

## Program Overview

Sustainable freshwater resources provide a foundation for aquatic and terrestrial ecosystems, as well as human use and economic development. However, inadequate understanding of aquatic resources and a prevailing inability to properly integrate scientific, technical, and socioeconomic elements continues to seriously hinder the goal of providing sustainable aquatic resources, not only in Texas but across the nation and around the world.

## Educational Goal

The doctoral program emphasizes original research and is designed to provide depth and breadth of knowledge in the field of aquatic resources and related disciplines, including basic and applied research, management, and policy. Students will work, both independently and with other specialists, in a multidisciplinary environment to identify and solve complex problems and issues relevant to the sustainable use of aquatic resources.

## Department Policies

Each doctoral student will develop a program of research and study in consultation with their Ph.D. advisor and the doctoral program director and approved by the dean of The Graduate College. This program will include a set of core courses and an appropriate selection of elective courses necessary to provide the student with the scientific expertise and knowledge to work independently and with others in a multidisciplinary environment to address the range of issues constituting sustainable aquatic resources.

Prospective students must contact doctoral faculty members to identify an individual willing to serve as their major advisor prior to submitting their application to the graduate program. A list of faculty and their research areas is available at <http://www.bio.txstate.edu/Graduate-Programs/Ph-D--Aquatic-Resources.html>.

## Financial Assistance

Assistantships and scholarships are available to qualified applicants. The Department of Biology offers doctoral instructional assistantships and teaching assistantships on a competitive basis to full-time students enrolled in the aquatic resources Ph.D. program. Detailed information on the department's assistantship policy is included in the Department's Graduate Guide. The office of The Graduate College can provide further information regarding scholarships.

## Application Requirements

The items listed below are required for admission consideration for applicable semesters of entry during the current academic year. Submission instructions, additional details, and changes to admission requirements for semesters other than the current academic year can be found on The Graduate College's website (<http://www.gradcollege.txstate.edu>). International students should review the International Admission Documents page (<http://mycatalog.txstate.edu/graduate/admission-documents/international/>) for additional requirements.

- completed online application
- \$55 nonrefundable application fee

or

- \$90 nonrefundable application fee for applications with international credentials
- baccalaureate degree from a regionally accredited university (Non-U.S. degrees must be equivalent to a four-year U.S. Bachelor's degree. In most cases, three-year degrees are not considered. Visit our International FAQs (<https://www.gradcollege.txst.edu/international/faqs.html>) for more information.)
- master's degree in biology, chemistry, engineering, geology, or a related natural science field from a regionally accredited university
- official transcripts from **each institution** where course credit was granted
- minimum 3.25 GPA in all completed graduate course work
- GRE not required
- mentor communication (intent to mentor letter) sent directly from a doctoral faculty member within the Aquatic Resources and Integrative Biology Program. The mentor must email their letter of support directly to The Graduate College at [gradcollege@txstate.edu](mailto:gradcollege@txstate.edu) prior to the program's deadline.
- resume/CV summarizing educational and professional accomplishments
- statement of purpose describing professional aspirations and rationale for pursuing a doctoral degree in aquatic resources
- three letters of recommendation addressing the substance and quality of the student's preparation for doctoral study

## Approved English Proficiency Exam Scores

Applicants are required to submit an approved English proficiency exam score that meets the minimum program requirements below unless they have earned a bachelor's degree or higher from a regionally accredited U.S. institution or the equivalent from a country on our exempt countries list (<http://www.gradcollege.txstate.edu/international/language.html#waiver>).

- official TOEFL iBT scores required with a 78 overall
- official PTE scores required with a 52 overall
- official IELTS (academic) scores required with a 6.5 overall and minimum individual module scores of 6.0
- official Duolingo scores required with a 110 overall
- official TOEFL Essentials scores required with an 8.5 overall

This program does **not** offer admission if the scores above are not met.

## Degree Requirements

The Doctor of Philosophy (Ph.D.) degree with a major in Aquatic Resources and Integrative Biology (for students entering with a master's degree) requires 61 semester credit hours, including a dissertation. The selection of electives should be made in consultation with the student's Ph.D. advisor and the program director.

Code	Title	Hours
<b>Required Courses</b>		
BIO 7102	Seminar in Aquatic Resources (Taken twice)	2
BIO 7303	Research (Taken three times)	9
BIO 7405	Statistics and Experimental Design I	4
or BIO 7406	Statistics and Experimental Design II	
BIO 7312		3
PHIL 7323	Environmental Ethics and Sustainable Aquatic Resources	3

**Prescribed Electives**

Choose 25 hours from the following: 25

BIO 7114	Collaborative Research
BIO 7120	Population Biology Seminar
BIO 7214	Collaborative Research
BIO 7308	History of Vegetation and Climate
BIO 7314	Collaborative Research
BIO 7324	Natural History and Conservation of Large Mammals
BIO 7336	Evolutionary Ecology
BIO 7346	Conservation Biology
BIO 7353	Biogeography
BIO 7355	Plant-Water Relations
BIO 7360A	Industry and Sustainable Aquatic Resources
BIO 7360B	Environmental Linkages and Sustainable Aquatic Resources
BIO 7360C	Role of State and Federal Courts in Protection and Maintenance of Aquatic Resources
BIO 7360D	Special Topics in Aquatic Resources: Evolutionary Ecology
BIO 7360E	Advances in Water Quality Investigations
BIO 7360F	Special Topics in Aquatic Resources: Approaches to Aquatic Resource Modeling
BIO 7360G	Molecular Techniques in Microbial Ecology
BIO 7360H	Parasites and Diseases of Fishes and Other Aquatic Animals
BIO 7360I	Bayesian Statistics for Biology
BIO 7360K	Evolution
BIO 7360L	Special Topics in Aquatic Resources: Landscape & Biogeography of Texas
BIO 7360P	Special Topics in Aquatic Resources: Regulation of Plant Growth and Development
BIO 7360Q	Special Topics in Aquatic Resources: Spatial Ecology of Animals
BIO 7360R	Special Topics in Aquatic Resources: Community and Ecosystem Ecology
BIO 7360S	Soil Biology
BIO 7360T	Karst Hydrogeology and Geomorphology
BIO 7360U	Sustainability in a Changing World
BIO 7360V	Techniques in Aquatic Biology
BIO 7410	Aquatic Microbial Ecology
BIO 7412	Environmental Hydrology
BIO 7419	Stream Ecology
BIO 7426	Ecology and Management of Aquatic Macrophytes
BIO 7427	Principles of Population Biology I
BIO 7428	Principles of Population Biology II
BIO 7433	Population Genetics
BIO 7434	Herpetology
BIO 7440	Aquatic Toxicology
BIO 7447	Microbial Physiology
BIO 7466	Phylogenetics
BIO 7468	Groundwater Resources
BIO 7469	Introduction to Ecological Modeling
CHEM 7330	Environmental Chemistry

ENG 7314 Specializations in Professional and Technical Communication Topics

GEO 7316 Remote Sensing and the Environment

GEO 7318 GIS and Environmental Geography

GEO 7334 Geographic Aspects of Water

GEO 7417 Geographic Information Systems

**Dissertation**

Choose a minimum of 15 hours from the following: 15

BIO 7199A Dissertation in Aquatic Resources

BIO 7299A Dissertation in Aquatic Resources

BIO 7399A Dissertation

BIO 7599A Dissertation in Aquatic Resources

BIO 7699A Dissertation

BIO 7999A Dissertation in Aquatic Resources

**Total Hours****61**

## Advancement to Candidacy

### Application for Advancement to Candidacy

Students can download the "Application for Advancement to Candidacy" from The Graduate College website or they can obtain a copy from the program director. The student should complete and sign the upper portion of the form and return it to the program director. When all requirements for admission to candidacy have been met (completion of core course work, submission of an approved dissertation proposal, and completion of the comprehensive examination), the program director will forward the Application for Advancement to Candidacy form to the dean of The Graduate College for review and approval.

