PRECISION AGRICULTURE MINOR

Description
The precision agriculture minor is for students who desire an understanding of how remote-sensing and geographic information system (GIS) techniques can be applied in the context of site-specific crop management. It will support the IANR strategic plan priority focused on sustainable food, fiber, and natural resource systems that support a bio-based economy. The minor will also provide an opportunity for students to receive documented, in-depth training regarding sensing systems and the integration and analysis techniques of geospatial information for crop management at the sub-field level.

College Requirements

College Admission
Requirements for admission into the College of Agricultural Sciences and Natural Resources (CASNR) are consistent with general University admission requirements (one unit equals one high school year): 4 units of English, 4 units of mathematics, 3 units of natural sciences, 3 units of social studies, and 2 units of foreign language. Students must also meet performance requirements (ACT composite of 20 or higher OR combined SAT score of 950 or higher OR rank in the top one-half of graduating class; transfer students must have a 2.0 (on a 4.0 scale) cumulative grade point average and 2.0 on the most recent term of attendance. For students entering the PGA Golf Management degree program, a certified golf handicap of 12 or better (e.g., USGA handicap card) or written ability (MS Word file) equivalent to a 12 or better handicap by a PGA professional or high school golf coach is required. For more information, please visit: http://pgm.unl.edu/requirements.

Admission Deficiencies/Removal of Deficiencies
Students who are admitted to CASNR with core course deficiencies must remove these deficiencies within the first 30 credit hours at the University of Nebraska–Lincoln, or within the first calendar year at Nebraska, whichever takes longer, excluding foreign languages. Students have up to 60 credit hours to remove foreign language deficiencies. College-level coursework taken to remove deficiencies may be used to meet degree requirements in CASNR.

Deficiencies in the required entrance subjects can be removed by completion of specified courses in the University or by correspondence.

The Office of Admissions, Alexander Building (south entrance), City Campus, provides information to new students on how deficiencies can be removed.

College Degree Requirements

Curriculum Requirements
The curriculum requirements of the College consist of three areas: ACE (Achievement-Centered Education); College of Agricultural Sciences and Natural Resources Core; and Degree Program requirements and electives. All three areas of the College Curriculum Requirements are incorporated within the description of the Major/Degree Program sections of the catalog. The individual major/degree program listings of classes insures that a student will meet the minimum curriculum requirements of the College.

Foreign Languages/Language Requirement
Two units of a foreign language are required. This requirement is usually met with two years of high school language.

Minimum Hours Required for Graduation
The College grants the bachelors degree in programs associated with agricultural sciences, natural resources and related programs. Students working toward a degree must earn at least 120 semester hours of credit. A minimum cumulative grade point average of C (2.0 on a 4.0 scale) must be maintained throughout the course of studies and is required for graduation. Some degree programs have a higher cumulative grade point average required for graduation. Please check the degree program on its graduation cumulative grade point average.

Grade Rules

Removal of C-, D and F Grades
Only the most recent letter grade received in a given course will be used in computing a student’s cumulative grade point average if the student has completed the course more than once and previously received a grade or grades below C in that course.

The previous grade (or grades) will not be used in the computation of the cumulative grade point average, but it will remain a part of the academic record and will appear on any transcript.

A student can remove from his/her cumulative average a course grade of C-, D+, D, D- or F if the student repeats the same course at the University of Nebraska and receives a grade other than P (pass), I (incomplete), N (no pass), W (withdraw), or NR (no report). If a course is no longer being offered, it is not eligible for the revised grade point average computation process.

For complete procedures and regulations, see the Office of the University Registrar website at http://www.unl.edu/regrec/course-repeats.

Pass/No Pass
Students in CASNR may take any course offered on a Pass/No Pass basis within the 24-hour limitation established by the Faculty Senate. However, a department may specify that the Pass/No Pass status of its courses be limited to non-majors or may choose to offer some courses for letter grades only.

GPA Requirements
A minimum cumulative grade point average of C (2.0 on a 4.0 scale) must be maintained throughout the course of studies and is required for graduation. Some degree programs have a higher cumulative grade point average required for graduation. Please check the degree program on its graduation cumulative grade point average.

Transfer Credit Rules
To be considered for admission, a transfer student, Nebraska resident or nonresident, must have an accumulated average of C (2.0 on a 4.0 scale) and a minimum C average in the last semester of attendance at another college. Transfer students who have completed less than 12 credit hours of college study must submit either ACT or SAT scores.

Ordinarily, credits earned at an accredited college are accepted by the University. The College, however, will evaluate all hours submitted on an application for transfer and reserves the right to accept or reject any of them. Sixty (60) is the maximum number of hours the University will accept on transfer from a two-year college. Ninety (90) is the maximum number of hours the University will accept from a four-year college. Transfer credit in the degree program must be approved by
the degree program advisor on a Request for Substitution Form to meet specific course requirements, group requirements, or course level requirements in the major. At least 9 hours in the major field, including the capstone course, must be completed at the University of Nebraska–Lincoln regardless of the number of hours transferred.

The College will accept no more than 10 semester hours of C, D+, D and D- grades from other schools. The C, D+, D and D- grades can only be applied to free electives. This policy does not apply to the transfer of grades from UNO or UNK to the University of Nebraska–Lincoln.

Joint Academic Transfer Programs
The College of Agricultural Sciences and Natural Resources has agreements with many institutions to support joint academic programs. The transfer programs include dual degree programs and cooperative degree programs. Dual degree programs offer students the opportunity to receive a degree from a participating institution and also to complete requirements for a bachelor of science degree in CASNR. Cooperative programs result in a single degree from either the University of Nebraska–Lincoln or the cooperating institution.

Dual Degree Programs
A to B Programs
The A to B Program, a joint academic program offered by the CASNR and participating community colleges, allows students to complete the first two years of a degree program at the participating community college and continue their education and study in a degree program leading toward a bachelor of science degree.

The A to B Program provides a basic knowledge plus specialized coursework. Students transfer into CASNR with junior standing.

Depending on the community college, students enrolled in the A to B Program may complete the requirements for an associate of science degree at the community college, transfer to the University of Nebraska–Lincoln, and work toward a bachelor of science degree.

Participating community colleges include:
- Central Community College
- Metropolitan Community College
- Mid-Plains Community College
- Nebraska College of Technical Agriculture
- Northeast Community College
- Southeast Community College
- Western Nebraska Community College

3+2 Programs
Two specialized degree programs in animal science and veterinary science are offered jointly with an accredited college or school of veterinary medicine. These two programs permit CASNR animal science or veterinary science students to receive a bachelor of science degree from the University of Nebraska–Lincoln with a degree in animal science or veterinary science after successfully completing two years of the professional curriculum in veterinary medicine at an accredited veterinary school. Students who successfully complete the 3+2 Program, must complete the Application for Degree form and provide transcripts to the Credentials Clerk, Office of the University Registrar, 107 Canfield Administration Building. Students should discuss these degree programs with their academic advisor.

Cooperative Degree Programs
Academic credit from the University and a cooperating institution is applied towards a four-year degree from either the University of Nebraska–Lincoln (University degree-granting program) or the cooperating institution (non University degree-granting program). All have approved programs of study.

UNL Degree-Granting Programs
A University of Nebraska–Lincoln degree-granting program is designed to provide students the opportunity to complete a two-year program of study at one of the four-year institutions listed below, transfer to CASNR and complete the requirements for a bachelor of science degree.

Chadron State College. Chadron State College offers a 2+2 program leading to a grassland ecology and management degree program and a transfer program leading to a bachelor of science in agricultural education in the teaching option.

Wayne State College. Wayne State College offers a 3+1 program leading to a bachelor of science in plant biology in the ecology and management option.

University of Nebraska at Kearney. Transfer programs are available for students pursuing degree programs leading to a bachelor of science degree.

University of Nebraska at Omaha. The University of Nebraska at Omaha (UNO) cooperates with CASNR in providing four-semester pre-agricultural sciences, pre-natural resources, pre-food science and technology, pre-horticulture and pre-turfgrass and landscape management transfer programs.

A student enrolled in these programs may transfer all satisfactorily completed academic credits identified in the suggested program of study, and enter CASNR to study toward a degree program leading to a bachelor of science degree. The total program would require a minimum of four years or eight semesters (16 credit hours/semester or 120 credit hours).

Nebraska CASNR faculty teach horticulture and food science and technology courses at UNO to assist an urban population in better understanding the food processing, horticulture, and landscape horticulture industries.

For more information, contact the CASNR Dean's Office, 800-472-8800, ext. 2541.

Non University of Nebraska–Lincoln Degree-Granting Programs
CASNR cooperates with other institutions to provide coursework that is applied towards a degree at the cooperating institution. Pre-professional programs offered by CASNR allow students to complete the first two or three years of a degree program at the University prior to transferring and completing a degree at the cooperating institution.

Chadron State College–Range Science. The 3+1 Program in range science allows Chadron State College students to pursue a range science degree through Chadron State College. Students complete three years of coursework at Chadron State College and one year of specialized range science coursework (32 credit hours) at CASNR.

