

Animal Science (BS): Industry Concentration

To see more about what you will learn in this program, visit the Learning Outcomes website (<https://apps.oirp.ncsu.edu/pgas/>)!

The degree of Bachelor of Science in Animal Science may be obtained by selecting one of three concentrations offered by the Department of Animal Science in the College of Agriculture and Life Sciences: Veterinary Bioscience, Science, and Industry.

The Industry concentration is designed for students who are more interested in the business or production aspects of animal science. It offers flexibility in completing Animal Science courses with business, marketing, economics, and applied science coursework. 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.

Accelerated Graduate Opportunities

Advanced undergraduates have the opportunity to complete the **Accelerated Bachelor's/Master's degrees**, which allows students to earn both the BS and the Master's of Animal Science degrees within five years. See listing of graduate degrees offered in the Graduate School (<https://grad.ncsu.edu/>). The **Accelerated BS/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 BS in Animal Science degree by transferring back 12 credits after one year in vet school.

For more information about our program, visit our website (<https://cals.ncsu.edu/animal-science/students/undergraduate/#bachelor-of-science>).

Contact

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Plan Requirements

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. All activities with live animals are IACUC (Institutional Animal Care and Use Committee) approved. Many lectures also incorporate animals or animal specimens into the course.

Code	Title	Hours	Counts towards
Orientation			
ALS 103	Freshman Transitions and Diversity in Agriculture & Life Sciences	1	
or ALS 303	Transfer Transitions and Diversity in Agriculture & Life Sciences		
Communication			
Select one of the following:		3	
COM 110	Public Speaking		
COM 112	Interpersonal Communication		
COM 211	Argumentation and Advocacy		
Mathematical & Natural Sciences			
MA 107	Precalculus I ¹	3	
ST 311	Introduction to Statistics	3	
or ST 350	Economics and Business Statistics		
BIO 181	Introductory Biology: Ecology, Evolution, and Biodiversity	4	
BIO 183	Introductory Biology: Cellular and Molecular Biology	4	
CH 101	Chemistry - A Molecular Science ¹	3	
CH 102	General Chemistry Laboratory	1	
ANS 215	Agricultural Genetics	3	
or GN 311	Principles of Genetics		
Major Requirements			
ANS 150	Introduction to Animal Science ¹	3	
ANS 151	Introduction to Animal Science Lab	1	
ANS 205	Physiology of Domestic Animals	3	
ANS 206	Anatomy of Domestic Animals Lab	1	
ANS 220 & ANS 221	Reproductive Physiology and Reproductive Physiology Lab	4	

ANS 230 & ANS 231	Animal Nutrition and Animal Nutrition Lab	4
Select two of the following Animal Management courses:		6
ANS 400	Companion Animal Management	
ANS 402	Beef Cattle Management	
ANS 403	Swine Management	
ANS 404	Dairy Cattle Management	
ANS 408	Small Ruminant Management	
ANS 410	Equine Breeding Farm Management	
ANS 411	Management of Growing and Performance Horses	
Animal Science Discipline Elective (p. 3)		3
Animal Science Electives (p. 4)		5
Select one of the following Economics Courses:		3
ARE 201	Introduction to Agricultural & Resource Economics	
ARE 201A	Introduction to Agricultural & Resource Economics	
EC 201	Principles of Microeconomics	
EC 202	Principles of Macroeconomics	
EC 205	Fundamentals of Economics	
Industry Option Requirements		
Select one of the following:		3
MA 114	Introduction to Finite Mathematics with Applications	
MA 121	Elements of Calculus	
MA 131	Calculus for Life and Management Sciences A	
Select one of the following:		4

CH 221 & CH 222	Organic Chemistry I and Organic Chemistry I Lab	
CH 220 & CH 222	Introductory Organic Chemistry and Organic Chemistry I Lab	
PY 131	Conceptual Physics	4
or PY 211	College Physics I	
Select one of the following BUS Management or Marketing Elective Courses:		3
ARE 303	Farm Management	
ARE 304	Agribusiness Management	
ARE 311	Agricultural Markets	
ARE 312	Agribusiness Marketing	
Economics or BUS Electives (p. 6)		6
GEP Courses		
ENG 101	Academic Writing and Research ¹	4
GEP Humanities (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/) ³		6
GEP Social Sciences (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/)		3
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		2
GEP Interdisciplinary Perspectives (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/) ³		5
GEP US Diversity, Equity, and Inclusion (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-usdei/)		3
GEP Global Knowledge (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-global-knowledge/) (verify requirement)		

Foreign Language Proficiency (<http://catalog.ncsu.edu/undergraduate/gep-category-requirements/foreign-language-proficiency/>) (verify requirement)

CALS Group A, B, or C

CALS Group A, B, or C (p. 6)	11
Courses for the Minor in Agricultural Business Management fulfill this requirement.	

Free Electives

Free Electives (12 Hr S/U Lmt) ^{2,3}	8
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Total Hours	120
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- ¹ A grade of C- or higher is required.
- ² Students should consult their academic advisors to determine which courses fill this requirement.
- ³ Students are encouraged to take an Ethics course as part of their Humanities, Additional Breadth, Interdisciplinary Perspectives, or Free electives.

Animal Science Discipline Elective

Code	Title	Hours	Counts towards
ANS 415	Comparative Nutrition	3	
ANS 425	Feed Manufacturing Technology	3	
ANS 440	Animal Genetic Improvement	3	
ANS 452	Comparative Reproductive Physiology and Biotechnology	3	
ANS 453	Physiology and Genetics of Growth and Development	3	
ANS 454	Lactation, Milk and Nutrition	3	
ANS 515	Comparative Nutrition	3	
ANS 525	Feed Manufacturing Technology	3	
ANS 530		3	
ANS 531		1	
ANS 540	Animal Genetic Improvement	3	
ANS 550	Applied Ruminant Nutrition	3	
ANS 552	Comparative Reproductive Physiology and Biotechnology	3	

ANS 553	Physiology and Genetics of Growth and Development	3
ANS 554	Lactation, Milk and Nutrition	3
ANS 561	Equine Nutrition	3
ANS 571	Regulation of Metabolism	3
ANS 575		3
ANS 590	Topical Problems in Animal Science	1-3
BCH 571	Regulation of Metabolism	3
FM 425	Feed Manufacturing Technology	3
FM 525	Feed Manufacturing Technology	3
NTR 415	Comparative Nutrition	3
NTR 419	Human Nutrition and Chronic Disease	3
NTR 425	Feed Manufacturing Technology	3
NTR 454	Lactation, Milk and Nutrition	3
NTR 515	Comparative Nutrition	3
NTR 525	Feed Manufacturing Technology	3
NTR 550	Applied Ruminant Nutrition	3
NTR 561	Equine Nutrition	3
PHY 452	Comparative Reproductive Physiology and Biotechnology	3
PHY 552	Comparative Reproductive Physiology and Biotechnology	3
PO 415	Comparative Nutrition	3
PO 425	Feed Manufacturing Technology	3
PO 515	Comparative Nutrition	3
PO 525	Feed Manufacturing Technology	3

VMP 420	Disease of Farm Animals	3
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Animal Science Electives

Code	Title	Hours	Counts towards
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Animal Science Electives

VMP 420	Disease of Farm Animals	3
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Any ANS Courses Not Planned

AEE 208	Agricultural Biotechnology: Issues and Implications	3
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ANS 105	Introduction to Companion Animal Science	3
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ANS 110	Introduction to Equine Science	3
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ANS 150	Introduction to Animal Science	3
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ANS 151	Introduction to Animal Science Lab	1
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ANS 201	Techniques of Animal Care	2
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ANS 205	Physiology of Domestic Animals	3
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ANS 206	Anatomy of Domestic Animals Lab	1
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ANS 208	Agricultural Biotechnology: Issues and Implications	3
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ANS 215	Agricultural Genetics	3
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ANS 220	Reproductive Physiology	3
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ANS 221	Reproductive Physiology Lab	1
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ANS 230	Animal Nutrition	3
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ANS 231	Animal Nutrition Lab	1
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ANS 240	Livestock Merchandising	3
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ANS 240A	Livestock Merchandising	3
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ANS 260	Basic Swine Science	2
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ANS 261	Swine Health and Biosecurity	1
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ANS 262	Swine Breeding and Gestation Management	1
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ANS 263	Farrowing Management	1
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ANS 264	Swine Nursery and Finishing Management	1
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ANS 265	Contemporary Issues in the Swine Industry	1
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ANS 266	Swine Environment Management	1
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ANS 267	Swine Manure and Nutrient Management	1
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ANS 268	Employee Management for the Swine Industry	1
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ANS 269	Internship in the Swine Industry	1
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ANS 270	Pork Export Markets from a Swine Production Perspective	1
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ANS 271	Swine Nutrition	1
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ANS 281	Professional Development of PreVeterinary Track Students	1
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ANS 290	Professional Development for Animal Science Careers	2
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ANS 303	Principles of Equine Evaluation	2
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ANS 304	Dairy Cattle Evaluation	2
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ANS 309	Livestock Evaluation	3
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ANS 322	Muscle Foods and Eggs	3
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ANS 324	Milk and Dairy Products	3
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ANS 330	Laboratory Animal Science	3
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ANS 395	Animal Science Study Abroad	1-6
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ANS 400	Companion Animal Management	3
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ANS 402	Beef Cattle Management	3
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ANS 403	Swine Management	3
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ANS 404	Dairy Cattle Management	3
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ANS 408	Small Ruminant Management	3
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ANS 410	Equine Breeding Farm Management	3
ANS 411	Management of Growing and Performance Horses	3
ANS 415	Comparative Nutrition	3
ANS 425	Feed Manufacturing Technology	3
ANS 440	Animal Genetic Improvement	3
ANS 452	Comparative Reproductive Physiology and Biotechnology	3
ANS 453	Physiology and Genetics of Growth and Development	3
ANS 454	Lactation, Milk and Nutrition	3
ANS 495	Special Topics in Animal Science	1-3
ANS 515	Comparative Nutrition	3
ANS 525	Feed Manufacturing Technology	3
ANS 530		3
ANS 531		1
ANS 540	Animal Genetic Improvement	3
ANS 550	Applied Ruminant Nutrition	3
ANS 552	Comparative Reproductive Physiology and Biotechnology	3
ANS 553	Physiology and Genetics of Growth and Development	3
ANS 554	Lactation, Milk and Nutrition	3
ANS 561	Equine Nutrition	3
ANS 571	Regulation of Metabolism	3
ANS 575		3
ANS 590	Topical Problems in Animal Science	1-3
BCH 571	Regulation of Metabolism	3