### Advancement to Candidacy Time Limit

Students entering the doctoral program in Aquatic Resources and Integrative Biology with a master's degree and receiving departmental support are expected to take the Advancement to Candidacy Comprehensive Examination by the end of their second year in the program; students entering with a bachelor's degree and receiving departmental support are expected to take the examination by the end of their third year. All students are expected to have passed the Advancement to Candidacy Comprehensive Examination within one calendar year of completing the core course work required by their degree audit. This expectation holds for both full-time and part-time students. Requests for a time extension must be submitted to the program director by the student's Ph.D. advisor and approved by the graduate committee.

No credit will be applied toward a student's doctoral degree for course work completed more than four years before the date on which the student is admitted to candidacy. This time limit applies to course credit earned at Texas State, as well as course credit transferred to Texas State from other accredited institutions.

### Grade-Point Requirements for Advancement to Candidacy

A minimum GPA of 3.0 on all course work undertaken as a graduate student in the Aquatic Resources and Integrative Biology doctoral program is required for admission to candidacy. No grade below "B" on any graduate course work may apply toward the Ph.D. degree at Texas State.

Incomplete grades must be cleared through the office of The Graduate College at least ten days before approval for advancement to candidacy will be granted.

## Advancement to Candidacy Comprehensive Examination

Students in the doctoral program are required to pass a comprehensive examination that will assess the student's preparedness to carry out the proposed plan of dissertation research. Students taking the Advancement to Candidacy Comprehensive Examination must have completed all required core and background courses as prescribed in their degree audit. Detailed information on the examination procedure can be found in the Department of Biology's *Guide to Graduate Study* or obtained from the program director.

The Advancement to Candidacy Comprehensive Examination will consist of both written and oral components. The written component of the examination will consist of questions submitted by the dissertation committee members and will be administered by the program director. Successfully passing the written component of the examination requires positive votes from all members of the dissertation committee.

Successful completion of the written portion of the candidacy exam must be followed within thirty days by an oral presentation and defense of the dissertation proposal. The oral component of the Advancement to Candidacy Comprehensive Examination will entail a public seminar presentation of the student's dissertation proposal, followed immediately by a closed defense of the proposal attended only by the student and his or her dissertation committee. Both the presentation and defense must take place on the same day. Successfully passing the oral examination requires positive votes from all members of the student's dissertation committee.

## Dissertation Proposal

A dissertation proposal prepared by the student and approved by the student's Ph.D. advisor and all other members of the dissertation committee is a requirement for advancement to candidacy status. The proposal must outline the substance and scope of the dissertation research, present the methodology to be used, and survey the relevant literature. The student's Ph.D. advisor and other dissertation committee members must indicate approval of the dissertation proposal on the "Dissertation Proposal form" which can be downloaded from The Graduate College website or obtained from the program director. A final copy of the dissertation proposal, accompanied by the signed approval form, must be turned in to the program director, who will forward it to the dean of The Graduate College for review and final approval.

## Recommendation for Advancement to Candidacy

The dissertation committee recommends the applicant for advancement to candidacy after completing the "Doctoral Comprehensive Examination Report" which can be downloaded from The Graduate College website or obtained from the program director. The results of the Advancement to Candidacy Comprehensive Examination and the Application for Advancement to Candidacy must be filed in the office of The Graduate College before the dean of The Graduate College gives final approval to candidacy. The program director is responsible for submitting these forms to the office of The Graduate College.

## Dissertation Research and Writing

All doctoral students are required to complete a dissertation. The dissertation must represent an original contribution to scholarship based on independent investigation. Preparation of the dissertation should

follow the guidelines in the current edition of the *CBE (Council of Biology Editors) Style Manual* or in an appropriate professional journal in the designated field, as deemed acceptable by the dissertation committee.

## Dissertation Enrollment Requirements

After being admitted to candidacy, students must be continuously enrolled for dissertation hours each term until the defense of their dissertation. If a student is receiving supervision on the dissertation during the summer or the student is graduating during the summer, the student must be enrolled in dissertation hours for the summer. All candidates for graduation must be enrolled in dissertation hours during the term in which the degree is to be conferred. Students must complete a minimum of 15 semester hours of dissertation research and writing credit.

## Dissertation Time Limit

Students are expected to complete the dissertation within three years of advancement to candidacy. Successful completion of the dissertation defense must occur within ten years of the student's entry into the Ph.D. program. Any exceptions to these time limits require the approval of the program director and the dean of The Graduate College. The dissertation committee and the program director will review each student annually to ascertain his or her progress in pursuing the degree, and will consult with the student's Ph.D. advisor and dissertation committee on this matter as appropriate.

## Dissertation Committee

The dissertation committee is responsible for the Advancement to Candidacy Comprehensive Examination and will oversee the research progress of a doctoral student and the writing of the student's dissertation. The committee will consist of at least five members, including the student's Ph.D. advisor, two other Texas State biology doctoral faculty members, and two external doctoral-level members, at least one of whom must be from an institution other than Texas State. The student's Ph.D. advisor will chair the committee and will normally be from the major department. The student, program director, department chair, and the dean of The Graduate College will approve the composition of the dissertation committee. The student is responsible for obtaining committee members' signatures on the "Dissertation/Research Advisor Assignment form" and the "Dissertation Committee Request form," which can be downloaded from The Graduate College website.

## Committee Changes

Any changes to the dissertation committee must be submitted for approval to the dissertation committee chair, the doctoral program director, the department chair, and the dean of The Graduate College. Changes must be submitted no less than sixty days before the dissertation defense. The "Dissertation Advisor/Committee Member Change Request form" may be downloaded from The Graduate College website.

## Dissertation Defense

The dissertation defense will consist of two parts. The first part is an oral presentation of the dissertation research as a public seminar that should be given as part of the department's weekly seminar series. The second part of the defense is restricted to the student's dissertation committee and will entail an oral examination over the dissertation research.

The oral examination over the dissertation research may not be scheduled until all other academic and program requirements have

been fulfilled. A complete draft of the dissertation must be given to the members of the dissertation committee at least 30 days before the anticipated defense date. After committee members have reviewed the draft with the student and provided comments, the student, in consultation with the Ph.D. advisor, will incorporate the recommended changes into a second draft of the dissertation. When each committee member is satisfied that the draft dissertation is defensible, the oral examination may be scheduled. The full committee, including all external members, must be present. Approval of the dissertation requires positive votes from all members of the dissertation committee. At the conclusion of the defense, a "Dissertation Defense Report form" – which can be downloaded from The Graduate College website – must be completed, signed by all committee members, and submitted to the program director, who will forward it to the dean of The Graduate College for review and final approval. Specific information on the examination procedure can be found in the Department of Biology's *Guide to Graduate Study* or obtained from the program director.

## Approval and Submission of the Dissertation

Following approval and signing of the dissertation by the members of the dissertation committee and submission of the "Dissertation Defense Report form", the student must submit one copy of the dissertation and the signed "Thesis/Dissertation Committee Approval" form to The Graduate College. Specific guidelines for approval and submission of the dissertation can be obtained from The Graduate College.