Dordt College (Iowa)–Agricultural Education: Teaching Option. This program allows students to pursue an Agricultural Education Teaching Option degree leading toward a bachelor of science in agricultural education. Students at Dordt College will complete 90 credit hours in the Agricultural Education: Teaching Option Transfer Program.
Residency
Students must complete at least 30 of the total hours for their degree using University of Nebraska–Lincoln credits. At least 18 of the 30 credit hours must be in courses offered through CASNR\(^1\) (>299) including the appropriate ACE 10 degree requirement or an approved ACE 10 substitution offered through another Nebraska college and excluding independent study regardless of the number of hours transferred. Credit earned during education abroad may be used toward the residency requirement if students register through UNL and participate in prior-approved education abroad programs. University of Nebraska–Lincoln open enrollment and summer independent study courses count toward residence.

\(^1\) Includes courses taught by CASNR faculty through interdisciplinary prefixes (e.g., LIFE, MBIQ, ENVR, SCIL, EAEP, HRTM, ENSC) and CASNR crosslisted courses taught by non-CASNR faculty.

Online and Distance Education
There are many opportunities to earn college credit online through the University of Nebraska–Lincoln. Some of these credits may be applicable not only as elective credits, but also toward the fulfillment of the College's education requirements. Credits earned online may count toward residency. However, certain offerings may not be counted toward scholarship requirements or academic recognition criteria.

For further information, contact:
Office of Online and Distance Education
University of Nebraska–Lincoln
305 Brace Labs
Lincoln, NE 68588-0109
402-472-4681
http://online.unl.edu/

Independent Study Rules
Students wishing to take part in independent studies must obtain permission; complete and sign a contract form; and furnish copies of the contract to the instructor, advisor, departmental office, and the Dean’s Office. The contract should be completed before registration. Forms are available in 103 Agricultural Hall or online at the CASNR website.

Independent study projects include research, literature review or extension of coursework under supervision and evaluation of a departmental faculty member.

Students may only count 12 hours of independent study toward their degrees and no more than 6 hours can be counted during their last 36 hours earned, excluding senior thesis, internships, and courses taught under an independent study number.

Other College Degree Requirements
Capstone Course Requirement
A capstone course is required for each CASNR degree program. A capstone course is defined as a course in which students are required to integrate diverse bodies of knowledge to solve a problem or formulate a policy of societal importance.

ACE Requirements
All students must fulfill the Achievement Centered Education (ACE) requirements. Information about the ACE program may be viewed at ace.unl.edu (https://ace.unl.edu).

The minimum requirements of CASNR reflect the common core of courses that apply to students pursuing degrees in the college. Students should work with an advisor to satisfy ACE outcomes 1, 2, 3, 4, 6 and 10 with the college requirements.

Catalog Rule
Students must fulfill the requirements stated in the catalog for the academic year in which they are first admitted to the University of Nebraska–Lincoln or when they were first admitted to a Joint Academic Transfer Program. In consultation with advisors, a student may choose to follow a subsequent catalog for any academic year in which they are admitted to and enrolled as a degree-seeking student at Nebraska in the College of Agricultural Sciences and Natural Resources. Students must complete all degree requirements from a single catalog year. The catalog which a student follows for degree requirements may not be more than 10 years old at the time of graduation.

Requirements for Minor Offered by Department
A minor in precision agriculture will include a minimum of 14 credit hours; including three core courses and one elective, all at the 400 level.

Required Courses
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGEN 431 / AGRO 431 / MSYM 431</td>
<td>Site-specific Crop Management</td>
<td>3</td>
</tr>
<tr>
<td>NRES 412 / GEOG 412</td>
<td>Introduction to Geographic Information</td>
<td>4</td>
</tr>
<tr>
<td>NRES 418 / GEOG 418</td>
<td>Introduction to Remote Sensing</td>
<td>4</td>
</tr>
<tr>
<td>Credit Hours Subtotal:</td>
<td></td>
<td>11</td>
</tr>
</tbody>
</table>

Elective Courses
Choose one of the following: 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRES 420 / AGRO 419 / GEOG 419 / GEOL 419</td>
<td>Applications of Remote Sensing in Agriculture and Natural Resources</td>
</tr>
<tr>
<td>NRES 421 / GEOG 421</td>
<td>Field Techniques in Remote Sensing</td>
</tr>
<tr>
<td>MSYM 416</td>
<td>Sensors and Control Systems for Agri-Industries</td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 3

Total Credit Hours: 14

NRES 101 Natural Resources Orientation
Description: Introduction to natural resource disciplines. Fisheries, wildlife, forestry, grasslands, climate, and water science. Participate in field exercises in terrestrial and aquatic ecosystems.

Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB
Offered: FALL
NRES 103 Introduction to Agricultural and Natural Resource Systems
Crosslisted with: AGRI 103
Description: Agricultural and natural resource systems. The interrelationship and the impact of increased human involvement on these systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: FALL

NRES 104 Climate in Crisis
Description: Past, present and future climate change. Climate science basics in the context of global changes (such as global warming, droughts, deforestation) that impact Earth and its inhabitants. Future climate change scenarios and possible impacts.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 9 Global/Diversity

NRES 107 Invasive Plant Species: Impacts on Ecosystems
Crosslisted with: AGRO 107
Notes: Online only
Description: The flora of the earth is constantly being re-distributed by natural and human forces. As plant species change locations, they affect ecosystems, but how? In this course, students will learn how invasive plants establish and spread in ecosystems and develop an understanding of the importance of invasive plants and their impacts on ecosystems from local to global scales.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 9 Global/Diversity

NRES 108 Earth’s Natural Resource Systems Laboratory
Description: Introduction to Earth’s natural resource systems. Interactions between the geosphere (solid earth) and the hydrosphere. The atmosphere and biosphere over many different spatial and temporal scales, and role of humans as part of the system.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LAB
ACE: ACE 4 Science

NRES 109 Water in Society
Crosslisted with: SCIL 109, AECN 109, ENV 109, GEOG 109
Description: Introduction to the scientific, social, and economic dimensions of historical and contemporary water systems. Students will develop an understanding of hydrologic systems and analyze and engage in decision-making about complex challenges associated with water resource use.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: FALL
Prerequisite for: SCIL 300
ACE: ACE 4 Science ACE 8 Civic/Ethics/Stewardship

NRES 111 Natural Resource Conservation in Society
Description: Explore and distinguish the values, civics, and stewardship of natural resource conservation in agricultural and natural ecosystems. Examine the philosophies of ecosystem services and stewardship within a dynamic human dominated world. Students will discuss and critically analyze current issues related to conservation of natural resources.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: SCIL 300

NRES 130 People of Great Plains
Description: The Great Plains region offers considerable ecological and cultural diversity, encompassing more than 600 million acres which have been occupied by humans for over 12,000 years. Introduction to the different populations who have called the Great Plains home, and how they have made a living on this landscape. Investigate Native American life ways in the Great Plains from the time of initial colonization up to European contact and the dramatic changes experienced during the historic era. Select topics centered on contemporary socio-ecological systems on the Plains and how understanding of past Plains experiences can be used to inform on these contemporary issues.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 5 Humanities

NRES 163 Oh My Cod: Exploring Aquatic Ecology Careers
Prerequisites: Limited to Freshman or Sophomore classification only
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC

NRES 170 Introduction to Great Plains Studies
Crosslisted with: ANTH 170, GEOG 170, GPSP 170, SOCI 170
Description: Interdisciplinary study of the natural environment, social environment, human heritage, arts and humanities of the Great Plains.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Groups: Regional Geography

NRES 201 Dendrology: Study and Identification of Trees and Shrubs
Crosslisted with: HORT 201
Description: An introduction to the naming, identification, and natural history of woody trees and shrubs in North America with emphasis on trees common to Nebraska. Covers morphology, natural site conditions, wildlife and human uses of woody trees and shrubs.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: FALL
NRES 208 Applied Climate Sciences
Description: Role of the atmosphere in the natural resource system. Solar radiation, water, wind and energy, hazards and risk in the plant-soil atmosphere system. Role of weather and climate in crop zones, land use, and wildlife habitat.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 210 Applied Ornithology
Description: To explore interactions between birds and people from economic and scientific perspectives, understand societal conflicts between feral cats and birds, hazards birds present to aircraft, the economics of bird feeding, how commercial bird hunting clubs work, how populations are affected by collisions with vehicles, windows and towers, the taxidermy industry and museum science, and hunting organizations such as Pheasants Forever and Ducks Unlimited.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB
Offered: SPRING

NRES 211 Introduction to Conservation Biology
Prerequisites: Sophomore standing.
Description: Introduction to problems faced in fulfilling the ever increasing human needs while maintaining ecosystem and biodiversity. The integration of biological fields such as wildlife biology, ecology, evolution, and genetics with non-biological fields such as economics, philosophy, and politics to the dilemma this presents.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 212 Landscape Plants I
Crosslisted with: HORT 212, LARC 212
Prerequisites: HORT 131
Notes: Requires Saturday off-campus field trips.
Description: Identification using botanical and common names for herbaceous annuals, perennials, grasses, ground covers, vines, trees, and shrubs commonly found in Great Plains gardens, parks, and landscapes is stressed through field visits.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ARCH 467, ARCH 567, ARCH 867, LARC 467, HORT 467; HORT 213, NRES 213, LARC 213