FM 425	Feed Manufacturing Technology	3
FM 525	Feed Manufacturing Technology	3
FS 322	Muscle Foods and Eggs	3
FS 324	Milk and Dairy Products	3
FS 435	Food Safety Management Systems	3
FS 535	Food Safety Management Systems	3
HS 215	Agricultural Genetics	3
NTR 415	Comparative Nutrition	3
NTR 419	Human Nutrition and Chronic Disease	3
NTR 425	Feed Manufacturing Technology	3
NTR 454	Lactation, Milk and Nutrition	3
NTR 515	Comparative Nutrition	3
NTR 525	Feed Manufacturing Technology	3
NTR 550	Applied Ruminant Nutrition	3
NTR 561	Equine Nutrition	3
PB 208	Agricultural Biotechnology: Issues and Implications	3
PHY 452	Comparative Reproductive Physiology and Biotechnology	3
PHY 552	Comparative Reproductive Physiology and Biotechnology	3
PO 322	Muscle Foods and Eggs	3
PO 415	Comparative Nutrition	3
PO 425	Feed Manufacturing Technology	3
PO 515	Comparative Nutrition	3

PO 525	Feed Manufacturing Technology	3
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Economics or BUS Electives

Code	Title	Hours	Counts towards
ACC 220	Introduction to Managerial Accounting	3	
ACC 280	Survey of Financial and Managerial Accounting	3	
ARE 215	Small Business Accounting	3	
ARE 303	Farm Management	3	
ARE 304	Agribusiness Management	3	
ARE 306	Agricultural Law	3	
ARE 309	Environmental Law & Economic Policy	3	
ARE 311	Agricultural Markets	3	
ARE 312	Agribusiness Marketing	3	
ARE 321	Agricultural Financial Management	3	
ARE 332	Human Resource Management for Agribusiness	3	
BUS 320	Financial Management	3	
BUS 360	Marketing Methods	3	
MIE 310	Introduction to Entrepreneurship	3	
MIE 330	Human Resource Management	3	

CALS Group A, B, or C

Code	Title	Hours	Counts towards
Group A - Biological Sciences			
AEC 360	Ecology	4	
AEC 420	Introduction to Fisheries Science	3	
AEC 423	Introduction to Fisheries Sciences Laboratory	1	
AEE 208	Agricultural Biotechnology: Issues and Implications	3	

ANS 105	Introduction to Companion Animal Science	3
ANS 110	Introduction to Equine Science	3
ANS 150	Introduction to Animal Science	3
ANS 151	Introduction to Animal Science Lab	1
ANS 205	Physiology of Domestic Animals	3
ANS 206	Anatomy of Domestic Animals Lab	1
ANS 208	Agricultural Biotechnology: Issues and Implications	3
ANS 215	Agricultural Genetics	3
ANS 220	Reproductive Physiology	3
ANS 221	Reproductive Physiology Lab	1
ANS 230	Animal Nutrition	3
ANS 231	Animal Nutrition Lab	1
ANS 415	Comparative Nutrition	3
ANS 452	Comparative Reproductive Physiology and Biotechnology	3
ANS 453	Physiology and Genetics of Growth and Development	3
ANS 454	Lactation, Milk and Nutrition	3
ANS 515	Comparative Nutrition	3
ANS 552	Comparative Reproductive Physiology and Biotechnology	3
ANS 553	Physiology and Genetics of Growth and Development	3
ANS 554	Lactation, Milk and Nutrition	3
BCH 101	Introduction to Microbiology and Biochemistry Laboratory Practices	3

BCH 220	Role of Biotechnology in Society	3	BIT 476	Applied Bioinformatics	2
BCH 351	General Biochemistry	3	BIT 481	Plant Tissue Culture and Transformation	2
BCH 451	Principles of Biochemistry	4	BIT 501	Ethical Issues in Biotechnology	1
BCH 452	Introductory Biochemistry Laboratory	2	BIT 562		2
BCH 453	Biochemistry of Gene Expression	3	BIT 563	Fermentation of Recombinant Microorganisms	2
BCH 454	Advanced Biochemistry Laboratory	4	BIT 564	Protein Purification	2
BCH 455	Proteins and Molecular Mechanisms	3	BIT 566	Animal Cell Culture Techniques	2
BCH 553	Biochemistry of Gene Expression	3	BIT 567	PCR and DNA Fingerprinting	2
BCH 555	Proteins and Molecular Mechanisms	3	BIT 568		2
BEC 463	Fermentation of Recombinant Microorganisms	2	CHE 463	Fermentation of Recombinant Microorganisms	2
BEC 563	Fermentation of Recombinant Microorganisms	2	CHE 563	Fermentation of Recombinant Microorganisms	2
BIO 181	Introductory Biology: Ecology, Evolution, and Biodiversity	4	ENT 201	Insects and People	3
BIO 267	Research in the Life Sciences I: Research Skills	3	ENT 207	Insects and Human Disease	3
BIO 414	Cell Biology	3	ENT 402	Forest Entomology	3
BIO 434	Hormones and Behavior	3	ENT 425	General Entomology	3
BIO 440	The Human Animal: An Evolutionary Perspective	3	FOR 402	Forest Entomology	3
BIT 410	Manipulation of Recombinant DNA	4	FS 231	Principles of Food and Bioprocess Engineering	4
BIT 462		2	FS 301	Introduction to Human Nutrition	3
BIT 463	Fermentation of Recombinant Microorganisms	2	FS 401	Advanced Nutrition and Metabolism	3
BIT 464	Protein Purification	2	FS 402	Chemistry of Food and Bioprocessed Materials	4
BIT 466	Animal Cell Culture Techniques	2	FS 403	Analytical Techniques in Food & Bioprocessing Science	4
BIT 467	PCR and DNA Fingerprinting	2	FS 405	Food Microbiology	3
BIT 468		2	FS 406	Food Microbiology Lab	1

FS 501	Advanced Nutrition and Metabolism	3	PB 205	Our Green World	3
FS 502	Chemistry of Food and Bioprocessed Materials	4	PB 208	Agricultural Biotechnology: Issues and Implications	3
FS 505	Food Microbiology	3	PB 213	Plants and Civilization	3
FS 506	Food Microbiology Lab	1	PB 215	Medicinal Plants	3
FW 313	Mountain Wildlife Ecology and Management	1	PB 219	Plants in Folklore, Myth, and religion	3
FW 353	Wildlife Management	3	PB 220	Local Flora	3
FW 403	Urban Wildlife Management	3	PB 250	Plant Biology	4
FW 404	Wildlife Habitat Management	3	PB 277	Space Biology	3
FW 453	Principles of Wildlife Science	4	PB 321	Introduction to Whole Plant Physiology	3
HS 215	Agricultural Genetics	3	PB 360	Ecology	4
MB 101	Introduction to Microbiology and Biochemistry Laboratory Practices	3	PB 400	Plant Diversity and Evolution	4
MB 405	Food Microbiology	3	PB 403	Systematic Botany	4
MB 406	Food Microbiology Lab	1	PB 413	Plant Anatomy	2
MB 505	Food Microbiology	3	PB 421	Plant Physiology	3
MB 506	Food Microbiology Lab	1	PB 445	Paleobotany	4
NTR 301	Introduction to Human Nutrition	3	PB 464	Rare Plants of North Carolina	3
NTR 401	Advanced Nutrition and Metabolism	3	PB 480	Introduction to Plant Biotechnology	3
NTR 415	Comparative Nutrition	3	PB 481	Plant Tissue Culture and Transformation	2
NTR 419	Human Nutrition and Chronic Disease	3	PB 503	Systematic Botany	4
NTR 454	Lactation, Milk and Nutrition	3	PB 513	Plant Anatomy	2
NTR 501	Advanced Nutrition and Metabolism	3	PB 545	Paleobotany	4
NTR 515	Comparative Nutrition	3	PB 564	Rare Plants of North Carolina	3
PB 103	Perspectives on Botany	1	PB 580	Introduction to Plant Biotechnology	3
PB 200	Plant Life	4	PHY 452	Comparative Reproductive Physiology and Biotechnology	3
			PHY 552	Comparative Reproductive Physiology and Biotechnology	3
			PO 415	Comparative Nutrition	3
			PO 466	Animal Cell Culture Techniques	2
			PO 515	Comparative Nutrition	3