Doctoral courses in Biology (and other related departments): BIO (p. 4), CHEM (p. 12), ENG (p. 14), GEO (p. 14), PHIL (p. 20)

## Courses Offered

### Biology (BIO)

#### **BIO 7100. Professional Development.**

This course is seminar-based and covers topics related to teaching, research, and employment responsibilities. Completion of the course is required as a condition of employment for graduate assistants. This course does not earn graduate degree credit. Repeatable with different emphasis.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Graduate Assistantship|Exclude from Graduate GPA

**Grade Mode:** Leveling/Assistantships

#### **BIO 7102. Seminar in Aquatic Resources.**

This course is an interactive discussion of timely issues and problems, designed to introduce students to the range of scientific, socioeconomic and policy issues likely to be encountered within the field of aquatic resources. All students seeking a doctoral degree in Aquatic Resources must enroll in BIO 7102 at least twice.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Standard Letter

#### **BIO 7103A. Ecology and Society.**

Interactive discussion on relationships between society and the life-supporting ecosystems on which humans depend. Topics include roles of natural systems in social systems; effects of social, economic and political institutions on ecological systems and services; and the means by which humans develop and sustain desired ecological and social states.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

#### **BIO 7103B. Aquaculture.**

The course comprises a survey of aquaculture production throughout the world. It also examines and discusses the impacts of aquaculture on nutrition, fisheries and the economy.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

#### **BIO 7103D. Molecular Biology of the Cell.**

Interactive discussion of current literature on molecular biology of the cell. The course is designed to discuss concepts and their applications and methodology associated with the structure and function of the cell at cellular and molecular level.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

#### **BIO 7103E. Contemporary Problems in Ecology.**

This course is an interactive discussion of the theoretical foundations and empirical basis for controversial topics in ecology, designed to develop critical thinking skills, and the ability to evaluate and integrate the biological, chemical and physical factors that affect the structure, functions, and interactions characterizing communities and ecosystems.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

#### **BIO 7103F. Molecular Genetics of Plant Development.**

The study of plant development is rapidly changing as plant genome projects discover a multitude of new genes, and their expression and interaction patterns are understood. This course is designed to discuss concepts in plant development, and developmental processes as pathways of gene regulatory activities.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7103G. Ecohydrology.**

A review of the concept of ecohydrology, its scientific foundation, and its ecological-hydrological linkages. Current topics in ecohydrology in the literature will be discussed, including manipulation of biota and hydrology interactions in a landscape, and the possibility of augmenting the resilience of ecosystems to anthropogenic changes.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7103H. Integrated Waterbird Management.**

This course focuses on the ecology and management of waterbirds, with an emphasis on the inland and coastal waterbirds of Texas. The basic ecology of waterbirds, waterbird management techniques, and waterbird habitat management will be discussed.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7103I. Avian Ecology and Evolution.**

This course is an interactive discussion of avian ecology and evolution, providing students with a critical examination of theories, hypotheses, and lab and field-based data that support or refute these hypotheses. This course also discusses peer-reviewed literature that challenges some paradigms in avian ecology and evolution.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7104. Marine Pollution.**

In this course, students will read and discuss the scientific literature on the sources, bioaccumulation, trophic transfer, and health effects of contaminants in the marine environment. Papers will address a variety of marine life including plankton, crustaceans, mollusks, fishes, marine mammals, turtles, and birds. Contaminants to be reviewed include trace elements, PCBs, oil, pesticides, radionuclides, plastics, pharmaceuticals, illegal drugs, and personal care products.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7105. Environmental Issues through Documentaries.**

In this course, students will examine how environmental issues are addressed in documentaries. Students will learn how to critically evaluate documentaries for scientific content, imagery, biases, and ease of understanding. Topics to be examined include overfishing, the wildlife trade, habitat degradation, pollution, energy resources, climate change, sustainability, and conservation.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7114. Collaborative Research.**

This course (concurrent enrollment allowed) allows Ph.D. level graduate students to initiate, conduct, and participate in collaborative research with graduate faculty of the Department of Biology that is in addition to research conducted under BIO 7303, BIO 7399A, or BIO 7699A. This course recognizes the collaborative nature of scientific investigation.

**1 Credit Hour. 1 Lecture Contact Hour. 1 Lab Contact Hour.**

**Grade Mode:** Standard Letter

**BIO 7120. Population Biology Seminar.**

This course facilitates exploration of current topics in population and conservation biology through reading and discussion of contemporary primary and secondary literature.

**1 Credit Hour. 2 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7199A. Dissertation.**

Original research and writing in Aquatic Resources, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Grade Mode:** Credit/No Credit

**BIO 7214. Collaborative Research.**

This course (concurrent enrollment allowed) allows Ph.D. level graduate students to initiate, conduct, and participate in collaborative research with graduate faculty of the Department of Biology that is in addition to research conducted under BIO 7303, BIO 7399A, or BIO 7699A. This course recognizes the collaborative nature of scientific investigation.

**2 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7299A. Dissertation.**

Original research and writing in Aquatic Resources, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Credit/No Credit

**BIO 7300. Communicating Science.**

This course explores how to successfully disseminate science through visualizations, oral presentations, and written works to multiple audiences. Special emphasis will be placed on communicating with the general public, media, granting agencies, and science peers.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7301. College Science Teaching.**

This course is designed for graduate students in the sciences who are interested in improving their science teaching and/or are interested in pursuing careers in academia. This course focuses on the central question, "How do college students best learn science, and thus how do we best teach them?"

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7302. Problems in Aquatic Resources.**

Individual study on specific state, national, or international aquatic resources issues, under direct supervision of a doctoral or associate faculty member. Students may not enroll in BIO 7302 more than twice for doctoral credit without the approval of the Graduate Program Director.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7303. Research.**

Research course for students who have not yet passed their Candidacy Exam, typically under direction of research-dissertation supervisor. Pre-candidacy students must enroll in course every semester until admission to Candidacy, although it may not be taken more than three times for doctoral credit without the approval of Graduate Program Director.

**3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7308. History of Vegetation and Climate.**

An overview of past vegetation and its relationship to changing climate. Topics include principles of paleovegetation analysis, paleoclimatology, the rise of flowering plants, vegetation during the age of dinosaurs, the rise of the grasslands, and the Quaternary Ice Age. Prerequisites: Instructor approval.

**3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.**

**Grade Mode:** Standard Letter

**BIO 7310. Global Aquatic Resources.**

Introduction to global, national, and regional aquatic resource issues, including scientific, environmental policy and socioeconomic components and perspectives. Water quantity and quality issues and their root causes in different regions of the world are examined, with an emphasis on case studies.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7311. Ecology of Temporary Waters.**

The course explores the diversity of temporary bodies of water and of the species that rely on them, including their special adaptations, population and community dynamics, the ecological role of temporary waters, and how these systems are impacted by humans. Background coursework or independent study in ecology is recommended.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7314. Collaborative Research.**

This course (concurrent enrollment allowed) allows Ph.D. level graduate students to initiate, conduct, and participate in collaborative research with graduate faculty of the Department of Biology that is in addition to research conducted under BIO 7303, BIO 7399A, or BIO 7699A. This course recognizes the collaborative nature of scientific investigation.