NRES 213 Landscape Plants II
Crosslisted with: HORT 213, LARC 213
Prerequisites: HORT/LARC/NRES 212.
Notes: Continuation of HORT/LARC/NRES 212.
Description: Site requirements, landscape use, natural history, and specific needs of herbaceous ornamentals, grasses, ground covers, vines, trees, and shrubs commonly found in Great Plains gardens, parks, and landscapes. Common cultivars and additional species not covered in HORT/LARC/NRES 212.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 214 Herbaceous Landscape Plants
Crosslisted with: HORT 214
Description: Identification of herbaceous plants with ornamental value in the landscape including native and introduced annuals, perennials, grasses and cultivars. Typical ecological associations, environmental tolerances and/or intolerance, cultural requirements, and design characteristics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 220 Principles of Ecology
Prerequisites: LIFE 121 or BIOS 101 or HORT 131; 3 hours MATH.
Notes: Not open to students who have completed BIOS 207. Will not count toward a major in BIOS.
Description: Ecology as a quantitative discipline that integrates the life and earth sciences to understand the dynamics of natural and managed ecosystems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: BIOS 459, BIOS 859, NRES 459, NRES 859, WATS 459; LARC 487, NRES 487; NRES 222, NRES 311; NRES 862, NRES 462

NRES 222 Ecology Laboratory
Prerequisites: NRES 220 or parallel.
Notes: May also be offered at Cedar Point Biological Station. Field trips to local ecosystems are required.
Description: Field and laboratory experiments in terrestrial and aquatic ecology.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB
Prerequisite for: NRES 862, NRES 462; WATS 481, WATS 881, BIOS 481, NRES 481

NRES 233 Wildlife Field Techniques
Prerequisites: Sophomore status.
Notes: Offered off-campus during academic breaks at Cedar Point Biological Station. Course fee applies.
Description: Field and laboratory skills needed for wildlife management emphasizing wildlife and vegetation surveys, mark-recapture of wildlife, radio-telemetry, aging and forensic methods, and habitat assessment.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB
NRES 245 Introduction to Grassland Ecology and Management
Crosslisted with: AGRO 245
Prerequisites: AGRO 153
Description: Grassland ecology and management is relevant to students with education and career goals in managing natural resources in Nebraska and the Great Plains. About 50% of the land area in Nebraska is classified as grassland (or rangeland) and is the land type with the most opportunity for enhancing biodiversity and wildlife habitat. Applying ecological principles and social values to managing rangeland resources, students will develop a knowledge and appreciation for the various grassland management uses and techniques available to resource managers.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 249 Individual and Cultural Perspectives on the Environment
Crosslisted with: ENVR 249
Description: The influence of culture on individual perspectives related to the concepts of sustainability and the relationship that humans have with the environment. The role of ethics, religion, and historical setting on the individual and cultural perspectives related to environmental challenges at the local to global scales.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 9 Global/Diversity

NRES 270 Biological Invaders
Crosslisted with: AGRO 270, HORT 270, PLPT 270
Prerequisites: 3 hrs biological sciences.
Description: Impact of exotic species and invasive organisms: agricultural and medical emerging disease; predicting biological invasions; biological control; regulatory, monitoring, and control efforts; ecological impact.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 279 Biological Invaders
Crosslisted with: AGRO 279, SOIL 279
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 3
Format: LEC

NRES 281 Introduction to Water Science
Crosslisted with: GEOG 281, WATS 281
Prerequisites: High school chemistry or one semester college chemistry; one course in geology or physical geography or soil.
Description: Survey of the water science from the perspective of both natural and social sciences. Water budget, precipitation, evapotranspiration, runoff and stream flow, groundwater, water quality parameters, economics of water, water policy, water law and water politics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: NRES 319
Groups: Physical Geography

NRES 289 People and the Land: Human Environmental Interactions on the Great Plains
Crosslisted with: GEOG 289
Description: Explore human environmental interaction on the Great Plains. Samples a variety of Great Plains cultures and time periods to explore past use of the Great Plains environment. Evaluation of attributes and related data critical to the operation of past social-ecological systems with reference to changing climatic/ecological dynamics, human environmental impacts, and the sustainability of various indigenous and western modes of land use on the Great Plains. Investigate knowledge of these processes and how they can be of relevance to contemporary issues of Great Plains land management and resource utilization.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 6 Social Science ACE 5 Humanities

NRES 299 Special Topics
Prerequisites: Permission.
Description: Special topics in natural resources.
Credit Hours: 1-4
Min credits per semester: 1
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

NRES 300 Toxins in the Environment
Crosslisted with: BIOS 300, ENTO 300
Prerequisites: One semester BIOS and one semester CHEM
Description: Introduction to the principles of toxicology as they apply to environmental contaminants, agri-chemicals, and industrial and naturally occurring chemicals.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 301 Environmental Communication Skills
Prerequisites: ACE 1 course. Sophomore or higher.
Description: Written and oral communication skills for natural resource management including writing for the media, grant writing, conflict resolution and advocacy.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: FALL
ACE: ACE 2 Communication Competence

NRES 302 Tree Biology
Crosslisted with: HORT 302
Prerequisites: BIOS 101, LIFE 120, HORT 131
Description: The study of the structure and function of woody plants, with a focus on trees growing in temperate climates. Covers the basics of tree physiology in terms of the biological, physical, and chemical processes utilized by tree to function. The anatomy and morphology of trees with a focus on the impacts of tree maintenance to the structure and function of landscape trees.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: FALL
### NRES 308 Biogeography
**Crosslisted with:** GEOG 308, GEOL 308  
**Prerequisites:** GEOG 155 or BIOS 101 and 101L or GEOL 101.  
**Notes:** Biogeography is a highly interdisciplinary science, relying heavily on ecology, geological science, and climatology. It is global in scope and offers the latest knowledge in understanding organism distributions, and the factors that determine those distributions.  
**Description:** Introduction to the basic concepts of biogeography, the study of distributions of plants and animals, both past and present.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**Groups:** Physical Geography

### NRES 310 Introduction to Forest Management
**Prerequisites:** BIOS 101, AGRO/HORT 131 or LIFE 120  
**Description:** Discussion of the history, biology, and management of the world's forest resources with emphasis on the Great Plains region. Topics include: forest types and their relationship to site conditions, ecological principles of forest management, basic forest management practices, economic and policy decisions in forest management. The field-oriented lab emphasizes tree identification, forest ecology, forest management and wood products.  
**Credit Hours:** 4  
**Max credits per semester:** 4  
**Max credits per degree:** 4  
**Format:** LEC  
**Offered:** FALL

### NRES 311 Wildlife Ecology and Management
**Prerequisites:** NRES 220 or BIOS 207, or concurrent with NRES 220 or BIOS 207.  
**Description:** Applied ecology, conservation biology, population biology, and enhancement of vertebrate, non-domestic animal populations through management. Emphasis on policy, decision-making, and management options involving people, habitat, and wildlife.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**Offered:** SPRING

### NRES 312 Introduction to Geospatial Information Sciences
**Crosslisted with:** GEOG 312  
**Prerequisites:** Junior standing; basic computer skills (spreadsheets, word processors, data and file management).  
**Description:** Introduction to the theory and applications of geospatial information technology. Remote sensing, GPS data collection, GIS data types, editing GIS data, and spatial data analysis with emphasis on applications to natural resources using a problem-based learning format.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**Groups:** Techniques

### NRES 315 Human Dimensions of Fish and Wildlife Management
**Description:** Introduction to the basic concepts and ideas relevant in the human dimension of fisheries and wildlife management. Covers social, cultural and economic values, attitudes and behavior of individuals and groups of various stakeholders in fisheries and wildlife management.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

### NRES 316 Case Studies in Theoretical Ecology
**Crosslisted with:** BIOS 316, MATH 316  
**Prerequisites:** MATH 106 or higher OR LIFE 121. Parallel registration in BIOS 316L.  
**Description:** Introduction to biological literature, applied mathematics, computer programming, and/or statistical techniques relevant to field questions in ecology, evolution, and behavior. Typical mathematical topics include discrete dynamics, systems of differential equations, matrix algebra, or statistical inference and probability.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**ACE:** ACE 4 Science  
**Groups:** Advanced Mathematics Courses

### NRES 319 Fundamentals of Environmental Sampling Laboratory
**Prerequisites:** SOIL 153, WATS 281, CHEM 105 or 109. Recommend taking STAT 218.  
**Description:** Development of sampling plans and quality assurance project plans (QAPP). Stepwise procedures for correct sampling of soil-air-water environments. Data quality assessment.  
**Credit Hours:** 2  
**Max credits per semester:** 2  
**Max credits per degree:** 2  
**Format:** LEC  
**Prerequisite for:** NRES 320

### NRES 320 Fundamentals of Environmental Sampling
**Prerequisites:** NRES 319 or concurrent enrollment  
**Notes:** Outdoor and analytical laboratory field trips required.  
**Description:** Demonstrations and hands on participation in sampling of soil-air-water environments.  
**Credit Hours:** 1  
**Max credits per semester:** 1  
**Max credits per degree:** 1  
**Format:** LAB