PO 566	Animal Cell Culture Techniques	2
PP 150	Introduction to Plant Molecular Biology	3
PP 222	Kingdom of Fungi	3
Group A - Biological Sciences		
AEC 419	Freshwater Ecology	4
AEC 420	Introduction to Fisheries Science	3
AEC 423	Introduction to Fisheries Sciences Laboratory	1
AEC 441	Biology of Fishes	3
AEC 442	Biology of Fishes Laboratory	1
AEC 460	Field Ecology and Methods	4
AEC 519	Freshwater Ecology	4
ANS 215	Agricultural Genetics	3
ANS 415	Comparative Nutrition	3
ANS 515	Comparative Nutrition	3
BEC 463	Fermentation of Recombinant Microorganisms	2
BEC 563	Fermentation of Recombinant Microorganisms	2
BIO 140	Survey of Animal Diversity	3
BIO 141	Animal Diversity Laboratory	1
BIO 227	Understanding Structural Diversity through Biological Illustration	3
BIO 315	General Parasitology	3
BIO 330	Evolutionary Biology	3
BIO 361	Developmental Biology	3
BIO 370	Developmental Anatomy of the Vertebrates	3
BIO 375	Developmental Anatomy Laboratory	2

BIO 405	Functional Histology	3
BIO 414	Cell Biology	3
BIO 424	Endocrinology	3
BIO 482	Capstone Course in Molecular, Cellular, and Developmental Biology	3
BIO 483	Capstone Course in Integrative Physiology and Neurobiology	3
BIO 484	Capstone Course in Human Biology	3
BIO 485	Capstone Course in Ecology, Evolution, and Conservation Biology	3
BIO 488	Neurobiology	3
BIO 588	Neurobiology	3
BIT 210	Phage Hunters	3
BIT 211	Phage Genomics	2
BIT 463	Fermentation of Recombinant Microorganisms	2
BIT 563	Fermentation of Recombinant Microorganisms	2
BME 301	Human Physiology : Electrical Analysis	4
BME 302	Human Physiology: Mechanical Analysis	4
CHE 463	Fermentation of Recombinant Microorganisms	2
CHE 563	Fermentation of Recombinant Microorganisms	2
CS 211	Plant Genetics	3
ENT 425	General Entomology	3
FS 301	Introduction to Human Nutrition	3
FS 405	Food Microbiology	3
FS 406	Food Microbiology Lab	1
FS 505	Food Microbiology	3
FS 506	Food Microbiology Lab	1

FW 353	Wildlife Management	3	MB 411	Medical Microbiology	3
GN 301	Genetics in Human Affairs	3	MB 412	Medical Microbiology Laboratory	1
GN 311	Principles of Genetics	4	MB 414	Microbial Metabolic Regulation	3
GN 312	Elementary Genetics Laboratory	1	MB 420	Fundamentals of Microbial Cell Biotransformations	2
GN 421	Molecular Genetics	3	MB 441	Immunology	3
GN 423	Population, Quantitative and Evolutionary Genetics	3	MB 451	Microbial Diversity	3
GN 425	Advanced Genetics Laboratory	2	MB 452	Microbial Diversity Lab	2
GN 434	Genes and Development	3	MB 455	Microbial Biotechnology	3
GN 441	Human and Biomedical Genetics	3	MB 461	Molecular Virology	3
GN 451	Genome Science	3	MB 480	Current Issues in Microbiology	1
GN 490	Genetics Colloquium	1	MB 505	Food Microbiology	3
GN 521	Molecular Genetics	3	MB 506	Food Microbiology Lab	1
GN 541	Human and Biomedical Genetics	3	MB 520	Fundamentals of Microbial Cell Biotransformations	2
HS 215	Agricultural Genetics	3	MEA 200	Introduction to Oceanography	3
HS 451	Plant Nutrition	3	MEA 210	Oceanography Lab	1
HS 551	Plant Nutrition	3	MEA 220	Marine Biology	3
MB 180	Introduction to Microbial Bioprocessing	3	MEA 250	Introduction to Coastal Environments	3
MB 200	The Fourth Horseman: Plagues that Changed the World	3	MEA 251	Introduction to Coastal Environments Laboratory	1
MB 210	Phage Hunters	3	MEA 369	Life on Earth: Principles of Paleontology	3
MB 211	Phage Genomics	2	NTR 301	Introduction to Human Nutrition	3
MB 351	General Microbiology	3	NTR 415	Comparative Nutrition	3
MB 352	General Microbiology Laboratory	1	NTR 419	Human Nutrition and Chronic Disease	3
MB 354	Inquiry-Guided Microbiology Lab	1	NTR 420		3
MB 405	Food Microbiology	3	NTR 421	Life Cycle Nutrition	3
MB 406	Food Microbiology Lab	1	NTR 490	Senior Capstone Experience in Nutrition	4

NTR 515	Comparative Nutrition	3
NTR 521	Life Cycle Nutrition	3
PO 404	Avian Anatomy and Physiology	4
PO 415	Comparative Nutrition	3
PO 504	Avian Anatomy and Physiology	4
PO 515	Comparative Nutrition	3
SSC 200	Soil Science	3
SSC 201	Soil Science Laboratory	1
SSC 332	Environmental Soil Microbiology	3
SSC 470	Wetland Soils	3
SSC 570	Wetland Soils	3
ZO 233	Human-Animal Interactions	3
ZO 250	Animal Anatomy and Physiology	4
ZO 317	Primate Ecology and Evolution	3
ZO 333	Captive Animal Biology	3
ZO 350	Animal Phylogeny and Diversity	4
ZO 402	Invertebrate Biology	4
ZO 410	Introduction to Animal Behavior	3
ZO 486	Capstone Course in Zoology	3

Group A - Biological Sciences

BIT 100	Current Topics in Biotechnology	4
BIT 465	Real-time PCR Techniques	2
BIT 471	RNA Interference and Model Organisms	2
BIT 473	Protein Interactions	2
BIT 474	Plant Genetic Engineering	2
BIT 565	Real-time PCR Techniques	2
BIT 571	RNA Interference and Model Organisms	2
BIT 573	Protein Interactions	2

BIT 574	Plant Genetic Engineering	2
ENT 305	Introduction to Forensic Entomology	3

Group A - Physical Sciences

AEE 226	Computer Applications and Information Technology in Agricultural & Extension Ed	3
BAE 200	Computer Methods in Biological Engineering	2
BMA 573	Mathematical Modeling of Physical and Biological Processes I	3
BMA 574	Mathematical Modeling of Physical and Biological Processes II	3
BUS 340	Information Systems Management	3
BUS 350	Economics and Business Statistics	3
CE 435	Engineering Geology	3
CE 479	Air Quality	3
CE 581	Fluid Mechanics in Natural Environments	3
CH 230	Computational Chemistry Lab I	1
CH 232	Computational Chemistry Lab II	1
CH 315	Quantitative Analysis	3
CH 316	Quantitative Analysis Laboratory	1
CH 331	Introductory Physical Chemistry	4
CH 401	Systematic Inorganic Chemistry I	3
CH 403	Systematic Inorganic Chemistry II	3
CH 415	Analytical Chemistry II	3

CH 431	Physical Chemistry I	3	CSC 236	Computer Organization and Assembly Language for Computer Scientists	3
CH 433	Physical Chemistry II	3	CSC 246	Concepts and Facilities of Operating Systems for Computer Scientists	3
CH 435	Introduction to Quantum Chemistry	3	CSC 251	Web Page Development	1
CH 437	Physical Chemistry for Engineers	4	CSC 255	String Processing Languages	1
CH 441	Forensic Chemistry	3	CSC 281	Foundations of Interactive Game Design	3
CH 442	Advanced Synthetic Techniques	4	CSC 295	Special Topics in Computer Science	1-3
CH 444	Advanced Synthetic Techniques II	4	CSC 302	Introduction to Numerical Methods	3
CH 452	Advanced Measurement Techniques I	4	CSC 316	Data Structures and Algorithms	3
CH 454	Advanced Measurement Techniques II	4	CSC 326	Software Engineering	4
CH 463	Molecular Origins of Life	3	CSC 333	Automata, Grammars, and Computability	3
CH 563	Molecular Origins of Life	3	CSC 342	Applied Web-based Client-Server Computing	3
CSC 110	Computer Science Principles - The Beauty and Joy of Computing	3	CSC 379	Ethics in Computing	1
CSC 111	Introduction to Computing: Python	3	CSC 401	Data and Computer Communications Networks	3
CSC 112	Introduction to Computing- FORTRAN	3	CSC 402	Networking Projects	3
CSC 113	Introduction to Computing - MATLAB	3	CSC 405	Computer Security	3
CSC 116	Introduction to Computing - Java	3	CSC 406	Architecture Of Parallel Computers	3
CSC 200		3	CSC 411	Introduction to Artificial Intelligence	3
CSC 216	Software Development Fundamentals	3	CSC 412	Compiler Construction	3
CSC 217	Software Development Fundamentals Lab	1	CSC 415	Software Security	3
CSC 226	Discrete Mathematics for Computer Scientists	3	CSC 416	Introduction to Combinatorics	3
CSC 230	C and Software Tools	3			