**3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7324. Natural History and Conservation of Large Mammals.**

This course will introduce students to advanced details of natural history, research, and conservation of large mammals. Topics considered will include natural history, range and population status (historic and current), importance to and interaction with humans, research design and analysis, and the development of conservation and management plans.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7326. Immunobiology.**

This lecture-based course will cover the mechanisms and biology of the innate and adaptive immune system. Emphasis will include relationship to cancer, transplantation, hypersensitivity (allergy), and disease. Students will evaluate current research in immunology.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7327. Ecological Immunology.**

This course explores the roles of immunity in natural ecosystems, focusing on central concepts in ecological immunology. From viruses to parasites, pathogenic threats are omnipresent. As epizootic outbreaks become more common, it is important to integrate immunological knowledge with traditional ecological perspectives. Background coursework in immunology is recommended.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7331. Human Dimensions of Wildlife and Fisheries Conservation.**

This course will provide principles, concepts, and case studies to understand how the human experience (e.g., culture, politics, economics) influences conservation outcomes. Students will have an opportunity to integrate human dimensions into decision-making.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7332. Introduction to R Programming for Biologists.**

This course introduces the programming language R. The course will focus on best practices in programming and the use of Base-R and RStudio. Topics include navigating the R and RStudio environment, installing packages, loading, manipulating, and visualizing data, declaring variables, writing loops, and writing functions.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7333. Phylogenetic Comparative Methods.**

This course introduces students to modern phylogenetic comparative methods and teaches how to perform them. Topics include constructing phylogenies, dating phylogenies, finding and using previously published phylogenetic datasets, phylogenetic data visualization, and a variety of methods to test ecological and evolutionary hypotheses in a phylogenetic framework.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7336. Evolutionary Ecology.**

This course will use an evolutionary perspective to explore questions provided by natural selection and sexual selection through assessment of current theory and research related to topics such as competition, coevolution, and phenotypic plasticity. Students will achieve comprehension and familiarity with the field through discussions and writing.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7342. Virology.**

This course examines the structure, multiplication and genetics of bacterial, plant, and animal viruses as well as the role of viruses in human and plant disease. Students are expected to become familiar with the research literature in virology.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7346. Conservation Biology.**

Examination of the alteration of habitats and associated biological changes threatening the continued existence of species and basic ecosystems. Topics include conservation ethics, working paradigms, levels and loss of global biodiversity, conservation at population and ecosystem levels, restoration ecology, endangered species biology and conservation laws. Recent Advances are stressed.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7353. Biogeography.**

Examines historical and ecological explanations of the geographic distribution of organisms including the role of geologic, climatic, and biologic changes. Emphasizes the historical and philosophical development of the science and modern methods of analysis.

**3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.**

**Grade Mode:** Standard Letter

**BIO 7354. Applied Analyses of Populations.**

In this course students will learn and apply a variety of statistical techniques for analyzing populations. They will build code to conduct and compare statistical analyses as they apply to real population data. Students will use real-world data sets to generate objectives and test hypotheses including conducting all data visualization and validations, performing models, selecting appropriate models, and estimating latent variables and their predictors. Analyses include assessing the effects of environmental attributes on occupancy, relative abundance, abundance, space (habitat) use, home range size, local colonization, local extinction, survival, and recruitment.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7355. Plant-Water Relations.**

Examination of the physiology and ecology of water use in higher plants, including the uptake, utilization, and movement of water, transpiration and adaptation to variable water availability including drought, and the ecological role of water in structuring plant communities.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7360A. Industry and Sustainable Aquatic Resources.**

Examination of industrial water needs and uses, the types and quantities of water pollutants produced by different industries, problems faced by industry regarding process water for different manufacturing activities, and the possibilities for industry to contribute to the goal of sustainable aquatic resources.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7360B. Environmental Linkages and Sustainable Aquatic Resources.**

Introduction to the environmental relationships between humans and other living beings and the ecological systems in which they exist. Emphasis will be on the potential for individual environmental problems to have serious impacts on other environmental components, as well as the nature of these impacts.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7360C. Role of State and Federal Courts in Protection and Maintenance of Aquatic Resources.**

Examination of current or emerging state, national and international aquatic resources issues, including root causes and their human and ecosystem interactions. The course may be repeated for credit, depending on the topic. No more than six hours can be counted for doctoral credit without the approval of the Program Director.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7360D. Evolutionary Ecology.**

Examination of current or emerging state, national and international aquatic resources issues, including root causes and their human and ecosystem interactions. The course may be repeated for credit, depending on the topic. No more than six hours can be counted for doctoral credit without the approval of the Program Director.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7360E. Advances in Water Quality Investigations.**

Examination of current or emerging state, national and international aquatic resources issues, including root causes and their human and ecosystem interactions. The course may be repeated for credit, depending on the topic. No more than six hours can be counted for doctoral credit without the approval of the Program Director.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7360F. Approaches to Aquatic Resource Modeling.**

Examination of current or emerging state, national and international aquatic resources issues, including root causes and their human and ecosystem interactions. The course may be repeated for credit, depending on the topic. No more than six hours can be counted for doctoral credit without the approval of the Program Director.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7360G. Molecular Techniques in Microbial Ecology.**

Lectures on molecular techniques used to analyze structure and function of uncultured microbial communities in the environment with selected examples of applications.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**BIO 7360H. Parasites and Diseases of Fishes and Other Aquatic Animals.**

Examination of current or emerging state, national and international aquatic resources issues, including root causes and their human and ecosystem interactions.

**3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Lab Required|Topics

**Grade Mode:** Standard Letter

**BIO 7360I. Bayesian Statistics for Biology.**

This course examines the theory and mathematical foundations of Bayesian statistics and provides instruction and experience conducting Bayesian analyses using computer-based procedures. The course emphasizes practical applications for Bayesian statistical procedures for problems in biological sciences.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7360K. Evolution.**

Examination of current or emerging state, national and international aquatic resources issues, including root causes and their human and ecosystem interactions. The course may be repeated for credit, depending on the topic. No more than six hours can be counted for doctoral credit without the approval of the Program Director.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7360L. Landscape and Biogeography of Texas.**

Examination of current or emerging state, national and international aquatic resources issues, including root causes and their human and ecosystem interactions. The course may be repeated for credit, depending on the topic. No more than six hours can be counted for doctoral credit without the approval of the Program Director.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7360P. Regulation of Plant Growth and Development.**

Examination of current or emerging state, national and international aquatic resources issues, including root causes and their human and ecosystem interactions. The course may be repeated for credit, depending on the topic. No more than six hours can be counted for doctoral credit without the approval of the Program Director.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7360Q. Spatial Ecology of Animals.**

Examination of current or emerging state, national and international aquatic resources issues, including root causes and their human and ecosystem interactions. The course may be repeated for credit, depending on the topic. No more than six hours can be counted for doctoral credit without the approval of the Program Director.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7360R. Community and Ecosystem Ecology.**

Examination of current or emerging state, national and international aquatic resources issues, including root causes and their human and ecosystem interactions. The course may be repeated for credit, depending on the topic. No more than six hours can be counted for doctoral credit without the approval of the Program Director.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7360S. Soil Biology.**

An introduction to the biology of soil systems, including the roles of biota in forming and maintaining soils, and the interactions between biotic and abiotic components in soils.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7360T. Karst Hydrogeology and Geomorphology.**

An introduction to, and advanced understanding of, karst hydrogeology, geology, and geomorphology, with emphasis on field and theoretical applications of this information to the study of karst systems, and recognition and understanding of karst landforms at the surface and their relationships with subsurface processes. Prerequisite: Instructor approval.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**BIO 7360U. Sustainability in a Changing World.**

Understanding the ecological-social interface, including policies, product development and actions towards sustainability, with emphasis on integrating and implementing theories and methods across disciplines, and improving the knowledge and experience base for public policy and decision-making regarding human-environment linkages within the context of sustainable development. Prerequisite: Instructor approval.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**BIO 7360V. Techniques in Aquatic Biology.**

The course will provide hands on experience with a suite of physical, chemical, and biological sampling techniques and gear used in applied river studies. Students will be exposed to the fundamentals of data quality objectives, accuracy, precision, detection limits, data visualization, exploratory analysis, univariate and multivariate statistics.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7360Y. Applied Bioinformatics.**

This course provides an introduction to scripting and other computational techniques used for visualizing and analyzing large biological datasets. Computational techniques include sequence and structural alignment, data mining, phylogenetic tree construction, and data clustering using UNIX, Python, and R. Students will gain a solid foundation in broadly applicable bioinformatics skills.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**BIO 7361A. Discipline-Based Educational Research Methods.**

This course will expose science graduate students to educational research in a practical setting, supervised by a professor experienced in conducting discipline-based educational research, focusing primarily on qualitative methods.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 7361C. Advanced Genomics and Bioinformatics.**

This course provides hands-on experience in processing and analyzing data produced from contemporary genomics tools for thesis students with basic bioinformatics training. Prerequisite: BIO 7360Y with a grade of "B" or better and instructor approval.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**BIO 7361D. Raptor Ecology.**

This course will examine the evolution, taxonomy, ecology, behavior, anatomy, physiology, and conservation of birds of prey of the world with emphasis on diurnal raptors, including those from Texas. Field trips will include at least two overnight visits to significant migration and overwintering areas.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**BIO 7399A. Dissertation.**

Original research and writing in Aquatic Resources, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each semester (including summer) for at least three dissertation hours.