### NRES 321 Arboriculture: Maintenance & Selection of Landscape Trees
**Crosslisted with:** HORT 321  
**Prerequisites:** Junior standing  
**Description:** Covers practical application of the science of tree growth, development, and management in human dominated landscapes. Tree selection for varying landscapes and objectives, proper planting and pruning, identification and correction of tree defects, and working with tree pest issues.  
**Credit Hours:** 4  
**Max credits per semester:** 4  
**Max credits per degree:** 4  
**Format:** LEC  
**Offered:** SPRING  
**Groups:** Laboratory and Field Training
NRES 322 Environmental Education Curricula
Description: National curricula are available to formal and non-formal environmental and STEM (science, technology, engineering, and math) educators. Become certified in a series of national environmental education curricula such as Project WILD, Project WET, Project Aquatic WILD and Project Learning Tree. Apply skills and curricula by teaching others through experiential service learning.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: FALL/SPR

NRES 323 Natural Resources Policy
Prerequisites: Junior standing.
Description: Conflicts and common ground perpetuated by increasing demands on our natural resources. Policy development and issue analysis stressed. Historical policy actions reviewed and evaluated.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 330 Environmental Health
Crosslisted with: NUTR 330
Prerequisites: Class standing of sophomore or above with at least one semester of chemistry and biology.
Description: Provides a comprehensive understanding of how environmental exposures to physical, chemical and biological hazards influence human health. Offers basic knowledge in the core concepts of toxicology, exposure and risk, vulnerable populations and the interrelationship between human, animal and environmental health.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: FALL/SPR
ACE: ACE 8 Civic/Ethics/Stewardship

NRES 348 Wildlife Damage Management
Description: Fundamentals of prevention and control of damage caused by vertebrate pests, principally birds and mammals. Philosophical, ecological, and behavioral basis for controlling population levels or individuals of pest species.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 361 Soils, Environment and Water Quality
Crosslisted with: AGRO 361, GEOL 361, SOIL 361, WATS 361
Prerequisites: AGRO/HORT/SOIL 153; MATH 102 or 103; two semesters chemistry (CHEM 105, 106 or CHEM 109,110) and WATS/GEOG/NRES 281
Description: Chemical and physical processes that influence the fate and transport of contaminants (inorganic, organic, microbial) in soil-water environments. Extent, fate, mitigation and impact of various sources of pollution. Remedial technologies used for environmental restoration of contaminated environments.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: AGRO 458, AGRO 858, NRES 458, NRES 858, SOIL 458

NRES 370 Basic and Applied Climatology
Crosslisted with: METR 370
Prerequisites: METR 100.
Description: Processes that give rise to spatial and temporal differences in climate. Various interrelationships between humans and climate. Influence of climate on building styles, the economy, water resources, human health, and society. Humans’ inadvertent and purposeful modification of the atmosphere.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 380 Geography of Africa
Crosslisted with: GEOG 380, ETHN 380
Description: Overview of the major physical and human landscapes in Africa. Prominent past and current events will be placed into a spatial context in an attempt to develop insight into the interrelationships that exist among people, cultures, countries, economies, and the environment, not only within Africa, but between Africa and the rest of the world.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 9 Global/Diversity
Groups: Regional Geography

NRES 386 Vertebrate Zoology
Crosslisted with: BIOS 386
Prerequisites: LIFE 121 & LIFE 121L
Description: Evolutionary origin and relationships, natural history, and ecological adaptations of vertebrates. Comparative form and function, particularly of bone and muscle systems among the diversity within vertebrate groups.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

NRES 388 Employment Seminar
Crosslisted with: AGRI 388
Prerequisites: Sophomore standing.
Description: Efficient job-hunting. Resumes, cover letters, mock interviews, and dining etiquette.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC
Prerequisite for: AGRI 395
NRES 393 Digital Imaging and Storytelling in Agriculture and Natural Resources
Crosslisted with: ALEC 393
Prerequisites: Consent of instructor(s). One college level course in photography or equivalent, and knowledge of the basics of shooting still photographs or video using digital cameras. Open only to College of Agricultural Sciences and Natural Resources students.
Notes: Can be repeated for a maximum of 9 credit hours by consent of instructor.
Description: Concepts and techniques related to use of remote and automated digital camera technology to capture images in agriculture and natural resource contexts to communicate a narrative/story. Completion of individual project using a variety of technologies including camera traps, time-lapse camera systems, remote triggered cameras, as well as traditional audio and video and conventional photography.
Credit Hours: 1-9
Min credits per semester: 1
Max credits per semester: 9
Max credits per degree: 9
Format: LAB

NRES 399 Independent Research
Prerequisites: 8 hrs NRES or closely related areas.
Notes: To be supervised and evaluated by a NRES faculty member.
Description: Research, literature review, or extension of course work.
Credit Hours: 1-5
Min credits per semester: 1
Max credits per semester: 5
Max credits per degree: 6
Format: IND

NRES 402 Aquatic Insects
Crosslisted with: BIOS 485, BIOS 885, ENTO 402, ENTO 802, NRES 802
Prerequisites: 12 hrs biological sciences.
Description: Biology and ecology of aquatic insects.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LEC
Prerequisite for: BIOS 485L, BIOS 885L, ENTO 402L, ENTO 802L, NRES 402L, NRES 802L

NRES 402L Identification of Aquatic Insects
Crosslisted with: BIOS 485L, BIOS 885L, ENTO 402L, ENTO 802L, NRES 802L
Prerequisites: Parallel ENTO 802, NRES 402/802, BIOS 485/885.
Description: Identification of aquatic insects to the family level.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB

NRES 404 Forestry, Fisheries and Wildlife Seminar
Prerequisites: Junior standing or above in natural resources.
Description: Seminar involving technical aspects of forestry, fisheries, and wildlife management.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 2
Format: LEC

NRES 412 Introduction to Geographic Information Systems
Crosslisted with: GEOG 412, GEOG 812, NRES 812
Description: Introduction to conceptual foundations and applications of computer-based geographic information systems (GIS). GIS database development, spatial data analysis, spatial modeling, GIS implementation and administration.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: GEOG 422, GEOG 822; GEOG 432, GEOG 832; GEOG 922, NRES 922
Groups: Techniques
NRES 413 Environmental Leadership
Crosslisted with: ALEC 410, ALEC 810, NRES 813
Prerequisites: Junior standing.
Notes: Offered on the World Wide Web (WWW) fall semester of odd-numbered years and in the classroom fall semester of even numbered-years.
Description: Major leaders in conservation and ecology that emphasizes agricultural and cultural issues and relationships with the environment.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 417 Agroforestry Systems in Sustainable Agriculture
Crosslisted with: HORT 418, HORT 818, NRES 817
Prerequisites: 12 hours biological or agricultural sciences.
Description: The roles of woody plants in sustainable agricultural systems of temperate regions. Emphasis on the ecological and economic benefits of trees and shrubs in the agricultural landscape. Topics include: habitat diversity and biological control; shelterbelts structure, function, benefits and design; intercropping systems; silvopastoral systems; riparian systems; and production of timber and specialty crops. Comparison of temperate agroforestry systems to those of tropical areas.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 418 Introduction to Remote Sensing
Crosslisted with: GEOG 418, GEOG 818, NRES 818
Prerequisites: 9 hours of GEOL, NRES or GEOG.
Notes: Advanced standing in geography, natural resources, environmental sciences, engineering or agronomy recommended.
Description: Introduction to remote sensing of the earth from aerial and satellite platforms. Aerial photography, multispectral scanning, thermal imaging and microwave remote sensing techniques. Physical foundations of remote sensing using electromagnetic energy, energy-matter interactions, techniques employed in data acquisition and methods of image analysis. Weekly laboratory provides practical experience in visual and digital interpretation of aerial photography, satellite imagery, thermal and radar imagery. Applications in geographic, agricultural, environmental and natural resources analyses.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

NRES 419 Chemistry of Natural Waters
Crosslisted with: GEOL 418, GEOL 818, NRES 819, WATS 418
Prerequisites: CHEM 109 and 110, 113 and 114, or CHEM 111.
Description: Principles of water chemistry and their use in precipitation, surface water, and groundwater studies. Groundwater applications used to determine the time and source of groundwater recharge, estimate groundwater residence time, identify aquifer mineralogy, examine the degree of mixing between waters of various sources and evaluate what types of biological and chemical processes have occurred during the water’s journey through the aquifer system.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 419L Chemistry of Natural Waters Laboratory
Crosslisted with: GEOL 418L, GEOL 818L, NRES 419L, NRES 819L, WATS 418L; GEOL 917, NRES 917

NRES 420 Applications of Remote Sensing in Agriculture and Natural Resources
Crosslisted with: AGRO 419, GEOG 419, GEOL 419, AGRO 819, GEOG 819, GEOL 819, NRES 820
Notes: GEOG 418/NRES 418 recommended
Description: Introduction to the practical uses of remote electromagnetic sensing in dealing with agricultural and water-resources issues.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Groups: Techniques

NRES 421 Field Techniques in Remote Sensing
Crosslisted with: GEOG 421, GEOG 821, NRES 821
Prerequisites: NRES 418/818
Description: Field techniques as they relate to remote-sensing campaigns. Research methods, systematic approaches to data collection, field spectroscopy, collecting ancillary information linked with spectroscopic data sets as well as aircraft or satellite missions and subsequent analyses of acquired data.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Groups: Techniques
NRES 422 Laboratory Earth: Earth's Changing Systems  
**Crosslisted with:** NRES 822  
**Description:** Fundamental concepts related to understanding Earth’s changing natural systems in the past, present, and the future. The cycling of matter and energy, the relationship between human activity and environmental change; and the consequence of these relationships.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