CSC 417	Theory of Programming Languages	3	CSC 501	Operating Systems Principles	3
CSC 422	Automated Learning and Data Analysis	3	CSC 503	Computational Applied Logic	3
CSC 427	Introduction to Numerical Analysis I	3	CSC 505	Design and Analysis Of Algorithms	3
CSC 428	Introduction to Numerical Analysis II	3	CSC 506	Architecture Of Parallel Computers	3
CSC 431	File Organization and Processing	3	CSC 510	Software Engineering	3
CSC 440	Database Management Systems	3	CSC 512	Compiler Construction	3
CSC 442	Introduction to Data Science	3	CSC 513	Electronic Commerce Technology	3
CSC 450	Web Services	3	CSC 515	Software Security	3
CSC 453	Introduction to Internet of Things (IoT) Systems	3	CSC 517	Object-Oriented Design and Development	3
CSC 454	Human-Computer Interaction	3	CSC 519	DevOps: Modern Software Engineering Practices	3
CSC 455	Social Computing and Decentralized Artificial Intelligence	3	CSC 520	Artificial Intelligence I	3
CSC 456	Computer Architecture and Multiprocessors	3	CSC 522	Automated Learning and Data Analysis	3
CSC 461	Computer Graphics	3	CSC 530	Computational Methods for Molecular Biology	3
CSC 462	Advanced Computer Graphics Projects	3	CSC 533	Privacy in the Digital Age	3
CSC 467	Multimedia Technology	3	CSC 540	Database Management concepts and Systems	3
CSC 474	Network Security	3	CSC 541	Advanced Data Structures	3
CSC 481	Game Engine Foundations	3	CSC 546	Management Decision and Control Systems	3
CSC 482	Advanced Computer Game Projects	3	CSC 547	Cloud Computing Technology	3
CSC 484	Building Game AI	3	CSC 548	Parallel Systems	3
CSC 492	Senior Design Project	3	CSC 554	Human-Computer Interaction	3
CSC 495	Special Topics in Computer Science	1-6	CSC 555	Social Computing and Decentralized Artificial Intelligence	3
CSC 499	Independent Research in Computer Science	1-6			

CSC 561	Principles of Computer Graphics	3	ECE 514	Random Processes	3
CSC 562	Introduction to Game Engine Design	3	ECE 517	Object-Oriented Design and Development	3
CSC 563	Visual Interfaces for Mobile Devices	3	ECE 547	Cloud Computing Technology	3
CSC 565	Graph Theory	3	ECE 560	Embedded System Architectures	3
CSC 568	Enterprise Storage Architecture	3	ECE 570	Computer Networks	3
CSC 570	Computer Networks	3	ECE 573	Internet Protocols	3
CSC 573	Internet Protocols	3	ECE 574	Computer and Network Security	3
CSC 574	Computer and Network Security	3	ECE 575	Introduction to Wireless Networking	3
CSC 575	Introduction to Wireless Networking	3	ECE 576	Networking Services: QoS, Signaling, Processes	3
CSC 576	Networking Services: QoS, Signaling, Processes	3	ECE 577	Switched Network Management	3
CSC 577	Switched Network Management	3	ECE 579	Introduction to Computer Performance Modeling	3
CSC 579	Introduction to Computer Performance Modeling	3	ECG 528	Options and Derivatives Pricing	3
CSC 580	Numerical Analysis I	3	ET 320	Fundamentals of Air Pollution	3
CSC 582	Computer Models of Interactive Narrative	3	FIM 528	Options and Derivatives Pricing	3
CSC 583	Introduction to Parallel Computing	3	FIM 548	Monte Carlo Methods for Financial Math	3
CSC 584	Building Game AI	3	FIM 549	Financial Risk Analysis	3
CSC 591	Special Topics In Computer Science	1-6	GIS 582	Geospatial Modeling	3
E 531	Dynamic Systems and Multivariable Control I	3	ISE 441	Introduction to Simulation	3
ECE 406	Architecture Of Parallel Computers	3	ISE 505	Linear Programming	3
ECE 460	Embedded System Architectures	3	ISE 546	Management Decision and Control Systems	3
ECE 506	Architecture Of Parallel Computers	3	LOG 201	Logic	3
			LOG 335	Symbolic Logic	3
			MA 105	Mathematics of Finance	3
			MA 205		3

MA 225	Foundations of Advanced Mathematics	3	MA 425	Mathematical Analysis I	3
MA 242	Calculus III	4	MA 426	Mathematical Analysis II	3
MA 302	Numerical Applications to Differential Equations	1	MA 427	Introduction to Numerical Analysis I	3
MA 303	Linear Analysis	3	MA 428	Introduction to Numerical Analysis II	3
MA 305	Introductory Linear Algebra and Matrices	3	MA 430	Mathematical Models in the Physical Sciences	3
MA 315	Mathematics Methods in Atmospheric Sciences	4	MA 432	Mathematical Models in Life Sciences	3
MA 325	Introduction to Applied Mathematics	3	MA 437	Applications of Algebra	3
MA 331	Differential Equations for the Life Sciences	3	MA 440		3
MA 335	Symbolic Logic	3	MA 444	Problem Solving Strategies for Competitions	1
MA 341	Applied Differential Equations I	3	MA 450	Methods of Applied Mathematics I	3
MA 351	Introduction to Discrete Mathematical Models	3	MA 451	Methods of Applied Mathematics II	3
MA 401	Applied Differential Equations II	3	MA 491	Reading in Honors Mathematics	1-6
MA 402	Mathematics of Scientific Computing	3	MA 493	Special Topics in Mathematics	1-6
MA 403	Introduction to Modern Algebra	3	MA 494	Major Paper in Math	1
MA 405	Introduction to Linear Algebra	3	MA 499	Independent Research in Mathematics	1-6
MA 407	Introduction to Modern Algebra for Mathematics Majors	3	MA 501	Advanced Mathematics for Engineers and Scientists I	3
MA 408	Foundations of Euclidean Geometry	3	MA 502	Advanced Mathematics for Engineers and Scientists II	3
MA 410	Theory of Numbers	3	MA 504	Introduction to Mathematical Programming	3
MA 412	Long-Term Actuarial Models	3	MA 505	Linear Programming	3
MA 413	Short-Term Actuarial Models	3	MA 507	Survey of Real Analysis	3
MA 416	Introduction to Combinatorics	3	MA 508	Survey of Geometry	3
MA 421	Introduction to Probability	3	MA 509	Survey of Abstract Algebra	3

MA 510	Selected Topics In Mathematics For Secondary Teachers	1-6	MA 548	Monte Carlo Methods for Financial Math	3
MA 511	Advanced Calculus I	3	MA 549	Financial Risk Analysis	3
MA 512		3	MA 551	Introduction to Topology	3
MA 513	Introduction To Complex Variables	3	MA 555	Introduction to Manifold Theory	3
MA 515	Analysis I	3	MA 561	Set Theory and Foundations Of Mathematics	3
MA 518	Geometry of Curves and Surfaces	3	MA 565	Graph Theory	3
MA 520	Linear Algebra	3	MA 573	Mathematical Modeling of Physical and Biological Processes I	3
MA 521	Abstract Algebra I	3	MA 574	Mathematical Modeling of Physical and Biological Processes II	3
MA 522	Computer Algebra	3	MA 580	Numerical Analysis I	3
MA 523	Linear Transformations and Matrix Theory	3	MA 583	Introduction to Parallel Computing	3
MA 524	Combinatorics I	3	MA 584	Numerical Solution of Partial Differential Equations-- Finite Difference Methods	3
MA 526	Mathematical Analysis II	3	MA 587	Numerical Solution of Partial Differential Equations--Finite Element Method	3
MA 528	Options and Derivatives Pricing	3	MA 591	Special Topics	1-6
MA 531	Dynamic Systems and Multivariable Control I	3	MBA 528	Options and Derivatives Pricing	3
MA 532	Ordinary Differential Equations I	3	MEA 100	Earth System Science: Exploring the Connections	4
MA 534	Introduction To Partial Differential Equations	3	MEA 101	Geology I: Physical	3
MA 537	Nonlinear Dynamics and Chaos	3	MEA 110	Geology I Laboratory	1
MA 540	Uncertainty Quantification for Physical and Biological Models	3	MEA 130	Introduction to Weather and Climate	3
MA 544	Computer Experiments In Mathematical Probability	3	MEA 135	Introduction to Weather and Climate Laboratory	1
MA 546	Probability and Stochastic Processes I	3			
MA 547	Stochastic Calculus for Finance	3			