**3 Credit Hours. 3 Lecture Contact Hours. 5 Lab Contact Hours.**

**Grade Mode:** Credit/No Credit

**BIO 7402. Molecular Field Techniques.**

The application of molecular tools for identifying, quantifying, and interpreting biological diversity assessments in aquatic systems. The course focuses on micro organismal identification and vertebrate model systems.

**4 Credit Hours. 2 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 7405. Statistics and Experimental Design I.**

Introduction to inferential statistics, including exploratory and confirmatory data analysis, estimation and hypothesis testing, analysis of variance and regression, and non-parametric techniques, as applied to aquatic resource issues. Computer applications emphasized.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 7406. Statistics and Experimental Design II.**

Introduction to the principles of experimental design, including randomization, replication, sample-size determination, completely randomized and randomized block design, factorial design, repeated measure design, and analysis of variance and covariance, as applied to aquatic resource issues. Computer applications emphasized.

Prerequisite: BIO 7405 with a grade of "C" or better or instructor approval.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 7410. Aquatic Microbial Ecology.**

Examination of microbial organisms, communities, and interactions affecting the form, structure, and functional aspects of aquatic ecosystems. Field trips may be required. Prerequisite: BIO 2400 with a grade of "D" or better or instructor approval.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 7412. Environmental Hydrology.**

Overview of the properties, distribution, and movement of water over and under the land surface and its relation to sustainable aquatic ecosystems, including quantitative methods to assess cumulative impacts of human activities on such systems. Field trips may be required. Knowledge of calculus recommended.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 7414. Ecology of Infectious Diseases of Wildlife.**

Concepts of the ecology of infectious diseases in wildlife are studied in depth with emphasis on their application to the management and conservation of wildlife species and for the control of zoonotic diseases. Prerequisite: Instructor approval.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7419. Stream Ecology.**

Study of ecological theories, concepts, and processes occurring at the population, community, and ecosystem levels of organization in running water. Laboratory includes sampling methods, descriptive and comparative studies, experiments, and critical discussion of literature. Field trips may be required.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 7426. Ecology and Management of Aquatic Macrophytes.**

Examination of aquatic macrophytes and their ecology, taxonomy, distribution and management. Field trips may be required.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7427. Principles of Population Biology I.**

This course provides a foundation in theory and mathematics of basic population biology. The course is divided into modular components, including defining evolutionarily significant units, ecology of populations, genetics of populations, and evolutionary genetics. A background in genetics and general ecology is recommended.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 7428. Principles of Population Biology II.**

This course provides a foundation in theory and mathematics of basic population biology. The course is divided into modular components which include: 1) Ecology of Communities, 2) Evolution of Behavior, 3) Phylogenetic Methods, and 4) Biological Diversity and Conservation Biology.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 7430. Mycology.**

This course provides an introduction to the organisms in the Kingdom Fungi and to fungus-like organisms, their ecology and evolution, and their role in industry and disease. Special emphasis will be placed on morphology, culturing, and using laboratory techniques for identification.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7433. Population Genetics.**

This course examines the theoretical foundations of population genetics, including the description of population genetic structure and the forces creating it. The course emphasizes application of principles to a wide range of current problems in evolution, systematics and ecology. Molecular methods, data interpretation and computer-based data analysis are emphasized.

**4 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 7434. Herpetology.**

A course treating the origin and evolution of amphibians and reptiles; their reproductive and physiological tactics; taxonomy/systematics; and population biology. While cosmopolitan in scope, emphasis will be placed on North American species and those groups inhabiting Texas.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 7440. Aquatic Toxicology.**

Introduction to principles for identifying and assessing the adverse effects of chemicals and other compounds and mixtures on aquatic organisms and ecosystems.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 7447. Microbial Physiology.**

Prokaryotes, including bacteria and archaea, are the most diverse group of organisms on earth. Many prokaryotes live in environments which are inhospitable to other life forms. This course covers major aspects of prokaryotic physiology that permit them to be so successful.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 7466. Phylogenetics.**

Study of the use of phylogenetic methodologies in aquatic research, including practical data collection, management, and analysis in the reconstruction of phylogenies. Laboratory exercises will introduce phylogenetic and DNA analysis software. Prerequisite: BIO 2450 and BIO 4369 and BIO 5466 all with grades of "C" or better or instructor approval.

**4 Credit Hours. 2 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 7468. Groundwater Resources.**

Study of the geological, physical, chemical and biological factors influencing sustainable groundwater resources, including hydrologic linkages and interactions with surface aquatic resources. Emphasis will be on the karst aquifer systems of Central Texas, and other groundwater aquifer systems of the United States.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 7469. Introduction to Ecological Modeling.**

Mathematical models range from simple conceptual models to complex mechanistic models for mimicking behavior of natural systems. This course provides a broad overview of modeling objectives, techniques and assumptions, as well as the practical skills needed to conduct modeling projects. Computer applications emphasized. Prerequisite: MATH 2471 with a grade of "C" or better or instructor approval.

**4 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 7599A. Dissertation.**

Original research and writing in Aquatic Resources, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**5 Credit Hours. 5 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Credit/No Credit

**BIO 7699A. Dissertation.**

Original research and writing in Aquatic Resources, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each semester (including summer) for at least three dissertation hours.

**6 Credit Hours. 6 Lecture Contact Hours. 10 Lab Contact Hours.**

**Grade Mode:** Credit/No Credit

**BIO 7999A. Dissertation.**

Original research and writing in Aquatic Resources, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**9 Credit Hours. 9 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Credit/No Credit

## Chemistry (CHEM)

### CHEM 7101. Doctoral Assistant Development.

This course is designed to prepare doctoral students employed as instructional assistants to perform effectively in diverse instructional settings. This course is seminar-based and covers topics related to teaching, research, and employment responsibilities. Completion of the course is required as a condition of employment for graduate assistants.

This course does not earn graduate degree credit. Repeatable with different emphasis.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Graduate Assistantship|Exclude from Graduate GPA

**Grade Mode:** Leveling/Assistantships

### CHEM 7110. Advances in Molecular and Biophysical Chemistry.

This course is designed to provide students in the Integrated Molecular and Biophysical Chemistry PhD program a forum to discuss ongoing research progress and new discoveries through literature study. Students in the course will give informal 'work in progress' presentations and critically analyze recent publications in the field.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

### CHEM 7199. Dissertation.

This course consist of original research and writing in integrated molecular and biophysical chemistry to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

### CHEM 7200. Graduate Research.

This course is designed to provide doctoral students with an elective research option to allow them to collect preliminary data as they develop their dissertation proposal.

**2 Credit Hours. 0 Lecture Contact Hours. 8 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

### CHEM 7201. Graduate Laboratory Rotations.

This course is designed to assist students in selecting a doctoral committee chair by having them work in several laboratories during their first semester in the program.