NRES 423 Integrated Resources Management  
**Crosslisted with:** NRES 823  
**Prerequisites:** Senior standing, natural resources or related major.  
**Description:** Integrated and multiple-use management. Economic, political, social, and physical impacts on natural resources management priorities.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

NRES 424 Forest Ecology  
**Crosslisted with:** NRES 824  
**Prerequisites:** NRES 220 or BIOS 207  
**Description:** The structure and function of forest ecosystems including their response to global change; emphasis on forest succession and disturbance regimes in order to understand the dynamics of forested landscapes.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  
Offered: SPRING

NRES 426 Invasive Plants  
**Crosslisted with:** AGRO 426, AGRO 826, HORT 426, HORT 826, NRES 826  
**Prerequisites:** AGRO/HORT/SOIL 153; AGRO/HORT 131  
**Description:** Identification, biology and ecology of weedy and invasive plants. Principles of invasive plant management by preventative, cultural, biological, mechanical and chemical means using an adaptive management framework. Herbicide terminology and classification, plant-herbicide and soil-herbicide interactions, equipment calibration and dosage calculations.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  
Offered: SPRING

NRES 427 Introduction to the Global Positioning System (GPS)  
**Crosslisted with:** GEOG 427, GEOG 827, NRES 827  
**Prerequisites:** Junior standing.  
**Notes:** Familiarity with mapping and GIS recommended.  
**Description:** Integrated lectures, lab exercises and field experience provide an understanding of GPS technology and applications. Students will learn to collect, correct and use GPS data in a geographic information system (GIS) environment.  
Credit Hours: 2  
Max credits per semester: 2  
Max credits per degree: 2  
Format: LEC

NRES 428 Leadership in Public Organizations  
**Crosslisted with:** ALEC 428, ALEC 828, NRES 828  
**Prerequisites:** Junior standing  
**Description:** Leadership in theories, research, and practices in public organizations and natural resource agencies.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

NRES 429A Food Security: A Global Perspective  
**Crosslisted with:** ANTH 429A, ANTH 829A, AGRO 429A, AGRO 829A, HORT 429A, HORT 829A, NRES 829A, NUTR 429A, NUTR 829A  
**Prerequisites:** Junior standing  
**Description:** Overview of the technical and sociocultural dimensions of global food insecurity.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

NRES 431 Waterfowl Ecology and Management  
**Crosslisted with:** NRES 831  
**Prerequisites:** NRES 311  
**Description:** Ecology and identification of North American waterfowl, management of habitats and populations, and current management issues.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

NRES 433 Wildlife Management Techniques  
**Crosslisted with:** NRES 833  
**Prerequisites:** NRES 311  
**Description:** Survey of methods used to obtain data and make decisions for wildlife management. Scientific methods for wildlife science; monitoring and surveys; construction of management plans; habitat use, classification, and management; harvest management.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  
ACE: ACE 10 Integrated Product

NRES 434 Environmental Education and Interpretation  
**Crosslisted with:** NRES 834, ENVR 434  
**Notes:** Requires 20 hours of service.  
**Description:** Examination of formal and informal environmental education and interpretation. Knowledge, application and practice relevant to science teachers and park, extension, museums, and zoo educators.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC
NRES 435 Agroecology
Crosslisted with: AGRO 435, AGRO 835, HORT 435, NRES 835
Prerequisites: For AGRO/HORT/NRES 435: Senior standing. For AGRO/ NRES 835: 12 hrs biological or agricultural sciences.
Description: Integration of principles of ecology, plant and animal sciences, crop protection, and rural landscape planning and management for sustainable agriculture. Includes natural and cultivated ecosystems, population and community ecology, nutrient cycling, pest management, hydrologic cycles, cropping and grazing systems, landscape ecology, biodiversity, and socioeconomic evaluation of systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 10 Integrated Product

NRES 436 Evolution of Cenozoic Mammals
Crosslisted with: GEOL 436, GEOL 836, NRES 836
Prerequisites: GEOL 103
Description: Survey of mammalian evolution with emphasis on the origin, radiation, and phylogenetic relationships of Cenozoic fossil mammals. Overview of climatic and ecological changes affecting mammalian adaptations and hands on experience with specimens.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: GEOL 835

NRES 438 Grassland Conservation: Planning and Management
Crosslisted with: NRES 838
Prerequisites: Introductory soils and introductory ecology
Description: Apply fundamental grassland ecology principles to grassland conservation and identify grassland establishment and management practices appropriate for different environmental and cultural situations. Based on field study, critically analyze management options and outcomes for several grasslands and develop a management plan for a grassland resource.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 10 Integrated Product

NRES 440 Great Plains Ecosystem
Crosslisted with: AGRO 440, AGRO 840, NRES 840, RNGE 440, GRAS 440
Prerequisites: Junior standing.
Notes: BIOS 101 and 101L, or equivalent, recommended.
Description: Characteristics of Great Plains ecosystems, interrelationships of ecological factors and processes, and their application in the management of grasslands. Interactions of fire, vegetation, grazing animals and wildlife.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: SPRING

NRES 441 Zoo Keeping and Management
Description: Examine and build on the knowledge, skills and abilities needed to work in a zoo in various capacities including animal keeping, guest services and curation. Acquire knowledge in all aspects needed to manage zoos including individual species care, collections, guest services, species conservation, and AZA accreditation. Become familiar with the concepts and challenges associated with the biological, educational, ethical, and administrative aspects of zoo science through partnerships and interactions with local zoos.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: FALL/SPR
ACE: ACE 10 Integrated Product

NRES 442 Wildland Plants
Crosslisted with: AGRO 442, AGRO 842, NRES 842, RNGE 442, GRAS 442
Prerequisites: Junior standing.
Notes: BIOS 101 and 101L, or equivalent, recommended.
Description: Wildland plants that are important to grassland and shrubland ecosystem management and production. Distribution, utilization, classification, identification (including identification by vegetative parts), uses by Native Americans, and recognition of grasses, forbs, shrubs, exotic and wetland plants.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 444 Ecosystem Monitoring and Assessment
Crosslisted with: AGRO 444, AGRO 844, NRES 844, RNGE 444, GRAS 444
Prerequisites: Junior standing.
Notes: NRES 220 or equivalent, recommended.
Description: Measurement and monitoring of the important vegetation and environmental factors used to develop management guidelines in grasslands, savannas, woodlands, and wetlands. Emphasis on using ecosystem monitoring protocols for assessment of wildlife habitat, fuels management for wild-land fire, livestock production, and watershed function. Requires field sampling and travel to local field sites.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 445 Human Remains in Forensic Science
Crosslisted with: FORS 445, FORS 845, NRES 845
Prerequisites: LIFE 120/L and LIFE 121/L, CHEM 109, CHEM 110, and FORS 120/L.
Description: Forensic anthropology within the broader context of forensic sciences and physical anthropology. Decomposition and bone modification through artificial means. Determination of individual identity, diet, chronic pathology and cause of death from human remains.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Offered: FALL
NRES 446 Pollen Analysis for Behavioral, Biological and Forensic Science
Crosslisted with: FORS 446, FORS 846, NRES 846
Prerequisites: BIOS 109 and FORS 120.
Description: Collection, processing, identification of common North American pollen types. Pollination ecology relating to scene reconstruction. Fundamental statistics and presentation requirements for a legal and scientific audience.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Offered: FALL

NRES 447 Archaeoparasitology: The Archaeology of Disease
Crosslisted with: NRES 847
Description: Study of parasites, their hosts, and the relationship between them. Human parasitology is especially interesting due to the adaptation of human populations to a great variety of parasites over long periods of time in the global diversity of environments. Fundamental understanding of human-parasite relations and methods of recovery of parasites from a variety of archaeological remains.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: FALL

NRES 448 Advanced Topics in Wildlife Damage Management
Crosslisted with: NRES 848
Prerequisites: NRES 348.
Description: Economic, global, and public policy issues relative to situations in which wildlife damage personal property or natural resources, threaten human health and safety, or are a nuisance. Demonstration and discussion of technological advances in fertility control, damage resistance, toxicology, behavioral modification, and biological management.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LEC
Offered: SPRING

NRES 450 Biology of Wildlife Populations
Crosslisted with: BIOS 450, BIOS 850, NRES 850
Prerequisites: NRES 311; MATH 104 or above; STAT 218 or equivalent Description: Principles of population dynamics. Management strategies (for consumptive and nonconsumptive fish and wildlife species) presented utilizing principles developed.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Offered: SPRING

NRES 451 Soils, Water, and Environmental Chemistry
Crosslisted with: ENVE 851, NRES 851
Prerequisites: NRES/WATS/SOIL/AGRO/GEOL 361 or graduate standing
Description: Environmental chemistry related to the fate and transport of organic contaminants in soil-water environments. Application of computer simulation models (i.e., MODFLOW) for predicting contaminant fate in aquifers. Basic chemical and biological principles of remediating contaminated soil and water.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Offered: SPRING
ACE: ACE 10 Integrated Product

NRES 452 Climate and Society
Crosslisted with: AGRO 450, GEOG 450, METR 450, AGRO 850, GEOG 850, METR 850, NRES 852
Prerequisites: Junior standing or above.
Notes: Offered spring semester of even-numbered calendar years.
Description: Impact of climate and extreme climatic events on society and societal responses to those events. Global in scope and interdisciplinary.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: SPRING
Groups: Physical Geography

NRES 453 Hydrology
Crosslisted with: NRES 853
Prerequisites: MATH 106
Notes: Not available for credit for engineering students and not a substitute for CIVE 456.
Description: Introduction to the principles of hydrology, with emphasis on the components of the hydrologic cycle: precipitation, evaporation, groundwater flow, surface runoff, infiltration, precipitation runoff relationships.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Pre requisite for: AGEN 957, BSEN 957, CIVE 957, GEOL 957

NRES 454 Ecological Interactions
Crosslisted with: BIOS 454, BIOS 854, NRES 854
Prerequisites: LIFE 121; LIFE 121L; BIOS 207 or NRES 220; Senior Standing
Description: Nature and characteristics of populations and communities. Interactions within and between populations in community structure and dynamics. Direct and indirect interactions and ecological processes, competition, predation, parasitism, herbivory, and pollination. Structure, functioning and persistence of natural communities, foodweb dynamics, succession, and biodiversity.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 10 Integrated Product
NRES 455 Soil Chemistry and Mineralogy
Crosslisted with: AGRO 455, AGRO 855, NRES 855, SOIL 455
Prerequisites: AGRO/HORT/SOIL 153 or GEOL 101; CHEM 109 and 110; CHEM 221 or 251; or equivalent.
Description: Chemical and mineralogical properties of soil components. Inorganic colloidal fraction. Structures of soil minerals as a means of understanding properties, such as ion exchange and equilibria; release and supply of nutrient and toxic materials; and soil acidity and alkalinity.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 456 Mathematical Models in Biology
Crosslisted with: BIOS 456, BIOS 856, NRES 856
Prerequisites: LIFE 120, LIFE 120L; LIFE 121; LIFE 121L; MATH 107
Description: Biological systems, from molecules to ecosystems, are analyzed using mathematical techniques. Strengths and weaknesses of mathematical approaches to biological questions. Brief review of college level math; introduction to modeling; oscillating systems in biology; randomness in biology; review of historically important and currently popular models in biology.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 457 Green Space and Urban Forestry Management
Crosslisted with: NRES 857, HORT 457
Prerequisites: Junior or senior standing, Graduate student or permission
Description: A focus on the management of trees, parks, and green infrastructure in rural and urban communities. Perspectives from community planning, landscape architecture, urban forestry, natural resources, horticulture, and environmental policy. Development and implementation of green space and forest management plans encompassing societal needs and biological limitations in rural and urban communities.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: SPRING
ACE: ACE 10 Integrated Product

NRES 458 Soil Physical Determinations
Crosslisted with: AGRO 458, AGRO 858, NRES 858, SOIL 458
Prerequisites: SOIL/AGRO/GEOL/WATS 361; PHYS 141 or equivalent; MATH 102 or 103.
Description: Survey of measurement techniques and principles used in characterizing the physical properties of soils. Includes analysis of experimental design and sources of experimental error. Techniques include: particle size analysis, soil water content, pore size analysis, field sampling techniques, soil strength, and saturated hydraulic conductivity.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LAB

NRES 459 Limnology
Crosslisted with: BIOS 459, BIOS 859, NRES 859, WATS 459
Prerequisites: 12 hrs BIOS, including BIOS/NRES 220/BIOS220x; two semesters CHEM.
Description: Physical, chemical, and biological processes that occur in fresh water. Organisms occurring in fresh water and their ecology; biological productivity of water and its causative factors; eutrophication and its effects.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: BIOS 866, NRES 866
ACE: ACE 10 Integrated Product

NRES 460 Soil Microbiology
Crosslisted with: AGRO 460, BIOS 460, SOIL 460, AGRO 860, BIOS 860, NRES 860
Prerequisites: One semester microbiology; one semester biochemistry or organic chemistry.
Description: Soil from a microbe's perspective-growth, activity and survival strategies; principles governing methods to study microorganisms and biochemical processes in soil; mechanisms controlling organic matter cycling and stabilization with reference to C, N, S, and P; microbial interactions with plants and animals; and agronomic and environmental applications of soil microorganisms.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 461 Soil Physics
Crosslisted with: AGRO 461, GEOL 461, SOIL 461, WATS 461, AGRO 861, GEOL 861, NRES 861
Prerequisites: AGRO/SOIL 153; PHYS 141 or equivalent, one semester of calculus.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 462 Conservation Biology
Crosslisted with: NRES 862
Prerequisites: 12 hours of biological sciences, including NRES 220 and NRES 222 or equivalent.
Description: Current issues in conservation biology. Theoretical principles from the areas of ecology and genetics to effectively preserve and manage biological diversity and small populations.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
NRES 463 Fisheries Science
Crosslisted with: NRES 863
Description: Fisheries biology emphasizing the determination and evaluation of vital statistics for the management of fish populations. Basis of specific management techniques. May also be offered at Cedar Point Biological Station.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: NRES 871
ACE: ACE 10 Integrated Product

NRES 463L Fisheries Science Lab
Crosslisted with: NRES 863L
Description: Field and laboratory skills needed for fisheries biology emphasizing the determination and evaluation of vital statistics for the management of fish populations. Applied data collection and fish sampling techniques will be used. May also be offered at Cedar Point Biological Station.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB

NRES 464 Fisheries Biology
Crosslisted with: BIOS 464, BIOS 864, NRES 864
Prerequisites: BIOS/NRES 489/889 or equivalent.
Description: Biology of fishes. Factors that affect fishes in the natural environment. Techniques used in the analysis and management of fish populations.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LAB

NRES 465 Soil Geomorphology and Paleopedology
Crosslisted with: GEOL 465, GEOL 865, NRES 865
Prerequisites: GEOL 450/850 and NRES 477/877.
Description: Soils and paleosols as evidence in reconstruction landscape evolution and paleoenvironments. Role of paleosols in stratigraphy.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 467 Global Climate Change
Crosslisted with: METR 483, METR 883, NRES 867
Prerequisites: Junior standing; and METR 475/875.
Notes: Offered fall semester of even-numbered calendar years.
Description: Elements of climate systems, El Nino/LaNina cycle and monsoons, natural variability of climate on interannual and interdecadal scales. Paleoclimate, and future climate, developed climate change scenarios and climate change impacts on natural resources and the environment.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 468 Wetlands
Crosslisted with: BIOS 458, NRES 868, WATS 468, BSEN 468, BSEN 868
Prerequisites: CHEM 109 and CHEM 110, or CHEM 105 and CHEM 106; Junior or Senior Standing.
Notes: Offered even-numbered calendar years.
Description: Physical, chemical and biological processes that occur in wetlands; the hydrology and soils of wetland systems; organisms occurring in wetlands and their ecology; wetland creation, delineation, management and ecotoxicology.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

NRES 469 Bio-Atmospheric Instrumentation
Crosslisted with: AGRO 469, GEOG 469, HORT 407, METR 469, MSYM 469, AGRO 869, GEOG 869, HORT 807, METR 869, MSYM 869, NRES 869
Prerequisites: Junior standing; MATH 106; 4 hrs physics; physical or biological science major.
Description: Discussion and practical application of principles and practices of measuring meteorological and related variables near the earth's surface including temperature, humidity, precipitation, pressure, radiation and wind. Performance characteristics of sensors and modern data collection methods are discussed and evaluated.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Groups: Physical Geography

NRES 470 Lake and Reservoir Restoration
Prerequisites: 12 hrs NRES or related fields.
Description: Theory, processes, and mechanisms underlying lake and reservoir water quality degradation and/or pollution and remediation of eutrophications and its effects. Current techniques used to restore and protect degraded lakes.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 472 Applied Soil Physics
Crosslisted with: AGRO 472, AGRO 872, NRES 872, SOIL 472, WATS 472
Prerequisites: AGRO/HORT/SOIL 153 or equivalent; MATH 104 or MATH 106 or equivalent.
Description: Emphasis on applied soil physics. Discussion of theoretical principles followed by field and laboratory exercises and applications. Fluxes of water, solutes, air, and heat through the soil. Emphasis on water infiltration, water retention, other soil hydraulic properties. Components of soil water balance. Management of soil water.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
NRES 474 Herpetology
Crosslisted with: BIOS 474, BIOS 874, NRES 874
Prerequisites: BIOS/NRES 386 and permission.
Notes: BIOS 388 recommended.
Description: Fossil and living amphibians and reptiles. Anatomy, classification, ecology and evolution.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

NRES 475 Water Quality Strategy
Crosslisted with: NRES 875, SOCI 475, SOCI 875, SOIL 475, WATS 475, AGRO 475, AGRO 875, CIVE 475, CIVE 875, CRPL 475, CRPL 875, GEOL 475, GEOL 875, MSYM 475, MSYM 875, POLS 475, POLS 875
Prerequisites: Senior standing.
Notes: Capstone course.
Description: Holistic approach to the selection and analysis of planning strategies for protecting water quality from nonpoint sources of contamination. Introduction to the use of methods for analyzing the impact of strategies on whole systems and subsystems; for selecting strategies; and for evaluating present strategies.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 476 Mammalogy
Crosslisted with: BIOS 476, BIOS 876, NRES 876
Prerequisites: 8 hrs BIOS; BIOS/NRES 386 or NRES 311.
Notes: May also be offered at Cedar Point Biological Station. Field trips are required and may occur outside of scheduled class time. Lab and field time emphasize diversity of mammalian families and species identification of Nebraska mammals.
Description: Evolution, natural history, ecology, and functional morphology of planetary mammals and mammals of the Northern Great Plains.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

NRES 477 Great Plains Field Pedology
Crosslisted with: AGRO 477, GEOG 467, SOIL 477, GEOG 867, NRES 877
Prerequisites: AGRO/SOIL 153.
Description: Spatial relationship of soil properties on various parts of landscape typical of the Plains, causal factors, and predictions of such relationships on other landscapes. Grouping these properties into classes, naming the classes, and the taxonomy that results from this grouping. Application of a taxonomy to a real situation through making a field soil survey in a region representative of the Plains border, predicting land use response of various mapped units as it affects the ecosystem, and evaluating the effectiveness of the taxonomic system used in the region surveyed.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Groups: Physical Geography

NRES 478 Regional Climatology
Crosslisted with: METR 478, METR 878, NRES 878
Prerequisites: NRES/METR 370.
Description: Regional differentiation of the climates of the earth on both a descriptive and dynamic basis. The chief systems of climatic classification.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 479 Hydroclimatology
Crosslisted with: METR 479, WATS 479, BSEN 479, NRES 879, METR 879, BSEN 879
Prerequisites: NRES 208 or METR 100 or METR/NRES 370.
Notes: Offered spring semester of even-numbered calendar years.
Description: Interaction between earth's climate and the hydrologic cycle. Energy and water fluxes at the land-atmosphere interface. Atmospheric moisture transport, precipitation, evaporation, snowmelt, and runoff.
Impacts of climate variability and change on the hydrologic cycle.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

NRES 481 Stream and River Ecology
Crosslisted with: WATS 481, WATS 881, BIOS 481
Prerequisites: NRES 222 or equivalent
Description: Fundamental physical drivers operating in stream and river ecosystems and how those vary in space and time. Major classes of organisms associated with stream ecosystems and their functional roles. Fundamental controls on biotic diversity in stream and river ecosystems and its variance. Major aspects of stream ecosystem function including energy flow and nutrient cycling. Ecosystem services provided by stream and river ecosystems and causes and consequences of human impacts on streams and rivers. Underlying principles of bioassessment and current methods of stream restoration.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

NRES 482 Ecophysiology of Wildlife
Crosslisted with: NRES 882
Prerequisites: NRES 220 or BIOS 207; AGRO 215/BIOS 206; BIOS 386
Description: Evaluation of the conserved physiological principles that are broadly used across animal groups, as well as the many unique adaptations used by specific taxa. Focuses on all major vertebrate groups, including fish, birds, mammals, reptiles and amphibians, and links the physiological mechanisms that allow them to survive to the environments in which they live. Highlights methods scientists use to gather physiological information, and the ways in which this information can be used by scientists in a variety of different fields.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: FALL
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Crosslisted with</th>
<th>Prerequisites</th>
<th>Description</th>
<th>Credit Hours</th>
<th>Max credits per semester</th>
<th>Max credits per degree</th>
<th>Format</th>
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</thead>
<tbody>
<tr>
<td>NRES 484</td>
<td>Water Resources Seminar</td>
<td>AGRO 484, GEOG 484, GEOL 484, WATS 484, NRES 884, AGRO 884, GEOG 884, GEOL 884, WATS 884</td>
<td>Junior or above standing</td>
<td>Seminar on current water resources research and issues in Nebraska and the region.</td>
<td>1</td>
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<td>1</td>
<td>LEC</td>
</tr>
<tr>
<td>NRES 487</td>
<td>Introduction to Landscape Ecology</td>
<td>LARC 487</td>
<td></td>
<td>The history, principles, and concepts of landscape ecology. Use and application of landscape structure, function in the planning, the design, and management of human and natural landscapes.</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>LEC</td>
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<tr>
<td>NRES 488</td>
<td>Groundwater Geology</td>
<td>GEOL 488, GEOL 888, NRES 888</td>
<td>GEOL 100-level course; MATH 106 or equivalent.</td>
<td>Occurrence, movement, and development of water in the geologic environment.</td>
<td>3</td>
<td>3</td>
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<td>LEC</td>
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<tr>
<td>NRES 489</td>
<td>Ichthyology</td>
<td>BIOS 489, BIOS 889, NRES 889</td>
<td>LIFE 120 and LIFE 121</td>
<td>Fishes, their taxonomy, physiology, behavior, and ecology. Dynamics of fish stocks and factors regulating their production.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>LEC</td>
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<tr>
<td>NRES 491</td>
<td>Geography Field Tour</td>
<td>GEOG 491, GEOG 891</td>
<td></td>
<td>Group educational tours to specific sites that illustrate aspects of physical and cultural geography. Off-campus travel required.</td>
<td>2-3</td>
<td>2</td>
<td>6</td>
<td>FLD</td>
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<tr>
<td>NRES 492</td>
<td>International Study Tours in Natural Resource Management</td>
<td>NRES 492H, NRES 892</td>
<td>Permission.</td>
<td>Group educational tours to sites that illustrate the diversity of approaches to natural resources management found around the world.</td>
<td>1-3</td>
<td>1</td>
<td>6</td>
<td>FLD</td>
</tr>
<tr>
<td>NRES 492H</td>
<td>International Study Tours in Natural Resource Management</td>
<td>NRES 492, NRES 892</td>
<td>Permission.</td>
<td>Group educational tours to sites that illustrate the diversity of approaches to natural resources management found around the world.</td>
<td>1-3</td>
<td>1</td>
<td>6</td>
<td>FLD</td>
</tr>
<tr>
<td>NRES 495</td>
<td>Grasslands Seminar</td>
<td>AGRO 495, ENTO 495, GRAS 495, HORT 495, RNGE 495, SOIL 495</td>
<td>Junior standing.</td>
<td>Topic varies and deals with different aspects of forage and/or range and/or livestock, turf and/or landscape grasses, natural habitats, and wetlands.</td>
<td>1-2</td>
<td>1</td>
<td>4</td>
<td>LEC</td>
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<tr>
<td>NRES 496</td>
<td>Independent Study</td>
<td></td>
<td>12 hrs natural resource sciences or closely-related fields, and permission.</td>
<td>Individual or group projects in research, literature review, or extension of course work.</td>
<td>1-5</td>
<td>1</td>
<td>12</td>
<td>IND</td>
</tr>
</tbody>
</table>

**Notes:**
- ACE 9 Global/Diversity
- Off-campus travel may be required.
NRES 497 Career Experiences in Natural Resource Sciences
Prerequisites: Sophomore standing; School of Natural Resources (SNR) majors; permission and advanced approval of a plan of work.
Description: Off-campus work experiences sponsored by natural resource agencies, companies, and organizations. Students collaborate in the development of a plan of work that will identify student responsibilities, including a final written report.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Format: FL

NRES 498 Special Topics in Natural Resources
Crosslisted with: NRES 898
Prerequisites: 6 hrs NRES or equivalent.
Description: Current issues in natural resource sciences.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 12
Format: LEC

NRES 499 Thesis Research
Prerequisites: Permission of thesis adviser.
Notes: Requires conducting a scholarly research project and writing an undergraduate thesis.
Credit Hours: 3-6
Min credits per semester: 3
Max credits per semester: 6
Max credits per degree: 6
Format: IND

NRES 499H Honors Thesis
Prerequisites: Admission to the University Honors Program and permission.
Notes: AGRI 299H recommended.
Description: Conduct a scholarly research project and write a University Honors Program or undergraduate thesis.
Credit Hours: 3-6
Min credits per semester: 3
Max credits per semester: 6
Max credits per degree: 6
Format: IND

MSYM 109 Physical Principles in Agriculture and Life Sciences
Prerequisites: MATH 101 or 102 or 103 or 104 or 106; or placement in MATH 102 or 104 or 106.
Notes: Students cannot receive credit for both MSYM 109 and PHYS 141 or 151.
Description: Fundamental principles of mechanics, heat, electricity, magnetism and electromagnetism and their relationship to energy utilization and conservation. Principles then applied to problem situations in agriculture and life sciences.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: FDST 363, MSYM 363; MSYM 109L; MSYM 232; MSYM 245; MSYM 262; MSYM 312; MSYM 342; MSYM 354, SOIL 354, WATS 354; MSYM 364; MSYM 452, MSYM 852, WATS 452, AGRO 452
ACE: ACE 4 Science

MSYM 109L Physical Principles in Agriculture and Life Sciences Laboratory
Prerequisites: MSYM 109 or parallel, or PHYS 151
Description: Laboratory experiments on mechanics, heat, electricity, magnetism and electromagnetism and their relationship to energy utilization and conservation in agriculture and life sciences.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB

MSYM 162 Introduction to Mechanized Systems Management
Description: Basic principles of describing and evaluating mechanized systems relevant to agriculture, food, energy, and water. Problem solving using systems-thinking. Exploration of major and career opportunities. Academic success and planning.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

MSYM 232 Power and Machinery Principles
Prerequisites: MSYM 109 or PHYS 141 or PHYS 151 or PHYS 211
Description: Operational characteristics of IC engines, field, material-handling, and processing machines and their components. Includes analyses, estimations, and objective comparisons of performance; principles for adjustment and calibration of metering systems; and cost-effective sizing of machines. Exercises include using ASABE Standards and available reports of machine performance (tractor test reports, etc.).
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

MSYM 245 Electrical Service Systems
Prerequisites: MSYM 109 or high school physics.
Description: Utilization of electric energy in agricultural production, processing, and residential applications. Wiring installations; selection of safe and adequate circuit devices; service equipment and conductors; and electric motors and their control; and energy management.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

MSYM 262 Problem Solving in Mechanized Systems Management
Prerequisites: MSYM 109 or PHYS 141 or PHYS 151 or PHYS 211.
Notes: Open to MSYM majors only.
Description: Use of computational tools to solve problems relevant to mechanized systems management. Professional communication of technical information. Discussion of current and emerging issues relevant to the major.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC
Offered: SPRING
MSYM 299 Career Experiences
Prerequisites: Permission and advanced approval of plan or work.
Description: Student participation in physical systems applications. May include participation in mechanization-related areas of agribusiness, production practices, and processing operations; research in laboratory, greenhouse and field; or preparation of teaching materials.
Credit Hours: 1-5
Min credits per semester: 1
Max credits per semester: 5
Max credits per degree: 12
Format: IND

MSYM 312 Engine Power Systems
Prerequisites: MSYM 109 or general physics.
Description: Internal combustion engine power systems used in agriculture with primary emphasis on power needs for both mobile and fixed operations, characteristics of power sources and energy resources, and selection and use of power units.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

MSYM 342 Animal Housing Systems
Prerequisites: MSYM 109 or PHYS 141 or PHYS 151 or PHYS 211
Description: Production facilities for livestock and poultry will be developed with emphasis on building and feedlot layout, ventilation, heating and cooling systems; energy utilization; and construction materials and methods.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: FALL

MSYM 354 Soil Conservation and Watershed Management
Crosslisted with: SOIL 354, WATS 354
Prerequisites: AGRO/SOIL 153; and MSYM 109 or PHYS 141 or PHYS 151 or PHYS 211
Description: Watershed hydrology, soil erosion, erosion control, water management, and land surveying and mapping. Includes rainfall-runoff relationships; determination of watershed characteristics; terraces, waterways, vegetative filters, and residue management; ponds, wetlands, non-point source pollution control, and water conservation; profile and topographic surveying.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: FALL

MSYM 363 Heat and Mass Transfer
Crosslisted with: FDST 363
Prerequisites: MATH 104 or 106; MSYM 109 or PHYS 141 or 151.
Description: Fundamentals of food engineering including material and energy balances, fluid mechanics, heat transfer and mass transfer.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

MSYM 364 Agricultural Products Processing and Handling
Prerequisites: MSYM 109 or PHYS 141 or PHYS 151 or PHYS 211
Description: Analysis of processing and handling operations. Chemical and physical characteristics of agricultural products. Application of psychrometrics. Power requirements, capacities, and efficiencies of drying and conveying systems. Discussion of safety issues, logistics, and survey of industry technologies.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: SPRING

MSYM 395 Internship in Mechanized Systems Management
Prerequisites: Junior standing.
Notes: Completion of internship approval form is required. The internship proposal is subject to approval by the Department of Biological Systems Engineering. Pass/No Pass only.
Description: Practical experience, directed learning, and career exploration and development in a selected business, industry, agency, or educational institution.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 5
Format: FLD

MSYM 400A Occupational Safety
Prerequisites: Junior standing
Notes: Contact CASNR Distance Education Consortium Coordinator for course details, prerequisites and registration information.
Description: Identifies safety and health risks in industrial work environments. Focus on how managers and supervisors meet their responsibilities for providing a safe workplace for their employees. Includes the identification and remediation of workplace hazards.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

MSYM 400B Agricultural Safety and Health
Notes: Contact CASNR Distance Education Consortium Coordinator for course details, prerequisites and registration information.
Description: Safety concepts, principles, practices, rules and regulations as they relate to agriculture will be explored. Developing and conducting safety programs, and conducting safety inspections and accident investigations are other aspects of the course.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

MSYM 400E Biorenewable Systems Technology
Notes: Contact CASNR Distance Education Consortium Coordinator for course details, prerequisites and registration information.
Description: The science, engineering, economics and business of converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, economics, transportation and logistics, and marketing.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
<th>Credits</th>
<th>Format</th>
<th>Offered</th>
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<tr>
<td>MSYM 400J</td>
<td>Machinery Management Using Precision Agriculture Technology</td>
<td>Junior standing</td>
<td>3</td>
<td>LEC</td>
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<tr>
<td>MSYM 400K</td>
<td>Chemical Application Systems</td>
<td>Contact CASNR Distance Education Consortium Coordinator for course details, prerequisites and registration information</td>
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<tr>
<td>MSYM 412</td>
<td>Hydraulic Power Systems</td>
<td>MSYM 245</td>
<td>3</td>
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<tr>
<td>MSYM 416</td>
<td>Sensors and Control Systems for Agri-Industries</td>
<td>MSYM 245 or permission</td>
<td>3</td>
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<td>FALL</td>
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<tr>
<td>MSYM 431</td>
<td>Site-specific Crop Management</td>
<td>AGEN 431, AGRO 431</td>
<td>3</td>
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<td>MSYM 433</td>
<td>Equipment and Tractor Testing</td>
<td>MSYM 833</td>
<td>3</td>
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<tr>
<td>MSYM 436</td>
<td>Embedded Controls for Agricultural Applications</td>
<td>AGEN 436, AGEN 836, MSYM 836</td>
<td>3</td>
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<td>SPRING</td>
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<tr>
<td>MSYM 452</td>
<td>Irrigation Systems Management</td>
<td>MSYM 852, WATS 452, AGRO 452</td>
<td>3</td>
<td>LEC</td>
<td>FALL</td>
</tr>
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</table>
MSYM 462 Equipment Systems
Crosslisted with: MSYM 862
Prerequisites: Senior standing in MYSM
Notes: Capstone course.
Description: Team-based activities to evaluate equipment systems, make technical and economic recommendations, develop professional written and oral reports. Topics include equipment system performance and management, project scheduling and planning, cost estimation, reliability analysis, and risk assessment.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 10 Integrated Product

MSYM 465 Food Engineering Unit Operations
Crosslisted with: FDST 465, FDST 865, MSYM 865
Prerequisites: FDST/MSYM 363.
Description: Unit operations and their applications to food processing.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3

MSYM 469 Bio-Atmospheric Instrumentation
Crosslisted with: AGRO 469, GEOG 469, HORT 407, METR 469, NRES 469, AGRO 869, GEOG 869, HORT 807, METR 869, MSYM 869, NRES 869
Prerequisites: Junior standing; MATH 106; 4 hrs physics; physical or biological science major.
Description: Discussion and practical application of principles and practices of measuring meteorological and related variables near the earth's surface including temperature, humidity, precipitation, pressure, radiation and wind. Performance characteristics of sensors and modern data collection methods are discussed and evaluated.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Groups: Physical Geography

MSYM 475 Water Quality Strategy
Crosslisted with: NRES 475, NRES 875, SOCI 475, SOCI 875, SOIL 475, WATS 475, AGRO 475, AGRO 875, CIVE 475, CIVE 875, CRPL 475, CRPL 875, GEOL 475, GEOL 875, MSYM 875, POLS 475, POLS 875
Prerequisites: Senior standing.
Notes: Capstone course.
Description: Holistic approach to the selection and analysis of planning strategies for protecting water quality from nonpoint sources of contamination. Introduction to the use of methods of analyzing the impact of strategies on whole systems and subsystems; for selecting strategies; and for evaluating present strategies.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 10 Integrated Product
Groups: American Government/Public Pol

MSYM 492 Special Topics in Mechanized Systems Management
Crosslisted with: MSYM 892
Prerequisites: Permission
Description: Subject matter in emerging areas of Mechanized Systems Management not covered in other courses within the curriculum. Topics, activities, and delivery methods vary.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Format: LEC

MSYM 496 Principles and Problems in Mechanized Agriculture
Crosslisted with: MSYM 896
Prerequisites: 15 hours in MSYM or closely related area.
Description: Individual or group projects in research, literature review, or extension of course work under the supervision and evaluation of a departmental faculty member.
Credit Hours: 1-5
Min credits per semester: 1
Max credits per semester: 5
Max credits per degree: 12
Format: IND

MSYM 499H Honors Thesis
Prerequisites: Admission to the University Honors Program and permission
Notes: AGRI 299H recommended.
Description: Conduct a scholarly research project and write a University Honors Program or undergraduate thesis.
Credit Hours: 3-6
Min credits per semester: 3
Max credits per semester: 6
Max credits per degree: 6
Format: IND