MEA 202	Geology II: Historical	3	MEA 458	Introduction to Tropical Meteorology	3
MEA 211	Geology II Laboratory	1	MEA 459	Field Investigation of Coastal Processes	5
MEA 300	Environmental Geology	4	MEA 460	Principles of Physical Oceanography	3
MEA 312	Atmospheric Thermodynamics	4	MEA 462	Observational Methods and Data Analysis in Marine Physics	3
MEA 315	Mathematics Methods in Atmospheric Sciences	4	MEA 463	Fluid Physics	3
MEA 320	Fundamentals of Air Pollution	3	MEA 464	Ocean Circulation Systems	3
MEA 321	Fundamentals of Air Quality and Climate Change	3	MEA 465	Geologic Field Camp	4
MEA 323	Geochemistry of Natural Waters	3	MEA 466	Preparatory Course for Field Camp	1
MEA 409	Watershed Forensics	3	MEA 467	Marine Meteorology	3
MEA 410	Introduction to Mineralogy	4	MEA 469	Ecology of coastal Resources	3
MEA 411	Marine Sediment Transport	3	MEA 470	Introduction to Geophysics	3
MEA 412	Atmospheric Physics	3	MEA 471	Exploration and Engineering Geophysics	3
MEA 415	Climate Dynamics	3	MEA 473	Principles of Chemical Oceanography	3
MEA 421	Atmospheric Dynamics I	3	MEA 476	Worldwide River and Delta Systems: Their Evolution and Human Impacts	3
MEA 422	Atmospheric Dynamics II	3	MEA 479	Air Quality	3
MEA 425	Introduction to Atmospheric Chemistry	3	MEA 481	Geomorphology: Earth's Dynamic Surface	3
MEA 440	Igneous and Metamorphic Petrology	4	MEA 485	Introduction to Hydrogeology	3
MEA 443	Synoptic Weather Analysis and Forecasting	4	MEA 488	Meteorology for Media	3
MEA 444	Mesoscale Analysis and Forecasting	4	MEA 493	Special Topics in MEAS	1-6
MEA 449	Principles of Biological Oceanography	3	MEA 495	Junior Seminar in the Marine, Earth, and Atmospheric Sciences	1
MEA 450	Introductory Sedimentology and Stratigraphy	4	MEA 498	Internship in MEAS	1-6
MEA 451	Structural Geology	4			
MEA 454	Marine Physical-Biological Interactions	3			
MEA 455	Micrometeorology	3			

MEA 507	Discipline-based Education Research in the Geosciences	3	MEA 581	Fluid Mechanics in Natural Environments	3
MEA 510	Air Pollution Meteorology	3	MEA 582	Geospatial Modeling	3
MEA 511	Introduction to Meteorological Remote Sensing	3	MEA 585	Physical Hydrogeology	3
MEA 514	Advanced Physical Meteorology	3	MEA 591	Special Topics in Marine Science	1-6
MEA 515	Climate Dynamics	3	MEA 592	Special Topics in Earth Sciences	1-6
MEA 517	Fundamentals of Climate Change Science	3	MEA 593	Special Topics in Atmospheric Science	1-6
MEA 518	Adaptation to Climate Change	3	MEA 599	Regional Geology of North America	1-6
MEA 519	Barriers to Climate Change Literacy	3	OR 504	Introduction to Mathematical Programming	3
MEA 525	Introduction to Atmospheric Chemistry	3	OR 505	Linear Programming	3
MEA 540	Principles of Physical Oceanography	3	OR 531	Dynamic Systems and Multivariable Control I	3
MEA 549	Principles of Biological Oceanography	3	OR 565	Graph Theory	3
MEA 553	Estuarine Biogeochemistry	3	OR 579	Introduction to Computer Performance Modeling	3
MEA 554	Marine Physical-Biological Interactions	3	PSY 240	Introduction to Behavioral Research I	3
MEA 562	Marine Sediment Transport	3	PSY 241	Introduction to Behavioral Research I Lab	1
MEA 570	Geological Oceanography	3	PSY 242	Introduction to Behavioral Research II	3
MEA 573	Principles of Chemical Oceanography	3	PSY 243	Introduction to Behavioral Research II Lab	2
MEA 574	Advanced Igneous Petrology	3	PY 414	Electromagnetism I	3
MEA 577	Electron Microprobe Analysis of Geologic Material	2	PY 415	Electromagnetism II	3
MEA 579	Principles of Air Quality Engineering	3	PY 514	Electromagnetism I	3
MEA 580	Air Quality Modeling and Forecasting	4	PY 515	Electromagnetism II	3
			ST 350	Economics and Business Statistics	3
			ST 412	Long-Term Actuarial Models	3
			ST 413	Short-Term Actuarial Models	3

ST 442	Introduction to Data Science	3
ST 546	Probability and Stochastic Processes I	3
Group A - Physical Sciences		
BME 201	Computer Methods in Biomedical Engineering	3
CSC 442	Introduction to Data Science	3
EC 351	Econometrics I	3
ECE 489	Solid State Solar and Thermal Energy Harvesting	3
ECE 589	Solid State Solar and Thermal Energy Harvesting	3
ECG 561	Applied Econometrics I	3
EMS 519	Teaching and Learning of Statistical Thinking	3
GPH 404	Epidemiology and Statistics in Global Public Health	3
MA 412	Long-Term Actuarial Models	3
MA 413	Short-Term Actuarial Models	3
MA 546	Probability and Stochastic Processes I	3
MA 555	Introduction to Manifold Theory	3
MEA 150	Environmental Issues in Water Resources	4
MEA 463	Fluid Physics	3
MSE 489	Solid State Solar and Thermal Energy Harvesting	3
MSE 589	Solid State Solar and Thermal Energy Harvesting	3
NE 528	Introduction to Plasma Physics and Fusion Energy	3

NE 529	Plasma Physics and Fusion Energy II	3
PSY 240	Introduction to Behavioral Research I	3
PSY 241	Introduction to Behavioral Research I Lab	1
PSY 242	Introduction to Behavioral Research II	3
PSY 243	Introduction to Behavioral Research II Lab	2
PY 123	Stellar and Galactic Astronomy	3
PY 124	Solar System Astronomy	3
PY 125	Astronomy Laboratory	1
PY 131	Conceptual Physics	4
PY 203	University Physics III	4
PY 301	Introduction to Quantum Mechanics	3
PY 328	Stellar and Galactic Astrophysics	3
PY 341	Relativity, Gravitation and Cosmology	3
PY 401	Quantum Physics I	3
PY 402	Quantum Physics II	3
PY 407	Introduction to Modern Physics	3
PY 411	Mechanics I	3
PY 412	Mechanics II	3
PY 413	Thermal Physics	3
PY 414	Electromagnetism I	3
PY 415	Electromagnetism II	3
PY 452	Advanced Physics Laboratory	3
PY 489	Solid State Solar and Thermal Energy Harvesting	3
PY 495	Special Topics in Physics	1-4

PY 499	Independent Research in Physics	1-6	ST 312	Introduction to Statistics II	3
PY 501	Quantum Physics I	3	ST 370	Probability and Statistics for Engineers	3
PY 502	Quantum Physics II	3	ST 371	Introduction to Probability and Distribution Theory	3
PY 506	Nuclear and Subatomic Physics	3	ST 372	Introduction to Statistical Inference and Regression	3
PY 507	Elementary Particle Physics	3	ST 380	Probability and Statistics for the Physical Sciences	3
PY 509	General Relativity	3	ST 401	Experiences in Data Analysis	4
PY 511	Mechanics I	3	ST 404	Epidemiology and Statistics in Global Public Health	3
PY 512	Mechanics II	3	ST 405	Applied Nonparametric Statistics	3
PY 514	Electromagnetism I	3	ST 412	Long-Term Actuarial Models	3
PY 515	Electromagnetism II	3	ST 413	Short-Term Actuarial Models	3
PY 516	Physical Optics	3	ST 421	Introduction to Mathematical Statistics I	3
PY 517	Atomic and Molecular Physics	3	ST 422	Introduction to Mathematical Statistics II	3
PY 519	Biological Physics	3	ST 430	Introduction to Regression Analysis	3
PY 525	Computational Physics	3	ST 431	Introduction to Experimental Design	3
PY 528	Introduction to Plasma Physics and Fusion Energy	3	ST 432	Introduction to Survey Sampling	3
PY 529	Plasma Physics and Fusion Energy II	3	ST 433	Applied Spatial Statistics	3
PY 543	Astrophysics	3	ST 434	Applied Time Series	3
PY 552	Condensed Matter Physics I	3	ST 435	Statistical Methods for Quality and Productivity Improvement	3
PY 570	Polymer Physics	3	ST 437	Applied Multivariate and Longitudinal Data Analysis	3
PY 581	Matter & Interactions for Teachers I	3			
PY 582	Matter & Interactions for Teachers II	3			
PY 589	Solid State Solar and Thermal Energy Harvesting	3			
PY 590	Special Topics In Physics	1-6			
PY 599	Special Topics in Physics	1-6			
SSC 200	Soil Science	3			
SSC 201	Soil Science Laboratory	1			
ST 311	Introduction to Statistics	3			