**2 Credit Hours. 0 Lecture Contact Hours. 8 Lab Contact Hours.**

**Grade Mode:** Credit/No Credit

### CHEM 7299. Dissertation.

This course consist of original research and writing in integrated molecular and biophysical chemistry to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

### CHEM 7300. Graduate Research.

This course is designed to provide doctoral students with an elective research option to allow them to collect preliminary data as they develop their dissertation proposal.

**3 Credit Hours. 0 Lecture Contact Hours. 12 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

### CHEM 7305A. Physico-Chemical Properties and Metabolism of Xenobiotics.

This course is designed to introduce students to the concepts of physico-chemical properties of small molecules and how these impact the ability of these molecules to be used as probes in biological systems, focusing on the role that metabolic processes play in limiting or activating chemical probes and the role of chemical probes in investigating these processes. Students will explore experimental and computational methods for determining the relevant properties of compounds.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

### CHEM 7311. Natural Products, Anti-Infective, and Anti-Cancer Agents.

This course is designed to introduce the natural products by discussing their important classes (secondary metabolites), classification, nomenclature, structure, biosynthesis, occurrence and structure elucidation. The study of their utilization in medicine as leads for the development of new antimicrobial and anticancer agents will constitute the main focus of the course. The students will learn how to utilize their knowledge of organic chemistry and biochemistry gained in undergraduate courses toward the application of advanced research active areas on chemistry-biology interface.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

### CHEM 7330. Environmental Chemistry.

An introduction to environmental chemistry, with an emphasis on aquatic resources. Basic principles of geochemistry and atmospheric chemistry, as they relate to pollutant impacts on aquatic ecosystems, also will be examined. Prerequisites: CHEM 2142 and CHEM 2342 and CHEM 3410 all with grades of "C" or better or instructor approval.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CHEM 7342. Bioinorganic Chemistry.**

This course is designed to provide a broad overview of metalloprotein active site design and reaction mechanisms catalyzed by metalloenzymes. Training sessions on the use of contemporary protein visualization tools will be provided and used throughout the course. Topics covered in the course include dioxygen transport and activating proteins, electron transfer proteins, dinitrogen (N<sub>2</sub>), and hydrogen (H<sub>2</sub>) activation, photosystem and oxygen evolution, zinc containing proteins, CO<sub>2</sub> reduction, and modern advancements in the field of bioinorganic chemistry. Students can expect to develop strong foundational knowledge in metalloenzyme structure, function, and reaction mechanisms.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CHEM 7354. Eukaryotic Molecular Biology and Macromolecular Structure.**

This course is designed to cover the specific topics of the regulation of gene expression in eukaryotes, including eukaryotic DNA replication, DNA repair, DNA recombination, DNA transcription, RNA processing, translation, post-translational protein modification. This course will also introduce the application of macromolecular structure determination in eukaryotic gene expression and its regulation. Students can expect to develop a strong foundation in eukaryotic molecular biology, a strong ability to discuss literatures and some grant writing ability.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CHEM 7361. Quantitative Methods in Biophysical Chemistry.**

This course will integrate the physical, chemical, and biological aspects of fundamental biophysical methods, including spectroscopy, calorimetry, and hydrodynamics. Students will develop a quantitative skillset in multiple analytical methods that are used to characterize a variety of biological systems. This course will provide students with the physical and chemical foundation to quantitatively study biological macromolecules at multiple levels of complexity.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CHEM 7385. Metabolism and Metabolomics.**

This course is designed to introduce students to the metabolism of macromolecules and the principles and practice of metabolomics. It will cover (1) biosynthesis and biodegradation of carbohydrates, lipids, amino acids, proteins, and nucleic acids; (2) metabolomics principles; (3) applications of metabolomics in the biomedical field. Discussions of literature in metabolomics studies will be emphasized.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CHEM 7391. Chemical Biology.**

This course will introduce the emerging field of chemical biology and common tools that are used to analyze and manipulate biological processes with small molecules. Students will develop a strong foundation in the design and synthesis of chemical tools to interrogate biological systems and focus on implementing and interpreting assays with these tools, using examples from the current literature.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CHEM 7395. Fundamentals in Molecular and Biophysical Chemistry.**

This course is designed to provide a functional overview of the physics, chemistry, and biology concepts that are central to the practice of molecular biophysical chemistry. Students will develop a broad scientific foundation to pursue interdisciplinary projects within the biophysical and biochemical sciences, as well as productively interface and collaborate with colleagues across sub-disciplines throughout their doctoral studies.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CHEM 7399. Dissertation.**

This course consist of original research and writing in integrated molecular and biophysical chemistry to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**CHEM 7599. Dissertation.**

This course consist of original research and writing in integrated molecular and biophysical chemistry to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**5 Credit Hours. 5 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**CHEM 7699. Dissertation.**

This course consist of original research and writing in integrated molecular and biophysical chemistry to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**6 Credit Hours. 6 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**CHEM 7999. Dissertation.**

This course consist of original research and writing in integrated molecular and biophysical chemistry to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**9 Credit Hours. 9 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**English (ENG)****ENG 7300. Language Problems in a Multicultural Environment.**

An introduction to the study of multicultural language and linguistics with descriptive, psychological, social, and semantic emphases.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**ENG 7314. Specializations in Professional and Technical Communication Topics.**

Provides theoretical and practical information for specialized types of technical and professional communication.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**ENG 7316. Foundations in Rhetoric and Composition.**

A course providing students with theoretical, pedagogical, and/or methodological foundations in the field of rhetoric and composition. Emphases vary but may include Contemporary Composition Pedagogy, Basic Writing Theory and Practice, and Writing Assessment. Repeatable with different emphases for up to nine hours of English credit.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**ENG 7317. Specializations in Rhetoric and Composition.**

A course providing theoretical, pedagogical, methodological, and/or administrative grounding in specialized areas of rhetoric and composition. Emphases vary but may include Writing Across the Curriculum, Service Learning, Writing Center Theory and Practice, Computers and Writing, Literacy. Repeatable with different emphases for up to nine hours of English credit.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**ENG 7326. Contemporary Composition Theory.**

Introduces students to the history of writing instruction in the university and to the theories of writing and composing that inform contemporary composition studies and the teaching of writing.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**ENG 7383. Studies in Rhetorical Theory.**

An introduction to classical and rhetorical theory in various areas of English studies. Recent emphases include Teaching of Composition and Technical Communication. Repeatable with different emphases for up to nine hours of English credit.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**Geography (GEO)****GEO 7190. Independent Study.**

Research in geography under the direction of a supervising professor. Repeatable once for additional credit with a different topic.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Standard Letter

**GEO 7199A. Dissertation.**

Original research and writing in Geography is to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**GEO 7199B. Dissertation.**

Original research and writing in Geographic Education is to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**GEO 7199C. Dissertation.**

Original research and writing in Geographic Information Science, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**GEO 7290. Independent Study.**

This course is designed to provide a student with credit while conducting independent research in consultation with his or her research advisor. Repeatable once for additional credit with a different topic.

