3.
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.

Prerequisite: Graduate standing or PBS status.
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 administrator within the first week of
the semester. Either a paper or a presentation of a body of work will be
the outcome of this effort.

TTM 693 Master’s Supervised Research 1-9.
Prerequisite: Master’s student.
Instruction in research and research under the mentorship of a member
of the Graduate Faculty.

TTM 695 Master’s Thesis Research 1-9.
Prerequisite: Master’s student.
Thesis research.

TTM 696 Summer Thesis Research 1.
Prerequisite: Master’s student.
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.

TTM 761 Supply Chain Management and Information Technology 3.
R: Graduate Students Only.
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.

TTM 791 Advanced Special Studies in Textile Technology
Management 1-4.
Prerequisite: Doctoral Student.
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.

TTM 801 Seminar 1.

TTM 830 Independent Study 3.

TTM 876 Special Project TTM 1-3.

TTM 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

TTM 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For students who are preparing for and taking written and/or oral
preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member
of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

TTM 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.

USC - University Studies Course Courses

USC 100 Transition into a Diverse Community 1.
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.

USC 101 Introduction to University Education I 1.
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;
available university resources; overview of university majors and minors
as well as policies and procedures. FYC students only. Student cannot
get credit for both USC 101 and 103.

USC 102 Introduction to University Education II 1.
Prerequisite: USC 101.
Continuation of USC 101; Emphasis on making a decision with respect to
an undergraduate major. Credit may not be earned for both USC 102 and
104. FYC Students Only; Credit cannot be received for both USC 102
and 104.

USC 103 Introduction to University Education for Varsity Student
Athletes I 1.
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.
USC 104 Introduction to University Education for Varsity Student-Athletes II 1.
Prerequisite: USC 103.
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 would relate to the day-to-day responsibilities and challenges that student-athletes face, as well as a review of NCAA and NCSU continuing eligibility.

USC 105 University Orientation I 1.
USC 105 serves as an orientation to academic requirements of the various colleges and departments as N.C. State. A review of study skills, time management, advising procedures, decision making and career exploration through inside and outside of class activities is designed to assist students in developing knowledge of major requirements and requisite comprehensions and skills needed to succeed in college. Course is restricted to 31TP students.

USC 106 University Orientation II 1.
Prerequisite: USC 105.
USC 106 continues to serve as an orientation to academic requirements of the various colleges and departments at the university. A review of study skills, time management, decision making and career exploration through in and outside of class activities is designed to assist students in making well informed choices about majors. Students will also be required to focus on career interviews as well as the development of university academic networks. Course is restricted to second semester 31TP students.

USC 110 Freshman Advancement Seminar 1.
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.

USC 120 SERV- Seminar Education for Military Veterans/Service Members 1.
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).

USC 202 Career Exploration and Development 2.
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.

USC 210 Introduction to College Tutoring 1.
Prerequisite: Cumulative GPA greater than or equal to 3.25. Course is restricted to 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.

USC 220 Leadership and the Resident Mentor 3.
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.

USC 223 Orientation Leader Development 2.
For new student orientation 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 orientation leaders. Class discussion, small groups activities, simulations, and journal writing employed. Individual projects and out-of-class team building experiences are required, including Saturday activities. Departmental Approval Required.

USC 225 Leadership Development for University Ambassadors 2.
Prerequisite: University Ambassadors Only. 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.

USC 240 Leadership and Coalition Building in Diverse Communities 3.
Prerequisite: Class Level = Sophomore, Junior, or Senior. 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.

USC 293 Independent Study 1-3.
A course in which students participate in individualized, independent, directed, or guided studies under the supervision of the instructor of the field or discipline. Topic, mode of study, evaluation criteria, and credit hours to be determined in consultation with the supervising faculty and documented. Course may be taken a maximum of 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.
USC 298 Special Topics in University Studies 1-3.
Special Topics in University Studies at the Undergraduate level for offering of courses on an experimental basis.

USC 301 Transfer Student Success 1.
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 received credit for both USC 301 and ALS 303 or T 101.

USC 401 Transitions for the College Graduate 3.
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 activities, 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.

USD - U.S. Diversity Courses

USD 295 U.S. Diversity Special Topics 1-3.
Special topics course offering for the general education U.S. Diversity category.

USP - University Scholars Program Courses

USP 110 Humanities and Social Sciences Scholars Forum 0.
Prerequisite: Enrollment limited to participants in the University Scholars Program.
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.

USP 111 Humanities and Social Sciences Scholars Forum 0.
Prerequisite: Enrollment limited to participants in the University Scholars Program.
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.