ST 440	Applied Bayesian Analysis	3	ST 516	Experimental Statistics For Engineers II	3
ST 442	Introduction to Data Science	3	ST 517	Applied Statistical Methods I	3
ST 445	Introduction to Statistical Computing and Data Management	3	ST 519	Teaching and Learning of Statistical Thinking	3
ST 446	Intermediate SAS Programming with Applications	3	ST 520	Statistical Principles of Clinical Trials	3
ST 491	Statistics in Practice	3	ST 524		3
ST 495	Special Topics in Statistics	1-6	ST 533	Applied Spatial Statistics	3
ST 497	Professional Experience in Statistics	1-3	ST 534	Applied Time Series	3
ST 498	Independent Study In Statistics	1-6	ST 535	Statistical Methods for Quality and Productivity Improvement	3
ST 499	Research Experience in Statistics	1-3	ST 537	Applied Multivariate and Longitudinal Data Analysis	3
ST 501	Fundamentals of Statistical Inference I	3	ST 540	Applied Bayesian Analysis	3
ST 502	Fundamentals of Statistical Inference II	3	ST 542	Statistical Practice	3
ST 503	Fundamentals of Linear Models and Regression	3	ST 544	Applied Categorical Data Analysis	3
ST 505	Applied Nonparametric Statistics	3	ST 546	Probability and Stochastic Processes I	3
ST 506		3	ST 555	Statistical Programming I	3
ST 507	Statistics For the Behavioral Sciences I	3	ST 556	Statistical Programming II	3
ST 508		3	ST 557		3
ST 511	Statistical Methods For Researchers I	3	ST 558	Data Science for Statisticians	3
ST 512	Statistical Methods For Researchers II	3	ST 561	Applied Econometrics I	3
ST 513	Statistics for Management and Social Sciences I	3	ST 562	Data Mining with SAS Enterprise Miner	3
ST 514	Statistics For Management and Social Sciences II	3	ST 563	Introduction to Statistical Learning	3
ST 515	Experimental Statistics for Engineers I	3	ST 590	Special Topics	1-6
			ST 701	Statistical Theory I	3
			ST 702	Statistical Theory II	3

ST 705	Linear Models and Variance Components	3	ARE 311	Agricultural Markets	3
TE 570	Polymer Physics	3	ARE 312	Agribusiness Marketing	3
Group B - Economics & Business			ARE 321	Agricultural Financial Management	3
ACC 200	Introduction to Managerial Accounting	3	ARE 336	Introduction to Resource and Environmental Economics	3
ACC 210	Concepts of Financial Reporting	3	ARE 345	Global Agribusiness Management	3
ACC 220	Introduction to Managerial Accounting	3	ARE 404	Advanced Agribusiness Management	3
ACC 280	Survey of Financial and Managerial Accounting	3	ARE 413	Applied Agribusiness Marketing	3
ACC 310	Intermediate Financial Accounting I	3	ARE 433	U.S. Agricultural Policy	3
ACC 311	Intermediate Financial Accounting II	3	ARE 490	Career Seminar in Agriculture & Resource Economics	1
ACC 330	An Introduction To Income Taxation	3	BUS 225	Personal Finance	3
ACC 340	Accounting Information Systems	3	BUS 320	Financial Management	3
ACC 411	Business Valuation	3	BUS 340	Information Systems Management	3
ACC 420	Cost Accounting for Effective Management	3	BUS 360	Marketing Methods	3
ACC 440	Enterprise Resource Planning Systems	3	BUS 370	Operations and Supply Chain Management	3
ACC 450	Auditing and Assurance Services	3	BUS 420	Financial Management of Corporations	3
ACC 451	Internal Auditing	3	BUS 422	Investments and Portfolio Management	3
ACC 460	Governmental and Nonprofit Accounting	3	BUS 425	Advanced Personal Financial Management	3
ARE 215	Small Business Accounting	3	BUS 426	International Financial Management	3
ARE 301	Intermediate Microeconomics	3	BUS 440	Database Management	3
ARE 303	Farm Management	3	BUS 441	Business Data Communications and Networking	3
ARE 304	Agribusiness Management	3	BUS 442	Information Systems Development	3
ARE 306	Agricultural Law	3			
ARE 309	Environmental Law & Economic Policy	3			

BUS 443	Web Development for Business Applications	3	MIE 330	Human Resource Management	3
BUS 444	Systems Analysis and Design	3	MIE 335	Organizational Behavior	3
BUS 461	Channel and Retail Marketing	3	MIE 432	Labor and Employee Relations	3
BUS 462	Marketing Research	3	MIE 434	Compensation Systems	3
BUS 464	International Marketing	3	MIE 435	Leadership and Management	3
BUS 465	Traditional and Digital Brand Promotion	3	MIE 436	Training and Development	3
BUS 466	Personal Selling	3	MIE 438	Staffing	3
BUS 467	Product and Brand Management	3	MIE 480	Business Policy and Strategy	3
BUS 468	Marketing Strategy	3	PRT 406	Sports Law	3
BUS 469	Digital Marketing Practicum	3	Group B - Economics & Business		
BUS 470	Operations Modeling and Analysis	3	ACC 200	Introduction to Managerial Accounting	3
BUS 472	Operations Planning and Control Systems	3	ACC 220	Introduction to Managerial Accounting	3
BUS 473	Supply Chain Strategy	3	ACC 280	Survey of Financial and Managerial Accounting	3
BUS 475	Purchasing and Supply Management	3	ARE 301	Intermediate Microeconomics	3
BUS 479	Supply Chain Management Undergraduate Practicum	3	ARE 332	Human Resource Management for Agribusiness	3
EC 301	Intermediate Microeconomics	3	ARE 336	Introduction to Resource and Environmental Economics	3
EC 336	Introduction to Resource and Environmental Economics	3	ARE 412	Advanced Agribusiness Marketing	3
FTM 482	Global Brand Management in Textiles and Apparel	3	BUS 340	Information Systems Management	3
M 100	Personal and Professional Identity Development	1	BUS 449	Information Technology Capstone	3
MIE 201	Introduction to Business Processes	3	BUS 474	Logistics Management	3
MIE 305	Legal and Regulatory Environment	3	EC 202	Principles of Macroeconomics	3
			EC 301	Intermediate Microeconomics	3
			EC 302	Intermediate Macroeconomics	3
			EC 305	A Closer Look at Capitalism	3

EC 336	Introduction to Resource and Environmental Economics	3	AEE 311	Communication Methods and Media	3
EC 348	Introduction to International Economics	3	AEE 322	Experiential Learning in Agriculture	3
EC 351	Econometrics I	3	AEE 323	Leadership Development in Agriculture and Life Sciences	3
EC 404	Money, Financial Markets, and the Economy	3	AEE 325	Planning and Delivering Non-Formal Education	3
EC 410	Public Finance	3	AEE 326	Teaching Diverse Learners in AED	3
EC 413	Industrial Organization	3	AEE 327	Conducting Summer Programs in Agricultural Education	1
EC 431	Labor Economics	3	AEE 350	Personal Leadership Development in Agriculture and Life Sciences	3
EC 437		3	AEE 360	Developing Team Leadership in Agriculture and Life Sciences	3
EC 449	International Finance	3	AEE 423	Practicum in Agricultural Extension/ Industry	8
EC 451	Econometrics II	3	AEE 424	Planning Agricultural Educational Programs	3
EC 474	Economics of Financial Institutions and Markets	3	AEE 426	Methods of Teaching Agriculture	3
EC 480		3	AEE 427	Student Teaching in Agriculture	8
EC 490	Research Seminar in Economics	3	AEE 433	Leadership and Management of Volunteers in Agricultural and Extension Education	3
FTM 482	Global Brand Management in Textiles and Apparel	3	AEE 435	Professional Presentations in Agricultural Organizations	3
MIE 412	Finance and Accounting for Entrepreneurs	3	AEE 460	Organizational Leadership Development in Agriculture and Life Sciences	3
MIE 413	New Venture Planning	3			
MIE 419	Entrepreneurship Practicum	3			
PRT 406	Sports Law	3			
Group C - Applied Sci & Tech					
AEE 101	Introduction to Career and Technical Education	1			
AEE 208	Agricultural Biotechnology: Issues and Implications	3			
AEE 230	Introduction to Cooperative Extension	3			
AEE 303	Administration and Supervision of Student Organizations	3			

AEE 478	Advanced Issues in Extension Education	3	ANS 309	Livestock Evaluation	3
AEE 490	Seminar in Agricultural and Extension Education	1	ANS 322	Muscle Foods and Eggs	3
AEE 533	Leadership and Management of Volunteers in Agricultural and Extension Education	3	ANS 324	Milk and Dairy Products	3
BAET 201	Shop Processes and Management	3	ANS 400	Companion Animal Management	3
BAET 323	Water Management	3	ANS 402	Beef Cattle Management	3
BAET 332	Management of Animal Environments	4	ANS 403	Swine Management	3
BAET 333	Processing Agricultural Products	4	ANS 404	Dairy Cattle Management	3
BAET 411	Agricultural Machinery and Power Units	4	ANS 408	Small Ruminant Management	3
BAET 432	Agricultural and Environmental Safety and Health	3	ANS 410	Equine Breeding Farm Management	3
BAET 443	Environmental Restoration Implementation	3	ANS 425	Feed Manufacturing Technology	3
ALS 110	Academic and Career Skills Seminar	1	ANS 440	Animal Genetic Improvement	3
ANS 105	Introduction to Companion Animal Science	3	ANS 453	Physiology and Genetics of Growth and Development	3
ANS 110	Introduction to Equine Science	3	ANS 454	Lactation, Milk and Nutrition	3
ANS 150	Introduction to Animal Science	3	ANS 525	Feed Manufacturing Technology	3
ANS 151	Introduction to Animal Science Lab	1	ANS 540	Animal Genetic Improvement	3
ANS 201	Techniques of Animal Care	2	ANS 553	Physiology and Genetics of Growth and Development	3
ANS 208	Agricultural Biotechnology: Issues and Implications	3	ANS 554	Lactation, Milk and Nutrition	3
ANS 303	Principles of Equine Evaluation	2	BAE 100	Introduction to Biological and Agricultural Engineering and Technology	1
ANS 304	Dairy Cattle Evaluation	2	BAE 202	Introduction to Biological and Agricultural Engineering Methods	4
			BAE 302	Transport Phenomena	3
			BAE 322	Introduction to Food Process Engineering	3