**2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Standard Letter

**GEO 7299A. Dissertation.**

Original research and writing in Geography to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**GEO 7299B. Dissertation.**

Original research and writing in Geographic Education to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**GEO 7299C. Dissertation.**

Original research and writing in Geographic Information Science, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**GEO 7300. Advanced Geographic Research Design.**

The purpose of this course is to develop an appreciation for the process of research as practiced by contemporary professional geographers. Topics covered include formulating research problems, reviewing and critiquing published literature, developing and executing a research design, and completing a research project.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7301. Advanced Quantitative Methods in Geography.**

How to mathematically and statistically model geographic problems is the focus of this course. The application of multivariate statistical techniques to geographic problems and the problems that spatial data create in the application of statistical and other quantitative techniques are central issues.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7302. Nature and Philosophy of Geography.**

This course is a critical analysis of the historical development of geographic thought: its roots, its present status, and future directions. (MULT)

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Multicultural Content

**Grade Mode:** Standard Letter

**GEO 7304. Qualitative Research Methods.**

This course introduces the qualitative research paradigm, including research design, methods of data collection, and inductive analysis. Standards of scientific research that call for a deeper evaluation of complex social relationships are emphasized. The focus and application will be oriented towards human geography and nature-society relations.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7305. Historical Geography of the Environment.**

This course examines the evolution of environmental problems using the techniques and analytical perspectives of historical geography. Special emphasis is given to the emergence of environmental challenges related to urbanization and climate change. Students engage with scholarship related to historical geography of the environment and develop original research related to environmental change.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7308. Advanced Regional Field Studies.**

Advanced study of geographic phenomena during field excursions to a particular site or region. Course includes preparation of site inventory, site guides, and on-site presentations. Repeatable once for additional credit with a different site or region.

**3 Credit Hours. 1 Lecture Contact Hour. 4 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Standard Letter

**GEO 7313. Environmental Systems.**

Theories and concepts involved in environmental systems will be examined. Tools and research issues relevant to their analysis will also be explored. Basic principles, as well as specific research questions and techniques, will be proposed to give students a foundation for analysis of current issues involving environmental systems.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7316. Remote Sensing and the Environment.**

A detailed examination and implementation of sophisticated approaches for processing satellite digital images with emphasis on environmental applications.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7318. GIS and Environmental Geography.**

This course examines the nature of environmental problems and explores the potential of GIS for environmental modeling and management. The conceptual basis for using GIS as well as the framing of environmental research problems will be covered.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7330. Geography of Hazards.**

This seminar examines research on issues related to the geography of hazards. Topics will be determined by instructor and student interests. Special emphasis will be placed on conceptual, theoretical, and methodological approaches to advance the study of spatial aspects of hazards such as risk, vulnerability, resilience, relief, recovery, and change.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7334. Geographic Aspects of Water.**

This seminar is a critical analysis of developmental and current literature that define water's critical role in determining the physical and cultural characteristics of the earth. Principal focus will be placed on water's role on land use and as a critical resource.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7341. Urban Environment.**

Students in this course will critically engage with scholarly and governmental research relating to urban environments, urban environmentalism, and urban environmental management. Emphasis is placed on students developing and executing a unique, topically relevant research project aimed at improving our understanding of the way in which human-environment interaction influences, and is influenced by, urban geography and the urban experience. (MULT).

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Multicultural Content

**Grade Mode:** Standard Letter

**GEO 7342. Theories and Methods in Geographic Education.**

This seminar is a critical analysis of previous and current literature concerning problems in pedagogy, philosophy, learning theory, research methods, teaching methodologies, and techniques of geographic education. A research paper will be required of each student on a topic related to the course content. (MULT).

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Multicultural Content

**Grade Mode:** Standard Letter

**GEO 7344. Seminar in Geographic Curriculum.**

The seminar will be a survey and discussion of major curricula in geographic education. Geography will be viewed as a school subject that is part of the social studies, as an element of interdisciplinary studies, and as a stand alone subject.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7345. Contemporary Topics in Geographic Education.**

This course is a survey of initiatives and reforms in geography education spanning from the 1980s to the present day. Students are expected to develop and carry out research plans that address current theories in geographic education. Repeatable once for additional credit with a different topic.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Standard Letter

**GEO 7346. Standards and Assessment in Geography.**

An introduction to assessment procedures in geography education is central to the course. Analysis of national standards in geography and how they have affected geographic learning in grades K-12 will be addressed.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7349. Population Geography.**

An in-depth study of the growth, movement, and spatial distribution of human populations is the central theme. Students will read and discuss professional articles that stress both theory and analytical techniques. Topics will include population growth and the environment, rural and small town depopulation, spatial diffusion processes, migration trends and theories, urban population growth, and techniques such as multivariate analysis and population projections. (MULT).

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Multicultural Content

**Grade Mode:** Standard Letter

**GEO 7350. Practicum in Teaching Geography.**

This course introduces key concepts in teaching geography and provides regular training and planned periodic evaluations of instructional responsibilities. Course topics include instructional and assessment strategies in geography and classroom management. This course is required for first-year instructional assistants in the Geography Department. Students do not earn graduate degree credit.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Graduate

Assistantship|Exclude from Graduate GPA

**Grade Mode:** Leveling/Assistantships

**GEO 7352. Social Theory, Space, and Geography.**

This course examines key texts and concepts in social and political theory, focusing on theories of space and their mobilization in geographical research. Space and geography are approached with respect to several topics and debates in social theory including structuralism and agency, feminist theory and embodiment, racial formations, assemblage thinking and actor-network theory, hybridity, governance, and scale.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7361. Advanced Geographic Information Systems.**

This course provides exposure to advanced topics in GIS, particularly to quantitative methods and techniques for developing and interpreting models of natural and anthropogenic phenomena over the geographical space.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7362. Geographic Visualization.**

This course focuses on the interdisciplinary field of Geographic Visualization. Students will review visualization research in computer graphics, human computer interaction, GIScience, and cartography and relate the research approaches to useful and usable geographic visualizations. Prerequisite: GEO 3411 with a grade of "D" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7364. Geocomputation.**

Geocomputation reviews and analyzes concepts of computational modeling in Geography. The course will include modeling theory and advanced topics such as parallel processing, neural networks, cellular automata, scientific visualization, and fuzzy modeling. Students will practice model development, specifically spatially explicit simulation.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7365. Theoretical Cartography.**

This course focuses on theoretical developments in cartography, and in particular looks at the role of maps and other graphic devices as tools for the discovery, analysis, and communication of geographical knowledge. Prerequisite: GEO 3411 with a grade of "D" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7366. Advanced Topics in Remote Sensing.**

The course focuses on advanced topics including the theoretical basis, mathematical foundations, and current research frontiers in remote sensing. Prerequisite: GEO 5415 with a grade of "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7368. Lidar and SfM Data Processing and Analysis.**

This course covers doctoral level skills in Light Detection and Ranging (lidar) systems and Structure from Motion (SfM) workflows for mapping and analysis of the environment. Students learn to successfully apply knowledge of lidar data and SfM workflows for a variety of Geographic Information Science applications.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7369. Exploring Spatial Databases.**

This course covers principles of spatial ontologies and spatial semantics to facilitate appropriate database conceptualization, design and implementation. Course assignments and projects provide in-depth experience with database query languages. Course work is completed using a spatially-enabled Relational Database Management Systems (RDBMS). Prerequisite: GEO 7417 or equivalent with a grade of 'B' or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7370. Advanced Seminar in Environmental Geography.**

This research seminar focuses on the methods, approaches, issues, and concepts of major themes in environmental geography. Special emphasis will be placed on theoretical and conceptual understandings of how humans interact with the environment from a geographical perspective. Repeatable once for additional credit with a different topic.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Standard Letter

**GEO 7371. Advanced Seminar in Geographic Education.**

This research seminar analyzes literature and research into recent trends in geographic education. Emphasis will be on new developments in curriculum, content, and teaching methodologies. Repeatable once for additional credit with a different topic.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Standard Letter

**GEO 7372. Seminar in Geographic Information Science.**

This course deals with advanced and current research issues in Geographic Information Science. Based on this objective, the course aims at educating doctoral students to conduct research in Geographic Information Science as well as develop innovative applications of Geographic Information Science. May be repeated for credit with a different topic.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Standard Letter

**GEO 7390. Independent Study.**

Research in geography under the direction of a supervising professor. Repeatable once for additional credit with a different topic.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Standard Letter

**GEO 7393B. Biogeography in Mountain Environments.**

This course examines how plants and animals interact with and affect geomorphological processes and landforms, and how geomorphological processes, landforms and geological factors affect spatial distribution of animals and plants; all within the environmental limitation and conditions of mountains. The role of humans in affecting these interrelationships will be emphasized.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**GEO 7393C. Managing Urbanization.**

This course examines survey methods and procedures related to managing and preparing for urban growth. Selected topics for examination include transportation planning, housing, historic preservation, and environmental design.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**GEO 7393D. International Migration.**

This course provides a survey of geographic and social science research conducted across various topics of international migration. (MULT).