USP 201 Great Decisions 1.
Prerequisite: 3 semesters of USP 110/111; R: RS/CS students.
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 three semesters of the Scholars Forum (USP 110/111). Must have GPA of at least 3.25.

USP 204 Readings Inspired By the Scholars Forum 1.
Prerequisite: 3 semesters of USP 110/111; R: RS/CS students.
Seminar course for upper class University Scholars who have completed three semesters of the Scholars Forum, with readings drawn from upcoming Scholars Forum themes.

VMA - Veterinary Medicine-Anatomy Phys Sci Radiology Courses

VMB - Veterinary Science - VMB Courses

VMB 911 Veterinary Anatomy I 5.
P: Admission to professional veterinary program.
Gross anatomy of the dog and cat. Neuroanatomy of the dog and cat. Dissection of embalmed (dog/cat) cadavers, study of projections, slides, models, and imaging modalities.

VMB 912 Introduction to Clinical Problem Solving in Veterinary Practice 2.
Requisite: Currently enrolled DVM student.
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.

VMB 913 Veterinary Physiology I 4.
P: Admission to professional veterinary program.
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, endocrine, and reproductive systems.

VMB 914 Histology and Cytology 2.
P: Admission to professional veterinary program.
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.

VMB 921 Comparative and Developmental Anatomy 4.
P: Admission to professional veterinary program.
Gross anatomy of domestic ungulates (horse, ox, sheep, goat, pig). Involves dissection of embalmed specimens and study of projections, models, radiographs, and live-animal palpation.

VMB 923 Veterinary Physiology II 4.
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 gastrointestinal, endocrine, and nervous systems.

VMB 930 Anesthesiology 2.
Anesthetic principles, agents, and techniques of mammalian, avian, and rodent species.

VMB 932 Veterinary Medical Decision Making 1.
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.
VMB 933 Introductory Pharmacology 3.
The action of drugs in animals including basic principles of drug disposition and pharmacokinetics are described and discussed. Modification of physiological processes by drugs influencing coordination by the nervous, endocrine, and circulatory systems are described.

VMB 936 Introduction to Radiology 1.
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 are discussed and related to 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.

VMB 943 Pharmacology and Veterinary Therapeutics 3.
A course in clinical pharmacology with emphasis on the pharmacology of antimicrobial drugs, systematic pharmacology, pharmacology applied to special species, prescription writing, and benefit-risk assessment.

VMB 954 Veterinary Toxicology and Poisonous Plants 3.
Pharmacological 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.

VMB 960 Veterinary Radiology and Radiobiology 3.
Fundamentals of radiographic diagnosis and radiation safety.

VMB 962 Clinician Scientist Research Experience 1-10.
Prerequisite: All freshman-junior DVM courses allowing the student to enroll in senior DVM courses.
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.

VMB 965 Veterinary Nutritional Health 2.
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.

VMB 975 Radiology 2.

VMB 976 Radiology Rotation 2.
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.
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.

VMB 978 Clinical Behavior & Nutrition 2.
Prerequisite: VMC 927 or equivalent, DVM Curriculum Student Status.
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.

VMB 991 SP Top in MBS 1-2.
One week special topic course in the Department of Molecular Biomedical Sciences.

VMB 992 SP Top in MBS 2.
Two week special topic course in the Department of Molecular Biomedical Sciences.

VMC - Veterinary Medicine-Companion Animal Sp Species Courses

VMC 910 Careers in Veterinary Medicine 1.
Specialists and invited speakers from multiple areas of veterinary medicine will present information about career opportunities.

VMC 911 Advanced Topics in Equine Medicine and Surgery 1.
Prerequisite: VMB 921.
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.

VMC 914 Group Communication in Veterinary Medicine 1.
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.
VMC 915 Ethic Jurispru 2.
VMC 917 Pre Hlth & Mgmt I 1.

VMC 920 Subtropical Zoology and Medicine in Bermuda 1.
Requisite: Currently enrolled DVM student.
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.

VMC 921 Special Topics in Zoological Medicine 1-3.
Prerequisite: 1st, 2nd, or 3rd year DVM student.
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.

VMC 922 Veterinary Acupuncture in China 2.
Prerequisite: VMB 911 and VMB 921; Corequisite: Current enrollment in the DVM program.
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.

VMC 923 Research in Zoological Health 1-4.
Restriction: DVM student status. By Instructor Permission only.
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 focus thesis option.

VMC 927 Introduction to Companion Animal Behavior 2.
Doctor of Veterinary Medicine Majors Only.
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.

VMC 928 Chelonian Medicine and Surgery 1.
The NCSU-CVM Turtle Rescue Team treats sick and injured wild turtles belonging to nine different species. First, second, and third year veterinary students 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 weekly rounds and make an oral presentation.

VMC 930 Rehabilitation and Mobility Clinical Rotation 2.
Requisite: Currently enrolled DVM student.
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.

VMC 931 Introduction to Physical Examination Skills- Laboratory Animal and Zoological Species 1.
Introduction to the biology, husbandry, physical examination, laboratory sample collection, and medication administration skills in laboratory animals and zoological species. Students must be enrolled in the Doctor of Veterinary Medicine program. Enrollment in year 2 of the Doctor of Veterinary Medicine Program.

VMC 932 Principles of Surgery 3.
Prerequisite: 2nd year DVM student.
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.

VMC 933 Theriogenology 3.
Prerequisite: Successful completion of the second year of the DVM program.
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.

VMC 934 Introduction to Physical Examination Skills- Small Animal 1.
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.

VMC 935 General Limited Small Animal Practice 2.
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.

VMC 937 Introduction to Physical Examination Skills- Laboratory Animal and Zoological Species 1.
Introduction to the biology, husbandry, physical examination, laboratory sample collection, and medication administration skills in laboratory animals and zoological species. Students must be enrolled in the Doctor of Veterinary Medicine program. Enrollment in year 2 of the Doctor of Veterinary Medicine Program.

VMC 938 Principles of Surgery 3.
Prerequisite: 2nd year DVM student.
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.

VMC 939 Theriogenology 3.
Prerequisite: Successful completion of the second year of the DVM program.
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.

VMC 940 Clinical Theriogenology 2.
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.
VMC 941 Special Topics in Theriogenology 2.
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.

VMC 948 Clinical Rotation in Veterinary Radiation Oncology 2.
Prerequisite: VMB 960.
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.

VMC 949 Equine Primary Care 4.
Prerequisite: 4th year DVM student.
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.

VMC 950 Sea Turtle Medicine and Rehabilitation 2.
Prerequisite: 4th year DVM student.
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: Successful completion of the 2nd year of the professional curriculum.
Overview of medical and surgical management of selective metabolic, neoplastic, nutritional, immune-mediated, developmental and degenerative diseases of companion animals.

Medical conditions in large domesticated animals are presented in this course. Discussions involve the agents causing diseases and the therapeutic methods used to correct. 4 semester hours.

VMC 953 Lab Anim Medicine 3.
The biology, use, and diseases of laboratory animal species are presented. Emphasis is on signs, epizootiology, pathogenesis, treatment, and disease control programs for the more significant diseases of these animals. Clinically important conditions of wildlife, zoo species caged birds, and aquarium fishes are presented. 3 semester hours.

Prerequisite: Senior DVM student.
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.

VMC 955 Extramural Experiences in Lab An Med 2.
Corequisite: Current enrollment in DVM program.
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 focus area requirements or recommendations.

VMC 957 Intro Clinic Pract 1.
The problem-oriented approach to diagnosis is introduced through exposure to clinical case studies, supervised visits with local veterinary practitioner, and participation in the medicine and surgery services in The Veterinary Teaching Hospital. Familiarity is gained with admission procedures, medical records, patient management, and clinical rounds. 1 semester hour.

VMC 958 Advanced Prosimian Medicine 2.
Prerequisite: VMC 991, restricted to 4th year DVM students.
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.

VMC 959 Advanced Primate Medicine 2.
Prerequisite: VMC 991 Primate Medicine.
This course is designed to provide senior veterinary students with clinical experience in nonhuman primate medicine. Students will gain practical experience in the diagnosis, treatment, and prevention of disease in captive research primates maintained in research facilities. Students participate in formal rounds, autodidactic exercises, and case management at Primate Center at Wake Forest University. Limited to 4th year DVM curriculum students.

VMC 960 Small Animal Emergency Service 2.
Prerequisite: fourth year clinical student, DVM student.
Assessment, triage, and management of canine and feline patients admitted to the small animal emergency service after 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. 4 semester hours.
Requisite: Currently enrolled DVM student.
Examines the social, legal and ethical issues behind the science of veterinary medicine and allows for critical evaluation and discussion of a variety of controversial issues challenging current belief systems. Provides the basic leadership and operational training necessary to become a Credentialed responder for the State of North Carolina. Limited to DVM students or by permission of instructor.

VMC 963 Extramural Experience in Zoo Medicine 2.
Requisite: Currently enrolled DVM student.
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, as well as 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.

VMC 964 Zoological Husbandry and Nutrition 2.
Requisite: Successful completion of 3 Zoological Medicine Selectives or course coordinator permission.
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.

VMC 965 Advanced Principles of Surgery 1.
Requisite: DVM student, Completion of fall semester, VM3 students.
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.

VMC 966 Equine Emergency and Critical Care 2.
Requisite: 4th year DVM student, Third year veterinary curriculum.
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.

VMC 967 Clinical Veterinary Dentistry 2.
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.).

VMC 968 Equine Orthopedic Surgery and Lameness 2.
Requisite: DVM student, Completion of 3rd year veterinary curriculum.
Application of problem solving skills and the art, science, and practice of equine orthopedic surgery and lameness in the veterinary teaching hospital setting.

VMC 969 Equine Podiatry 2.
Requisite: 4th yr. standing in the veterinary curriculum at the CVM, Successful completion of 3rd yr. of Veterinary Curriculum.
Two-week clinical block in equine podiatry clinic Tuesday, Wednesday, and Thursday, with guided independent clinically applied study Monday and Friday.

VMC 970 Companion Animal and Special Species 2.
Requisite: Fourth year student in the professional curriculum at The College of Veterinary Medicine.
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.

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.

VMC 972 Clinical Small Animal Veterinary Cardiology 2.
Requisite: 4th yr. standing in the veterinary curriculum at the CVM, Successful completion of 3rd yr. of Veterinary Curriculum.
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 rounds.

VMC 973 Small Animal Surgery 2.
Requisite: Completion of third year veterinary curriculum.
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.

VMC 975 Equine General Surgery 2.
Requisite: DVM student, Completion of 3rd year veterinary curriculum.
Application of problem solving skills and the art, science, and practice of equine general surgery in the veterinary teaching hospital setting.

VMC 976 Veterinary Critical Care 2.
Requisite: 4th year DVM student.
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.
VMC 977 Equine Preventative Health Care 2.
Prerequisite: Completion of 3rd year in veterinary curriculum.
Perform routine preventative health care procedures for the horse in a field setting.

VMC 978 Equine Lameness 2.
Prerequisite: DVM student, Completion of the third year of the veterinary curriculum.
Development and use of problem solving skills and techniques for diagnosis, treatment, and management of lameness in horses.

VMC 979 Equine Medicine 2.
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.

VMC 980 Vet Clini Oncology 2.
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.

VMC 981 Lab Animal Medicin 2.
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.

VMC 982 Ophthamology 2.
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. 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.

VMC 983 Dermatology 2.
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.

VMC 984 Intro Clin Neuro 2.
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.

VMC 985 Avian and Reptile Medicine 2.
Prerequisite: 4th year standing in the veterinary curriculum at the CVM, VMC 953, VMF 964.
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.

VMC 986 Adv Com An Int Med 2.
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 emergency/intensive care unit duty.

VMC 987 Aquatic Medicine 2.
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.

VMC 988 Exotic Animal Medicine 2.
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.
VMC 989 Zoological Medicine 4.
Prerequisite: VMC 964 or successful completion of 3 Zoological Medicine Focus Selectives; and Course Coordinator's Permission.
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.

VMC 990 Musculoskeletal Ultrasound in the Horse 2.
Prerequisite: VMC 975.
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.

VMC 991 SP Top in DOCS 1.
Corequisite: Current enrollment in DVM program.
One week special topic course in the Department of Clinical Sciences.

VMC 992 SP Top in DOCS 1-4.
Two week special topic course in the Department of Clinical Sciences.

VMC 993 Special Problems Equine Medicine and Surgery 2.
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.

VMC 994 Small Animal 4th Year Extramural Studies 1-6.
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.

VMC 995 Clinical Conference 1.
Each senior student is required to do a 25 minute presentation during their senior year. The presentation may involve a case report, series of cases, or epidemiological study. Retrospective study of a disease or syndrome including data drawn from other institutions or published findings may be used as well as topics of general interest to veterinary medicine of an innovative nature.

VMC 996 Advanced Avian Clinical Medicine 2.
P: VMC 988.
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.

VMC 997 Raptor Medicine and Rehabilitation 2.
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.

VMC 998 Basic Wildlife Rehabilitation Medicine 2.
Prerequisite: VMC 964 or successful completion of 3 Zoological Medicine Focus Selectives, VMC 989, and Course Coordinator's Permission.
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.

VMC 999 Advanced Wildlife Rehabilitation Medicine 2.
Prerequisite: VMC 964 or VMC 989.
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.

VMF - Veterinary Medicine-Food Animal
Equine Medicine Courses

VMM - Veterinary Medicine-Microbio
Pathology Parasitol Courses

VMP - Veterinary Science - VMP Courses

VMP 162 Livestock and Poultry Disease Management 3.
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.

VMP 401 Poultry Diseases 4.
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.

VMP 420 Disease of Farm Animals 3.
Prerequisite: Junior standing.
Pathology of bacterial, viral, parasitic, nutritional, thermal and mechanical disease processes for farm animals. This emphasis practices for prevention and control of each disease.
VMP 910 Infection and Immunity 1 3.
Prerequisite: Admission to the DVM Curriculum.
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.

VMP 916 Health Maintenance and Animal Production I 1.
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.

VMP 920 Infection and Immunity 2 4.
Prerequisite: Admission to the DVM Curriculum.
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.

VMP 921 Problem Solving for Cases in Infectious Diseases and Immunity 1 2.
Prerequisite: Admission to the DVM Curriculum.
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.

VMP 922 Small Group Problem Solving in Veterinary Medicine 1.
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.

VMP 930 Infection and Immunity 3 3.
Prerequisite: Admission to the DVM Curriculum.
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.

VMP 931 Veterinary Pathology 1 4.
Introduction to the basic pathologic changes which occur in animal tissues. Developmental processes and resulting morphology observed at gross, cellular, and subcellular level emphasized.

VMP 934 Problem Solving for Cases in Infectious Diseases & Immunity 2 2.
Prerequisite: Admission to the DVM Curriculum.
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.

VMP 936 Health Maintenance and Animal Production II 1.
Prerequisite: VMP 916.
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.

VMP 941 Veterinary Pathology II 5.
Systemic Pathology - A study of specific responses of organ systems to pathogenic influences with emphasis on the effects of the pathogenic systems on the body as a whole.

VMP 942 Veterinary Clinical Pathology 3.
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.

VMP 945 Epidemiology & Public Health 3.
Prerequisite: VMP 912, DVM student.
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.

VMP 956 Health Maintenance and Animal Production III 1.
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.

VMP 962 Ruminant Medicine & Surgery 3.
This course is a study of the clinical disorders of the integumentary, respiratory, digestive, urogenital, and musculoskeletal (including lameness) systems in food animals and horses that are corrected by surgical interventions. The laboratory sessions include the practical application of anesthesia in large animals and the performance of surgical procedures to correct common surgical lesions in large animals.

VMP 964 Swine and Poultry Medicine 3.
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.
VMP 970 Ruminant Health Management I 2.
Prerequisite: VMP 956 or VMP 974 or consent of the instructor.
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: Prior undergraduate coursework, summer work experiences, and/or consistent enrollment and good performance in food animal selectsives.
This course 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.

VMP 972 Ruminant Health Management II 2.
Prerequisite: VMP 970.
Senior veterinary students will experience advanced training in ruminant clinical medicine.

VMP 973 Special Topics in Epidemiology 2.
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. No one textbook is required for this course.

VMP 974 Food Supply Veterinary Medicine 2.
Prerequisite: Completion of first 3 years of veterinary curriculum; consent of instructor for any enrollment >8.
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.

VMP 975 Advanced Topics in Veterinary Anatomic Pathology 1-6.
Prerequisite: VMP 977.
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.

VMP 976 Food Animal Pharmacology 2.
Prerequisite: VMB 943; VMP 962; VMP 964.
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.

VMP 977 Clinical Laboratory and Necropsy 2.
VMP 978 Clinical Pathology/IMM 2.
VMP 979 Epidemiology 2.
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.

VMP 980 Theriogenology I 2.
Prerequisite: Enrolled in fourth year clinical rotations.
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 VMP 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.

VMP 981 Special Topics in Theriogenology 2.
The primary objective of this course is to provide additional information and training to veterinary students that had taken the VMP 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
Poultry Health Management I is a clinical rotation elective for 4th 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.

VMP 983 Poultry Health Management II
Poultry Health Management II is a clinical rotation elective for 4th 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 on the web site listed above.

VMP 984 Swine Health Management I
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.

VMP 985 Swine Medicine & Production I
This course will provide senior veterinary students with the opportunity to utilize the techniques and expertise gained in VMP 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.

VMP 986 One Health: From Philosophy to Practice
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.

VMP 987 Ruminant Topics
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 3rd and 4th year veterinary students only upon consent of faculty. VMF 970 may be a required prerequisite.
VPH - Veterinary Public Health Courses

VPH 554 Trade and Agricultural Health 2.
Prerequisite: Graduate standing, Upper Class Undergraduate standing.
This course is designed for agriculture and food safety specialists, veterinarians, and epidemiologists interested in learning about international trade and agricultural health. WTO/SPS affect all aspects of agricultural health including production, food security, public health, tourism and the environment. This introductory course will review SPS articles, GATT provisions, the associations between WTO and public health, the work of the OIE, CAC, and IPPC; the impact of TRIPS and anti-dumping measures.

VPH 555 Public Health, Sustainable Development and Gender in Global Context 3.
Prerequisite: Undergraduate biological sciences courses such as biology, zoology, neurobiology, or genetics.
This course will examine the complex intersections of human health, public policy, agriculture in developing world, and gender issues, drawing on theory and research from international and interdisciplinary perspectives.

Prerequisite: A prior degree in veterinary medicine or public health.
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.

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.

VPH 675 Supervised Public Health Research 1-7.
Supervised research focused on Public Health. Permission by course instructor required for enrollment.

VPH 693 Supervised Public Health Research 1-5.
Prerequisite: VPH 580, ST 511 or equivalent.
Supervised research focused on Public Health.

VPH 713 Zoonoses and Public Health 3.
Prerequisite: VPH 580 or equivalent, ST 511 or equivalent.
Enrollment to graduate veterinarians, MVPH, MPH, or other graduate students. Veterinary students will be considered for enrollment after consultation with the course coordinator.

VPH 720 Epidemiology of Wildlife Diseases 3.
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.

VPH 760 Molecular Technologies for Epidemiologic Investigation 3.
Prerequisite: An introductory epidemiology class or consent of instructor.
The course is designed to help students refine their ability to select and interpret molecular diagnostic technologies for epidemiologic disease surveillance and investigation.

VPUS - Visual and Performing Arts and U.S. Div Courses

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.

WGS - Women's and Gender Studies Courses

WGS 200 Introduction to Women's and Gender Studies 3.
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.

WGS 204 Sociology of Family 3.
Contemporary American family structures and processes and their development. Focus on socialization, mate selection, marital adjustment and dissolution. Includes core sociological concepts, methods, theories.

WGS 210 Women and Gender in Science and Technology 3.
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.

WGS 220 Men and Masculinity 3.
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.

WGS 224 Contemporary Issues in Ecofeminism 3.
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 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 or online discussion groups, self-reflective writing, and comparative analyses.

WGS 293 Special Topics in WGS 3.
Examination of varying topics on women and/or gender from an interdisciplinary perspective at an introductory level.
WGS 300 Introduction to Feminist Theories 3.
Prerequisite: WGS 200.
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.

WGS 304 Women and Men in Society 3.
Prerequisite: 3 cr. in SOC, 200 level

WGS 305 Women and Literature 3.
Prerequisite: Sophomore standing.
Nineteenth- and twentieth-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.

WGS 306 Gender and Politics in the United States 3.
Prerequisite: PS 201.
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.

WGS 310 Women's and Gender Studies Internship 3.
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.

WGS 327 Language and Gender 3.
Prerequisite: ENG 101.
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).

WGS 330 Women and Health 3.
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.

WGS 360 Women In Music 3.
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.

WGS 362 Communication and Gender 3.
Prerequisite: Junior standing, COM 112.
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.

WGS 370 Advanced Studies of Gender in Science 3.
Prerequisites: WGS 200 or (WGS 210 or STS 210).
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.

WGS 393 Special Topics in Women's and Gender Studies 3.
Special topics in Women's and Gender Studies at the 300 level for offering courses on an experimental basis.

WGS 406 Psychology of Gender 3.
Prerequisite: PSY 200, 201 or HSS 200.
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 cannot be given for both PSY 406 and PSY 506.

WGS 407 Sociology of Sexualities 3.
Prerequisite: 3 hours SOC 200 level, 300 level, or equivalent research methods course.

WGS 410 Studies in Gender and Genre 3.
Prerequisite: Sophomore standing.
This course examines the ways in which writers have revised the literary genres to include gendered experience. It will focus on a different generic area, such as poetry, fiction, drama or autobiography, depending on its instructor.

WGS 418 Gender Law and Policies 3.
Prerequisite: 3 hours of Political Science.
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.

WGS 444 Cross-Cultural Perspectives on Women 3.
Prerequisite: ANT 252 and one of the following: ANT 310, 325, 330 or 346.
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.
WGS 447 History of American Women to 1900 3.
The historical experience of women in America from the colonial period to 1890. Women's work, education, legal and political status, religious experience, 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) 447 and HI (WGS) 547.

WGS 448 American Women in the Twentieth Century 3.
**Prerequisite:** 3 hrs. of History.
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.

WGS 472 Women and Religion 3.
**Prerequisite:** one course in religious studies or women's and gender studies.
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.

WGS 473 Religion, Gender, and Reproductive Technologies 3.
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.

WGS 492 Theoretical Issues in Women's and Gender Studies 3.
**Prerequisite:** WGS 200.
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.

WGS 493 Special Topics in Women's and Gender Studies 3.
Examination of varying topics on women and/or gender from a multidisciplinary perspective.

WGS 506 Psychology of Gender 3.
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. Credit for both PSY 406 and PSY 506 is not allowed.

WGS 540 Gender Issues in Counseling 3.
**Prerequisite:** Graduate standing or 6 hrs. of ED or PSY.
Exploration of gender as primary identity and social construct. Emphasis on gender dynamics in counseling, client empowerment and preventive approaches.

WGS 547 History Of American Women To 1900 3.
Historical experience of women in America from colonial period to 1890. Women's work, education, legal and political status, religious experience and sex roles: age, class, race, sexual preference and region as significant variables in women's experience. Credit for both HI (WGS) 447 and HI (WGS) 547 is not allowed.

WGS 548 American Women In the Twentieth Century 3.
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 for both HI (WGS) 448 and HI (WGS) 548 is not allowed.

WGS 573 Religion, Gender, and Reproductive Technologies 3.
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.

WGS 593 Special Topics 3.
Examination of a core topic on women and/or gender from an interdisciplinary perspective at the graduate level.

WGS 633 Independent Study 1-6.

WGS 704 Feminist Thought in the Social Sciences 3.
**Prerequisite:** SOC 701 and SOC 702.
This course is designed to provide an overview of feminist thought in the social sciences. We evaluate theoretical writings on social structure, social processes, the development of consciousness about gender inequality. We include both discussion of and distortions within mainstream theory and the recent development of alternative theory using the standpoint of women as a point of departure. We begin with general theoretical issues and move quickly to the complexity of matrices of domination within U.S. and global contexts.

WGS 737 Sociology Of Gender 3.
**Prerequisite:** SOC 736 OR 731, Graduate standing.
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 relationships.

WGS 739 Social Psychology Of Inequality 3.
**Prerequisite:** SOC 746 or 508.
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.
WPS - Wood and Paper Science Courses

WPS 201 Sustainable Materials for Green Housing 2.
Prerequisite: Sophomore standing.
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 Life Cycle 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.

WPS 491 Special Topics in Wood and Paper Science 1-4.
Independent study of management or technology problems selected with faculty approval or the offering of experimental courses.

WRT - Professional Writing Courses

WRT 111 Expository Writing 3.
Prerequisite: Sophomore standing.
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.

WRT 114 Professional Writing, Research and Reporting 3.
Prerequisite: WRT 111.
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.

ZO - Zoology Courses

ZO 492 External Learning Experience 1-6.
Prerequisite: Sophomore standing.
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 and the departmental teaching coordinator prior to the experience.

ZO 493 Special Problems/Research Exploration 1-6.
Prerequisite: Sophomore standing.
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 prior to the experience.

ZO 495 Special Topics in Zoology 1-3.
Offered as needed for development of new courses in various areas of zoology.

ZO 503 General Physiology I 3.
Prerequisite: Senior standing or Graduate standing, the following courses are recommended: ZO 421, BCH 451, a yr. of physics. The discussion of general principles of homeostasis, emphasizing importance of integrative action. Following systems studied: muscular, cardiovascular and nervous systems.

ZO 504 General Physiology II 3.
Prerequisite: PHY (ZO) 503.
Discussion of general principles of homeostasis, emphasizing importance of integrative action. Following systems studied: alimentary, renal, respiratory and endocrine systems.

ZO 509 Biology of Aquatic Insects 3.
Prerequisite: ENT 425.
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.

ZO 512 Animal Symbiosis 3.
Prerequisite: 12 hrs. of biology and zoology.
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.

ZO 513 Comparative Physiology 3.
Prerequisite: ZO 421.
Comparative study of the organ systems of vertebrates and physiological processes involved in maintaining homeostatic state. Various compensatory mechanisms employed during environmental stress included.

ZO 518 Experience and the Brain 3.
Prerequisite: BIO 488 or ZO 588.
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.

ZO 522 Biological Clocks 3.
Prerequisite: Graduate standing.
The anatomy, physiology and development of biological clocks in a variety of organisms, including humans. Required readings in primary literature.

ZO 524 Comparative Endocrinology 3.
Prerequisite: BIO 421 or PO 405.
Basic concepts of endocrinology, including functions of major endocrine glands involved in processes of growth, metabolism and reproduction.

ZO 542 Herpetology 3.
Prerequisite: ZO 250 and ZO 421.
The biology of the amphibians and reptiles: systematics, life history, anatomy, behavior, physiology and ecology.

ZO 544 Mammalogy 4.
Prerequisite: BIO 250.

ZO 548 Principles of Biological Oceanography 3.
Prerequisite: BIO 181.
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.

ZO 549 Principles Of Wildlife Science 3.
Prerequisite: BIO 260 or BIO/PB 360.
The principles of wildlife management and their application studied in the laboratory and in the field.
ZO 582 Medical and Veterinary Entomology 3.
Prerequisite: ENT 425 and ZO 315.
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.

ZO 588 Neurobiology 3.
Prerequisite: BIO 250 or BIO 212 and Graduate standing.
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 function. Multiple levels of analysis, from molecular to behavioral, with an emphasis on the mammalian nervous system. Students may not receive credit for both BIO 488 and ZO 588.

ZO 592 Topical Problems 1-3.
Organized, formal lectures and discussion of a special topic.

ZO 601 Seminar 1.
The presentation and defense of original research and current literature.

ZO 602 Seminar In Biology Of Reproduction 2.
Prerequisite: ANS(PHY) 702.
Current topics in animal reproduction presented by reproductive physiologists from various Research Triangle institutions. Student presentations of research projects or library projects in area of animal reproduction.

ZO 624 Topical Problems 1-3.
Organized, formal lectures and discussion of a special topic.

ZO 631 Special Topics 1-6.
Prerequisite: Twelve hours ZO.
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.

ZO 685 Master's Supervised Teaching 1-3.
Prerequisite: Master's student.
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.

ZO 688 Non-Thesis Masters Continuous Registration - Half Time Registration 1.
Prerequisite: Master's student.
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.

ZO 689 Non-Thesis Master Continuous Registration - Full Time Registration 3.
Prerequisite: Master's student.
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.

ZO 690 Master's Examination 1-6.
Prerequisite: Master's student.
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.

ZO 693 Master's Supervised Research 1-9.
Prerequisite: Master's student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student.
Thesis research.

ZO 696 Summer Thesis Research 1.
Prerequisite: Master's student.
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.

ZO 699 Research In Zoology 1-9.
Prerequisite: Twelve semester credits in ZO.
Credits Arranged.

ZO 710 Sampling Animal Populations 3.
Prerequisite: ST 512.
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.

ZO 718 Community Ecology 3.
Prerequisite: BO 360 or ZO 260, BO(ZO) 760; BO(ZO) 365.
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.

ZO 750 Marine Benthic Ecology 3.
Marine benthic systems in deep sea and in shallow waters, focusing upon abiotic and biotic processes regulating density, diversity and taxonomic and functional composition. Discussions of benthic-pelagic coupling, predation, interspecific competition, biogeography, sampling problems, evolutionary trends, trophic structure and community organization.

ZO 756 Ecology Of Fishes 3.
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.

ZO 770 Advanced Topics In Ecology I 3.
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.

ZO 790 Special Topics 1-3.

ZO 791 Topics In Animal Behavior 3.
Prerequisite: Graduate standing.
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.

ZO 792 Topical Problems 1-3.
Organized, formal lectures and discussion of a special topic.

ZO 802 Seminar In Biology Of Reproduction 2.
Prerequisite: ANS(PHY) 702.
Current topics in animal reproduction presented by reproductive physiologists from various Research Triangle institutions. Student presentations of research projects or library projects in area of animal reproduction.
ZO 824 Topical Problems 1-3.
Organized, formal lectures and discussion of a special topic.

ZO 829 Special Topics 1-3.
Prerequisite: Twelve hours ZO.
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.

ZO 831 Special Topics 1-6.
Prerequisite: Twelve hours ZO.
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.

ZO 885 Doctoral Supervised Teaching 1-3.
Prerequisite: Doctoral student.
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.

ZO 890 Doctoral Preliminary Examination 1-9.
Prerequisite: Doctoral student.
For student who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student.
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student.
Dissertation research.

ZO 896 Summer Dissertation Research 1.
Prerequisite: Doctoral student.
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.
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.
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