BAE 361	Analytical Methods in Engineering Design	3	BME 342		3
BAE 371	Fundamentals of Hydrology for Engineers	3	BME 412	Biomedical Signal Processing	3
BAE 401	Sensors and Controls	3	BME 385	Bioinstrumentation	3
BAE 435	Precision Agriculture Technology	3	BME 425	Bioelectricity	3
BAE 451	Engineering Design I	2	BME 525	Bioelectricity	3
BAE 452	Engineering Design II	2	CS 470	Advanced Turfgrass Pest Management	2
BAE 462	Machinery Design and Applications	3	ECI 424	Student Teaching in Modern Foreign Languages	12
BAE 472	Irrigation and Drainage	3	ENT 470	Advanced Turfgrass Pest Management	2
BAE 473	Introduction to Hydrologic and Water Quality Modeling	3	FM 425	Feed Manufacturing Technology	3
BAE 474	Principles and Applications of Ecological Engineering	3	FM 525	Feed Manufacturing Technology	3
BAE 481	Structures & Environment	3	FS 322	Muscle Foods and Eggs	3
BAE 501	Sensors and Controls	3	FS 324	Milk and Dairy Products	3
BAE 535	Precision Agriculture Technology	3	FS 435	Food Safety Management Systems	3
BAE 572	Irrigation and Drainage	3	FS 535	Food Safety Management Systems	3
BAE 573	Introduction to Hydrologic and Water Quality Modeling	3	MSE 203		3
BEC 330	Principles and Applications of Bioseparations	2	NTR 425	Feed Manufacturing Technology	3
BEC 436	Introduction to Downstream Process Development	2	NTR 454	Lactation, Milk and Nutrition	3
BEC 440		3	NTR 525	Feed Manufacturing Technology	3
BEC 536	Introduction to Downstream Process Development	2	PB 208	Agricultural Biotechnology: Issues and Implications	3
BEC 540		3	PO 322	Muscle Foods and Eggs	3
BME 203		3	PO 425	Feed Manufacturing Technology	3
BME 207	Biomedical Electronics	4	PO 525	Feed Manufacturing Technology	3
			PP 470	Advanced Turfgrass Pest Management	2

SSC 440	Geographic Information Systems (GIS) in Soil Science and Agriculture	3	ANS 411	Management of Growing and Performance Horses	3
SSC 473	Introduction to Hydrologic and Water Quality Modeling	3	ANS 425	Feed Manufacturing Technology	3
SSC 540	Geographic Information Systems (GIS) in Soil Science and Agriculture	3	ANS 525	Feed Manufacturing Technology	3
SSC 573	Introduction to Hydrologic and Water Quality Modeling	3	BAE 325	Introductory Geomatics	3
USC 291	Service Learning Program Leader Development I	1	BAE 425	Industrial Microbiology and Bioprocessing	3
USC 292	Service Learning Program Leader Development II	2	BAE 435	Precision Agriculture Technology	3
Group C - Applied Sci & Tech			BAE 525	Industrial Microbiology and Bioprocessing	3
AEC 420	Introduction to Fisheries Science	3	BAE 535	Precision Agriculture Technology	3
AEE 206	Introduction to Teaching Agriculture	3	BBS 201	Introduction to Biopharmaceutica Science	3
AEE 303	Administration and Supervision of Student Organizations	3	BBS 301	Process Validation Science	3
AEE 322	Experiential Learning in Agriculture	3	BBS 426	Upstream Biomanufacturing Laboratory	2
AEE 327	Conducting Summer Programs in Agricultural Education	1	BBS 526	Upstream Biomanufacturing Laboratory	2
AEE 424	Planning Agricultural Educational Programs	3	BCH 220	Role of Biotechnology in Society	3
AEE 426	Methods of Teaching Agriculture	3	BEC 426	Upstream Biomanufacturing Laboratory	2
AEE 427	Student Teaching in Agriculture	8	BEC 483	Tissue Engineering Technologies	2
ANS 322	Muscle Foods and Eggs	3	BEC 526	Upstream Biomanufacturing Laboratory	2
ANS 324	Milk and Dairy Products	3	BEC 583	Tissue Engineering Technologies	2
ANS 330	Laboratory Animal Science	3	BME 444	Orthopaedic Biomechanics	3
			BME 451	BME Senior Design: Product Development	3

BME 452	BME Senior Design: Product Implementation and Strategy	3	CS 465	Turf Management Systems and Environmental Quality	3
BME 466	Polymeric Biomaterials Engineering	3	CS 524	Seed Physiology	3
BME 467	Mechanics of Tissues & Implants Requirements	3	CS 565	Turf Management Systems and Environmental Quality	3
BME 483	Tissue Engineering Technologies	2	CSSC 490	Senior Seminar in Crop Science and Soil Science	1
BME 484	Fundamentals of Tissue Engineering	3	ECI 424	Student Teaching in Modern Foreign Languages	12
BME 544	Orthopaedic Biomechanics	3	ENT 203	An Introduction to the Honey Bee and Beekeeping	3
BME 566	Polymeric Biomaterials Engineering	3	ENT 401	Honey Bee Biology and Management	3
BME 583	Tissue Engineering Technologies	2	ES 100	Introduction to Environmental Sciences	3
BME 584	Fundamentals of Tissue Engineering	3	ES 200	Climate Change and Sustainability	3
CS 200	Introduction to Turfgrass Management	4	ES 300	Energy and Environment	3
CS 210	Lawns and Sports Turf	3	ES 400	Analysis of Environmental Issues	3
CS 213	Crop Science	3	FM 425	Feed Manufacturing Technology	3
CS 216	Southern Row Crop Production - Cotton, Peanuts, and Tobacco	3	FM 460	Feed Mill Operations and Leadership	3
CS 218	Southern Row Crop Production - Corn, Small Grains and Soybeans	3	FM 480	Feed Quality Assurance & Formulation	3
CS 230	Introduction to Agroecology	3	FM 490	Feed Science Seminar	1
CS 312		3	FM 525	Feed Manufacturing Technology	3
CS 400	Turf Cultural Systems	3	FOR 318	Forest Pathology	3
CS 411	Crop Ecology	3	FOR 420	Watershed and Wetlands Hydrology	4
CS 413	Plant Breeding	2	FOR 472	Forest Soils	4
CS 414	Weed Science	4	FOR 520	Watershed and Wetlands Hydrology	4
CS 415	Integrated Pest Management	3	FS 201	Introduction to Food Science	3
CS 424	Seed Physiology	3			
CS 430	Advanced Agroecology	4			

FS 290	Careers in Food and Bioprocessing Sciences	1	FW 312	Fisheries Techniques and Management	1
FS 322	Muscle Foods and Eggs	3	FW 313	Mountain Wildlife Ecology and Management	1
FS 324	Milk and Dairy Products	3	FW 314	Coastal Ecology and Management	1
FS 330	Science of Food Preparation	3	FW 353	Wildlife Management	3
FS 352	Introduction to Microbiological Food Safety Hazards	3	FW 403	Urban Wildlife Management	3
FS 354	Food Sanitation	3	FW 411	Human Dimensions of Wildlife and Fisheries	3
FS 416	Quality Control in Food and Bioprocessing	3	FW 453	Principles of Wildlife Science	4
FS 421	Food Preservation	3	FW 460	International Wildlife Management and Conservation	3
FS 426	Upstream Biomanufacturing Laboratory	2	FW 465	African Ecology and Conservation	4
FS 435	Food Safety Management Systems	3	FW 511	Human Dimensions of Wildlife and Fisheries	3
FS 453	Food Laws and Regulations	3	FW 560	International Wildlife Management and Conservation	3
FS 462	Postharvest Physiology	3	FW 565	African Ecology and Conservation	4
FS 475	Problems and Design in Food and Bioprocessing Science	3	GPH 201	Fundamentals of Global Public Health	3
FS 516	Quality Control in Food and Bioprocessing	3	HS 432	Introduction to Permaculture	3
FS 521	Food Preservation	3	HS 462	Postharvest Physiology	3
FS 526	Upstream Biomanufacturing Laboratory	2	HS 532	Introduction to Permaculture	3
FS 535	Food Safety Management Systems	3	HS 562	Postharvest Physiology	3
FS 553	Food Laws and Regulations	3	IDS 303	Humans and the Environment	3
FS 562	Postharvest Physiology	3	NR 303	Humans and the Environment	3
FW 221	Conservation of Natural Resources	3	NR 350	International Sustainable Resource Use	4
FW 311	Piedmont Wildlife Ecology and Management	3	NR 406	Conservation of Biological Diversity	3
			NR 420	Watershed and Wetlands Hydrology	4

NR 460	Renewable Natural Resource Management and Policy	3	AEC 419	Freshwater Ecology	4
NR 520	Watershed and Wetlands Hydrology	4	AEC 423	Introduction to Fisheries Sciences Laboratory	1
NR 560	Renewable Natural Resource Management and Policy	3	AEC 519	Freshwater Ecology	4
NTR 425	Feed Manufacturing Technology	3	ANS 322	Muscle Foods and Eggs	3
NTR 525	Feed Manufacturing Technology	3	ANS 425	Feed Manufacturing Technology	3
PO 322	Muscle Foods and Eggs	3	ANS 525	Feed Manufacturing Technology	3
PO 424	Poultry Meat Production	3	BAET 323	Water Management	3
PO 425	Feed Manufacturing Technology	3	BIO 227	Understanding Structural Diversity through Biological Illustration	3
PO 435	Poultry Incubation & Breeding	4	BME 204		3
PO 525	Feed Manufacturing Technology	3	BME 217	Biomedical Electronics Laboratory	1
PP 318	Forest Pathology	3	BME 298	Biomedical Engineering Design and Manufacturing I	2
SSC 440	Geographic Information Systems (GIS) in Soil Science and Agriculture	3	BME 398	Biomedical Engineering Design and Manufacturing II	2
SSC 462	Soil-Crop Management Systems	3	CS 470	Advanced Turfgrass Pest Management	2
SSC 540	Geographic Information Systems (GIS) in Soil Science and Agriculture	3	CSSC 490	Senior Seminar in Crop Science and Soil Science	1
TE 466	Polymeric Biomaterials Engineering	3	ENT 470	Advanced Turfgrass Pest Management	2
TE 467	Mechanics of Tissues & Implants Requirements	3	FM 425	Feed Manufacturing Technology	3
TE 566	Polymeric Biomaterials Engineering	3	FM 525	Feed Manufacturing Technology	3
VMP 401	Poultry Diseases	4	FOR 318	Forest Pathology	3
VMP 420	Disease of Farm Animals	3	FOR 420	Watershed and Wetlands Hydrology	4
			FOR 472	Forest Soils	4
			FOR 520	Watershed and Wetlands Hydrology	4

Group C - Applied Sci & Tech

FS 322	Muscle Foods and Eggs	3	HS 357	Landscape Grading and Drainage	4
FS 435	Food Safety Management Systems	3	HS 400	Residential Landscaping	6
FS 462	Postharvest Physiology	3	HS 411	Nursery Management	3
FS 535	Food Safety Management Systems	3	HS 416	Planting Design	4
FS 562	Postharvest Physiology	3	HS 421	Temperate-Zone Tree Fruits: Physiology and Culture	3
FW 221	Conservation of Natural Resources	3	HS 422	Small Fruit Production	3
FW 404	Wildlife Habitat Management	3	HS 423	Viticulture	3
FW 460	International Wildlife Management and Conservation	3	HS 431	Vegetable Production	4
FW 560	International Wildlife Management and Conservation	3	HS 440	Greenhouse Management	3
HS 200	Home Horticulture	3	HS 442	Floriculture Crop Production	3
HS 201	The World of Horticulture: Principles and Practices	3	HS 462	Postharvest Physiology	3
HS 203	Home Plant Propagation	3	HS 471	Landscape Ecosystem Management	4
HS 242	Introduction to Small Scale Landscape Design	3	HS 516	Planting Design	4
HS 250	Home Landscape Design: Creating Garden Spaces	3	HS 521	Temperate-Zone Tree Fruits: Physiology and Culture	3
HS 252	Landscape Graphic Communication	2	HS 523	Viticulture	3
HS 272	Landscape Design/Build	6	HS 562	Postharvest Physiology	3
HS 290	Horticulture: Careers and Opportunities	1	IDS 303	Humans and the Environment	3
HS 301	Plant Propagation	4	NR 300	Natural Resource Measurements	4
HS 302	Gardening with Herbaceous Perennials	3	NR 303	Humans and the Environment	3
HS 303	Ornamental Plant Identification I	3	NR 400	Natural Resource Management	4
HS 304	Ornamental Plant Identification II	3	NR 420	Watershed and Wetlands Hydrology	4
			NR 421	Wetland Science and Management	3
			NR 460	Renewable Natural Resource Management and Policy	3
			NR 484	Environmental Impact Assessment	4
			NR 500	Natural Resource Management	4

NR 520	Watershed and Wetlands Hydrology	4
NR 521	Wetland Science and Management	3
NR 560	Renewable Natural Resource Management and Policy	3
NTR 420		3
NTR 425	Feed Manufacturing Technology	3
NTR 525	Feed Manufacturing Technology	3
PO 201	Poultry Science and Production	3
PO 201A	Poultry Science and Production	3
PO 202	Poultry Science and Production Laboratory	1
PO 202A	Poultry Science and Production Laboratory	1
PO 290	Poultry Seminar	1
PO 322	Muscle Foods and Eggs	3
PO 340	Live Poultry and Poultry Product Evaluation, Grading, and Inspection	3
PO 410	Production and Management of Game Birds in Confinement	3
PO 411	Agrosecurity	3
PO 421	Commercial Egg Production	3
PO 425	Feed Manufacturing Technology	3
PO 433	Poultry Processing and Products	3
PO 525	Feed Manufacturing Technology	3
PO 533	Poultry Processing and Products	3
PP 315	Principles of Plant Pathology	4
PP 318	Forest Pathology	3

PP 470	Advanced Turfgrass Pest Management	2
SSC 185	Land and Life	3
SSC 341	Soil Fertility and Nutrient Management	3
SSC 342	Soil and Plant Nutrient Analysis	1
SSC 421	Role of Soils in Environmental Management	3
SSC 440	Geographic Information Systems (GIS) in Soil Science and Agriculture	3
SSC 442	Soil and Environmental Biogeochemistry	3
SSC 452	Soil Classification	4
SSC 461	Soil Physical Properties and Plant Growth	3
SSC 462	Soil-Crop Management Systems	3
SSC 470	Wetland Soils	3
SSC 540	Geographic Information Systems (GIS) in Soil Science and Agriculture	3
SSC 570	Wetland Soils	3
TOX 201	Poisons, People and the Environment	3
TOX 401	Principles of Toxicology	4
TOX 415	Environmental Toxicology and Chemistry	4
TOX 501	Principles of Toxicology	4

Semester Sequence

This is a sample.

First Year

Fall Semester		Hours
ALS 103	Freshman Transitions and Diversity in Agriculture & Life Sciences	1
ANS 150 & ANS 151	Introduction to Animal Science and Introduction to Animal Science Lab ¹	4
BIO 181	Introductory Biology: Ecology, Evolution, and Biodiversity	4
ENG 101	Academic Writing and Research ¹	4

MA 107	Precalculus I ¹	3
Hours		16
Spring Semester		
CH 101	Chemistry - A Molecular Science ¹	3
CH 102	General Chemistry Laboratory	1
Animal Science Course (p. 4)		3
Select one of the following:		3
MA 114	Introduction to Finite Mathematics with Applications	
MA 121	Elements of Calculus	
MA 131	Calculus for Life and Management Sciences A	
BIO 183	Introductory Biology: Cellular and Molecular Biology	4
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		1
Hours		15
Second Year		
Fall Semester		
ANS 205 & 205	Physiology of Domestic Animals and Physiology of Domestic Animals	4
ANS 215	Agricultural Genetics	3
Economics Course (p. 1)		3
CH 221 & CH 222 or CH 220	Organic Chemistry I or Introductory Organic Chemistry	4
Communications Course (p. 1)		3
Hours		17
Spring Semester		
ANS 220	Reproductive Physiology	3
ANS 221	Reproductive Physiology Lab	1
Business Management or Marketing Elective (p. 1)		3
ST/BUS 350 or ST 311	Economics and Business Statistics or Introduction to Statistics	3
GEP Social Sciences (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/)		3
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		1
Hours		14
Third Year		
Fall Semester		
ANS 230 & ANS 231	Animal Nutrition and Animal Nutrition Lab	4
PY 131	Conceptual Physics	4
Business/Economics Elective (p. 6)		3
Free Elective ²		3
Hours		14
Spring Semester		
CALs Group A, B, or C Electives (p. 6)		5
Business/Economics Elective (p. 6)		3
Animal Science Course (p. 4)		2

GEP Humanities (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/)	6	
Hours		16
Fourth Year		
Fall Semester		
ANS Animal Management Elective (p. 1)	3	
GEP Interdisciplinary Perspectives (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/)	5	
Free Elective ²	3	
CALS Group A, B, or C Elective (p. 6)	3	
Hours		14
Spring Semester		
ANS Discipline Course Elective (p. 3)	3	
ANS Animal Management Elective (p. 1)	3	
GEP US Diversity, Equity, and Inclusion (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-usdei/)	3	
Free Elective ²	2	
CALS Group A,B, or C Elective (p. 6)	3	
Hours		14
Total Hours		120

¹ ANS 150 Introduction to Animal Science, MA 107 Precalculus I, ENG 101 Academic Writing and Research, and CH 101 Chemistry - A Molecular Science must be completed with a grade of C-minus or higher, and the student should repeat the course in the semester following the initial attempt if less than a C-minus is earned.

² Students are encouraged to take an Ethics course as part of their Humanities, Additional Breadth, Interdisciplinary Perspectives, or Free electives.

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. All activities with live animals are IACUC (Institutional Animal Care and Use Committee) approved. Many lectures also incorporate animals or animal specimens into the course.