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Multicultural Content|Topics

**Grade Mode:** Standard Letter

**GEO 7393E. Geography of Land Management.**

This course explores U.S. land management philosophies, techniques, and development approaches. Major topics include land ethics/philosophies, U.S. traditions in cadastral geography, urban sprawl and green development, land conservation techniques, the role of local/state/federal regulation in land management, and the human-environment impacts of land development.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**GEO 7393F. Gender and Development.**

This course is a survey of geographic and social science research conducted across various topics of gender studies and international development. (MULT).

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Multicultural Content|Topics

**Grade Mode:** Standard Letter

**GEO 7393G. Political Geography.**

This course is a survey of geographic and social science research conducted across various topics of political geography. (MULT).

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Multicultural Content|Topics

**Grade Mode:** Standard Letter

**GEO 7393J. Soil and Society.**

This course explores the importance of soil resources for environmental and socioeconomic sustainability. Soil science will be introduced, but the majority of the course will focus on soil's value to societies. Specific topics that will be explored include soil geography, historical abuses of soil resources, and current conservation efforts.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**GEO 7393K. Biogeomorphology.**

This course will examine the ways in which plants and animals interact with and affect geomorphological processes and landforms, and how geomorphological processes, landforms, and geological factors affect spatial distributions of animals and plants. The role of humans in affecting these interrelationships will be emphasized.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**GEO 7393M. Global Climate Change.**

This course examines various implications of global climate change, including impacts on science, politics, and society. Emphasis will be placed on anthropogenic influences across the 20th and 21st centuries, contemporary mitigation options, and future adaptation strategies amidst a complex and dynamic climate system.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**GEO 7393N. Rivers and Society.**

This course examines river system processes and how they are influenced by human activities. We will discuss the principles and practices of large-scale river basin management with an emphasis on the different perspectives and motivations driving different management goals.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**GEO 7393P. Advanced Seminar in Human Geography.**

This course will engage students in systematic critical analysis of the theories and methods of human geography. The students will conduct careful research on a topic in human geography.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**GEO 7393Q. Geomorphology in the Anthropocene.**

This course will examine the ways in which humans interact with and affect geomorphological processes and landforms, and how humans directly act as geomorphological agents. The level at which human activities have transformed the surface of the Earth will be examined.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**GEO 7399A. Dissertation.**

Original research and writing in Geography, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each semester (including summer) for at least three dissertation hours.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**GEO 7399B. Dissertation.**

Original research and writing in Geographic Education, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each semester (including summer) for at least three dissertation hours.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**GEO 7399C. Dissertation.**

Original research and writing in Geographic Information Science, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each semester (including summer) for at least three dissertation hours.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**GEO 7415. Geographic Applications of Remote Sensing.**

Students will focus on geographic applications of the principles and practices of digital image processing, classification, and modeling using satellite images.

**4 Credit Hours. 2 Lecture Contact Hours. 4 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**GEO 7417. Geographic Information Systems.**

Course is concerned with the analysis of interpretation of maps stored in digital form. Students are introduced to the concepts involving computerized cartographic and geographic data input, storage and retrieval, data manipulation and analysis, graphic and tabular report generation, and cartographic modeling.

**4 Credit Hours. 2 Lecture Contact Hours. 4 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**GEO 7418. Technical Foundations and Methods in Geographic Information Science.**

This course addresses technical foundations and methods in management, analysis, visualization, and dissemination of geographically-referenced data and information in digital form. Topics include data structures, algorithms, and a variety of methods used in GIS and spatial data analysis.

**4 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**GEO 7419. Advanced Techniques in Geographic Information Science.**

This course develops advanced Geographic Information System (GIS) concepts and application issues, spatial data manipulation and analysis skills, and provides hands-on experience with GIS, programming, and spatial analytics hardware/software programs. Emphasis is placed on practical application of skills to real world issues using advanced GIS techniques and geoprogramming. Prerequisite: GEO 7417 or equivalent with a grade of "C" or better and instructor approval.

**4 Credit Hours. 2 Lecture Contact Hours. 3 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**GEO 7430. Field Methods.**

Methods and techniques for observing, measuring, recording, and reporting on geographic phenomena are investigated in this course. Students will learn the use of instruments and materials in the collection of data for mapping and field research in the local area. Prerequisites: GEO 2410 and GEO 3301 both with grades of "D" or better.

**4 Credit Hours. 2 Lecture Contact Hours. 4 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**GEO 7447. Spatial Graphics in Geographic Education.**

This course examines traditional and innovative geoinformation and geovisualization technologies and their relationship to spatial thinking and the teaching and learning of geography. The course reviews academic literature, research methods, and teaching methodologies related to spatial graphics in geographic education. The lab portion provides geovisualization design skills for geographic education.

**4 Credit Hours. 2 Lecture Contact Hours. 4 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**GEO 7599A. Dissertation.**

Original research and writing in Geography to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**5 Credit Hours. 5 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**GEO 7599B. Dissertation.**

Original research and writing in Geographic Education to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**5 Credit Hours. 5 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**GEO 7599C. Dissertation.**

Original research and writing in Geographic Information Science, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.

**5 Credit Hours. 5 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**GEO 7699A. Dissertation.**

Original research and writing in Geography, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each semester (including summer) for at least three dissertation hours.

**6 Credit Hours. 6 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**GEO 7699B. Dissertation.**

Original research and writing in Geographic Education, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each semester (including summer) for at least three dissertation hours.

**6 Credit Hours. 6 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**GEO 7699C. Dissertation.**

Original research and writing in Geographic Information Science, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each semester (including summer) for at least three dissertation hours.

**6 Credit Hours. 6 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**GEO 7999A. Dissertation.**

Original research and writing in Geography, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each semester (including summer) for at least three dissertation hours.

**9 Credit Hours. 9 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**GEO 7999B. Dissertation.**

Original research and writing in Geographic Education, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each semester (including summer) for at least three dissertation hours.

**9 Credit Hours. 9 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

**GEO 7999C. Dissertation.**

Original research and writing in Geographic Information Science, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each semester (including summer) for at least three dissertation hours.

**9 Credit Hours. 9 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit

## **Philosophy (PHIL)**

**PHIL 7101. Responsible Conduct of Research and Research Ethics.**

In this course students will examine issues, concepts, and cases in research ethics and the responsible conduct of research. Designed to meet NSF and NIH requirements for training, topics will include research integrity, conflicts of interest, authorship, peer review, human and animal experimentation, mentorship, data, and values in science. This course does not earn graduate degree credit.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from Graduate GPA|Leveling

**Grade Mode:** Leveling/Assistantships

**PHIL 7323. Environmental Ethics and Sustainable Aquatic Resources.**

Examination of the ethical implications of environmental use and management policies and practices, with emphasis on sustainable aquatic resources.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**PHIL 7355. Philosophy of Science.**

Students in this course will investigate the nature and processes of scientific inquiry; the role of values in generating and using scientific knowledge; some of the fundamental concepts in science, including relevant evidence, induction, explanation; and the intellectual commitments made when accepting a scientific theory.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter