College of Science and Engineering

Ph.D. in Aquatic Resources

Doctoral Major and Degree Offered
Aquatic Resources, Ph.D.

Ph.D. Program

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 also 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.

Admission Policy

For information regarding admission application requirements and deadlines, please visit our website at www.gradcollege.txstate.edu/aqrp.html.

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.aquaticresources.bio.txstate.edu/.

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
Degree Audit

Each Ph.D. student is issued a preliminary degree audit by the Office of the Graduate College that should be used to plan the student’s course of study. In the first term of enrollment, students should review the degree audit in consultation with their supervising professor and the Program Director.

With admission into the doctoral program, it is expected that students will pursue their course work and research activities in an efficient and timely manner. If it is determined that a student is not making adequate progress toward completion of the doctoral degree requirements, consultations will be undertaken between the student, his or her Ph.D. advisor, the Program Director, and the department Graduate Committee to develop a remediation plan, which may include revising a student’s program of study or research. Failure to successfully remedy documented deficiencies will result in termination of the student’s enrollment in the doctoral program at the discretion of the Graduate Committee. Students removed from the doctoral program in this manner may appeal to the Dean of the Graduate College for reinstatement in the program.

Course Work Requirements

For students entering the program with a master’s degree, the Ph.D. in Aquatic Resources requires the completion of 20 hours of core courses and 40 hours of elective courses and dissertation (including a minimum of 15 hours of dissertation credit). For students entering the program with a bachelor’s degree, the Ph.D. in Aquatic Resources requires the completion of 27 hours of core courses and 63 hours of elective courses and dissertation (including a minimum of 15 hours of dissertation credit). The selection of core courses should be made in consultation with the student’s Ph.D. advisor and the Program Director. With approval of the Program Director, a core course beyond the minimum required hours can be counted as an elective course toward the total hours required for the degree.

Core Courses

- BIO 7102 Seminar in Aquatic Resources
- BIO 7302 Problems in Aquatic Resources
- BIO 7303 Research
- BIO 7310 Global Aquatic Resources
- BIO 7312 Government Policy Impacts on Aquatic Resources
- BIO 7322 Scientific Method and Aquatic Resources
- BIO 7362 Environmental Impact Analysis
- BIO 7401 Assessment Techniques for Aquatic Resources
- BIO 7402 Molecular Field Techniques
- BIO 7405 Statistics and Experimental Design I
- BIO 7406 Statistics and Experimental Design II
- PHIL 7323 Environmental Ethics and Sustainable Aquatic Resources

Elective Courses:

- AG 7310 Agriculture and Sustainable Aquatic Resources
- BIO 7114 Collaborative Research
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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>BIO 7120</td>
<td>Population Biology Seminar</td>
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<tr>
<td>BIO 7214</td>
<td>Collaborative Research</td>
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<tr>
<td>BIO 7308</td>
<td>History of Vegetation and Climate</td>
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<tr>
<td>BIO 7314</td>
<td>Collaborative Research</td>
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<td>BIO 7324</td>
<td>Natural History and Conservation of Large Mammals</td>
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<td>BIO 7325</td>
<td>Wildlife and Recreation: Impacts and Management</td>
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<td>BIO 7328</td>
<td>Integrated Waterbird Management</td>
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<tr>
<td>BIO 7336</td>
<td>Evolutionary Ecology</td>
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<tr>
<td>BIO 7346</td>
<td>Conservation Biology</td>
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<td>BIO 7348</td>
<td>Aquatic Resources Economics</td>
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<td>BIO 7350</td>
<td>Aquatic Resources Law</td>
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<td>BIO 7353</td>
<td>Biogeography</td>
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<td>BIO 7355</td>
<td>Plant-Water Relations</td>
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<td>BIO 7356</td>
<td>Pollution of Aquatic Ecosystems</td>
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<td>BIO 7360</td>
<td>Special Topics in Aquatic Resources</td>
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<td>BIO 7366</td>
<td>Integrated Water Resources Management</td>
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<td>BIO 7367</td>
<td>Behavioral Ecology</td>
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<td>BIO 7368</td>
<td>Introduction to Ecological Modeling</td>
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<td>BIO 7407</td>
<td>Instrumentation for Water Quality Analysis</td>
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<td>BIO 7408</td>
<td>Fish Ecology and Conservation</td>
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<td>BIO 7410</td>
<td>Aquatic Microbial Ecology</td>
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<td>BIO 7412</td>
<td>Environmental Hydrology</td>
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<td>BIO 7415</td>
<td>Ichthyology</td>
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<td>BIO 7419</td>
<td>Stream Ecology</td>
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<td>BIO 7421</td>
<td>Landscape Dynamics</td>
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<td>BIO 7422</td>
<td>Wetlands Ecology</td>
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<td>BIO 7424</td>
<td>Phycology</td>
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<td>BIO 7426</td>
<td>Ecology Management of Aquatic Macrophytes</td>
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<td>BIO 7427</td>
<td>Principles of Population Biology I</td>
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<td>BIO 7428</td>
<td>Principles of Population Biology II</td>
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<td>BIO 7433</td>
<td>Population Genetics</td>
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<td>BIO 7434</td>
<td>Herpetology</td>
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<td>BIO 7440</td>
<td>Aquatic Toxicology</td>
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<td>BIO 7447</td>
<td>Microbial Physiology and Genetics</td>
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<td>BIO 7466</td>
<td>Phylogenetics</td>
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<td>BIO 7468</td>
<td>Groundwater Resources</td>
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<td>BIO 7470</td>
<td>Limnology</td>
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<td>BIO 7471</td>
<td>Reservoir Ecology</td>
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<td>BIO 7475</td>
<td>Restoration of Polluted Aquatic Resources</td>
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<td>CHEM 7330</td>
<td>Environmental Chemistry</td>
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<td>ENG 7314</td>
<td>Specializations in Professional and Technical Communication Topics: Writing</td>
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<td>GEO 7316</td>
<td>Remote Sensing and the Environment</td>
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<td>GEO 7318</td>
<td>GIS and Environmental Geography</td>
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<td>GEO 7334</td>
<td>Geographic Aspects of Water</td>
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<tr>
<td>HR 7375</td>
<td>Aquatic Health Ecology and Human Disease</td>
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<tr>
<td>POSI 7310</td>
<td>Resolution of Disputes Involving Aquatic Resources</td>
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Dissertation: 15 hours minimum

- BIO 7199A Dissertation
- BIO 7299A Dissertation
- BIO 7399A Dissertation
- BIO 7599A Dissertation
- BIO 7699A Dissertation
- BIO 7999A Dissertation

Advancement to Candidacy

Application for Advancement to Candidacy

Students can download the “Advancement to Candidacy Application” from the Biology Department 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 Advancement to Candidacy application to the Dean of the Graduate College for review and approval.

Advancement to Candidacy Time Limit

Students entering the doctoral program in Aquatic Resources with a master’s degree and receiving departmental support are expected to take the Advancement to Candidacy 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 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 doctoral program is required for admission to candidacy. No grade below “B” on any graduate course work may apply toward a Ph.D. degree in Aquatic Resources 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.

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 “Ph.D. 
Dissertation Proposal” form which can be downloaded from the Biology Department 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.

Advancement to Candidacy Examination

Students in the Aquatic Resources 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 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 Biology Department’s Guide to Graduate Study or obtained 
from the Program Director.

The Advancement to Candidacy 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 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.

Recommendation for Advancement to Candidacy

The Dissertation Committee recommends the applicant for Advancement to Candidacy by 
completing the “Advancement to Candidacy Examination Report” which can be downloaded from the 
department’s website or obtained from the Program Director. The results of the Advancement to 
Candidacy Examination 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 
this report 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 Graduate 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 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 doctorate-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 Advisor Assignment Form” and the “Dissertation Committee Request Form,” which can be downloaded from the department’s website or obtained from the Program Director.

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 “Ph.D. Research Advisor/Committee Member Change Request Form” may be downloaded from the department’s website or obtained from the Program Director.

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 65 days before the date of commencement during the semester in which the student intends to graduate. 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,” which can be downloaded from the department’s website or obtained from the Program Director, 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 Biology Department’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, the student must submit one copy of the dissertation, at least two signature pages, and a copy of the dissertation abstract to the Office of the Graduate College for final approval. All dissertation abstracts must be published in Dissertation Abstracts International. Specific guidelines for approval and submission of the dissertation can be obtained from the Office of the Graduate College.

Fee Reduction

Fee Reduction. A master’s or doctoral degree candidate for graduation may be eligible for a one-time fee reduction under V.T.C.A, Education Code, Section 54.054. Please refer to the section titled Fee Reduction in the Additional Fees and Expenses chapter of this catalog for more information.

Courses Offered

AG 7310 Agriculture and Sustainable Aquatic Resources. (3-0) Study of the impacts of agricultural on aquatic resources, including agricultural water requirements for various types of crops and soils, impacts of agricultural chemicals on aquatic ecosystems, efficiency of alternative irrigation practices, and means for altering or mitigating current practices that can adversely affect aquatic resources.

BIO 7100 Professional Development. (1-0) 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. Graded on a credit (CR), no-credit (F) basis.

BIO 7102 Seminar in Aquatic Resources. (1-0) 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.

BIO 7103 Topics in Aquatic Resources. (1-0) This course focuses on selected topics in aquatic resources, including scientific and socioeconomic aspects of aquatic resources issues.

BIO 7103A Ecology and Society. (1-0) 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.

BIO 7103B Aquaculture. (1-0) 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.
BIO 7103C Aquatic Toxicology. (1-0) An introduction to the principles, concepts and mechanisms of aquatic toxicology, and the implications of this issue regarding environmental and ecosystem quality and sustainability.

BIO 7103D Molecular Biology of the Cell. (1-0) 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.

BIO 7103E Contemporary Problems in Ecology. (1-0) 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.

BIO 7103F Molecular Genetics of Plant Development. (1-0) 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.

BIO 7103G Ecohydrology. (1-0) 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.

BIO 7103H Integrated Waterbird Management. (1-0) 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.

BIO 7103I Avian Ecology and Evolution. (1-0) 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 there hypotheses. This course also discusses peer-reviewed literature that challenges some paradigms in avian ecology and evolution.

BIO 7114 Collaborative Research. (1-1) 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, 7399A, or 7699A. This course recognizes the collaborative nature of scientific investigation.

BIO 7120 Population Biology Seminar. (1-0) This course facilitates exploration of current topics in population and conservation biology through reading and discussion of contemporary primary and secondary literature.

BIO 7214 Collaborative Research. (2-2) 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, 7399A, or 7699A. This course recognizes the collaborative nature of scientific investigation.

BIO 7302 Problems in Aquatic Resources. (3-0) 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.

BIO 7303 Research. (3-3) 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 term until admission to Candidacy, although it may not be taken more than three times for doctoral credit without the approval of Graduate Program Director.

BIO 7308 History of Vegetation and Climate. (3-1) 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: Consent of instructor.
BIO 7310 Global Aquatic Resources. (3-0) 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.

BIO 7312 Government Policy and Aquatic Resources. (3-0) Examination of aquatic resources issues in federal, state, or local governments, including examination of goals and relations of different governmental entities to each other. Relevant international treaties, and federal and state statutes in which these policies are embodied, are examined.

BIO 7314 Collaborative Research. (3-3) 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, 7399A, or 7699A. This course recognizes the collaborative nature of scientific investigation.

BIO 7322 Scientific Method and Aquatic Resources. (3-0) Analysis of the scientific method applied to ecological research, focusing on aquatic ecosystems. Topics include methods of reasoning and statistical inferences in research, strategies of scientific research in aquatic ecology, and scientific research as a social process.

BIO 7324 Natural History and Conservation of Large Mammals. (3-0) 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.

BIO 7325 Wildlife and Recreation: Impact, Policy, and Management. (3-0). Students will be introduced to the impact human recreational activities have on wildlife habitats and populations. Management practices to enhance human-wildlife encounters or to minimize detrimental effects on wildlife populations will be presented. Prerequisite: BIO 4416.

BIO 7328 Integrated Waterbird Management. (3-0) This course examines the principles and practical methodology of integrated waterbird conservation and management, including overview of waterbird ecology, techniques in monitoring and data collection related to population dynamics, and habitat parameters of waterbird species. Field trips may be required.

BIO 7336 Evolutionary Ecology. (3-0) 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.

BIO 7346 Conservation Biology. (3-0) 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.

BIO 7348 Aquatic Resources Economics. (3-0) Examination of economic and related social issues for facilitation of sustainable aquatic resources for competing beneficial human uses and ecosystem maintenance, including valuation of aquatic ecosystem services. Prerequisite: BIO 7312 or consent of instructor.

BIO 7350 Aquatic Resources Law. (3-0) Examination of treaties, state and federal laws, and regional and local regulations, affecting freshwater and coastal aquatic resources. The focus is on aquatic ecosystems, water quantity and quality and environmental conditions, including the availability, storage, use, and protection of aquatic resources. Prerequisite: BIO 7312 or consent of instructor.

BIO 7353 Biogeography. (3-1) 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. Prerequisites: Undergraduate evolution and ecology courses, or consent of instructor.
BIO 7355 Plant-Water Relations. (3-0) 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. Prerequisite: BIO 3465 or equivalent, or consent of instructor.

BIO 7356 Pollution of Aquatic Ecosystems. (3-0) Overview of the water quality degradation of aquatic ecosystems (rivers, lakes, wetlands, groundwater aquifers) and their living resources from point and nonpoint pollutant sources. Topics will include aquatic ecosystem pollution and impacts attributable to nutrients, heavy metals, organic chemicals, sediment, salinization, and acid rain. Field trips may be required.

BIO 7356A Industry and Sustainable Aquatic Resources. (3-0) 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.

BIO 7360 Special Topics in Aquatic Resources. (3-0) Examination of current or emerging state, national and international aquatic resources issues, including root causes and their human and ecosystem implications. 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 Graduate Program Director.

BIO 7360B Environmental Linkages and Sustainable Aquatic Resources. (3-0) 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.

BIO 7360E Advances in Water Quality Investigations. (3-0) Examination of current or emerging state, national and international aquatic resources issues, including root cause 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.

BIO 7360G Molecular Techniques in Microbial Ecology. (3-0) Lectures on molecular techniques used to analyze structure and function of uncultured microbial communities in the environment with selected examples of applications. Prerequisites: None.

BIO 7360I Bayesian Statistics for Biology. (3-0) 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 procedure for problems in biological sciences. Prerequisites: BIO 7405 and BIO 7406.

BIO 7360N Behavioral Ecology. (3-0) Examination of evolutionary implications of behavioral interactions through the assessment of current theory and research related to cooperation and conflict, mating and parental conflict and sexual selection. Class will consist of lectures, discussions of recent primary literature, and scientific writing.

BIO 7360P Special Topics in Aquatic Resources: Regulation of Plant Growth and Development. (3-0) 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.

BIO 7360Q Special Topics in Aquatic Resources: Spatial Ecology of Animals. (3-0) 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.
BIO 7360R Special Topics in Aquatic Resources: Community and Ecosystem Ecology. (3-0) 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.

BIO 7360T Special Topics in Aquatic Resources: Karst Hydrogeology and Geomorphology. (3-0) 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. Pre-requisite: Graduate status and instructor's approval.

BIO 7360U Sustainability in a Changing World. (3-0) 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.

BIO 7360V Techniques in Aquatic Biology. (3-0) 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.

BIO 7362 Environmental Impact Analysis. (3-0) Examination of government regulations regarding environmental impact, content of environmental impact statements, procedure for impact studies, application of ecological principles to impact studies, and the review process for environmental impact statements, focusing on aquatic resources.

BIO 7366 Integrated Water Resources Management. (3-0) Study of principles for integrated management of aquatic ecosystems, including drainage basin, regional, and transboundary dimensions. Other global issues (climate change, biodiversity, etc.) also are discussed as components of integrative approach for multi-functional programs for sustainable use of aquatic ecosystems. Prerequisites: BIO 7310 and 7412 or consent of instructor.

BIO 7367 Behavioral Ecology. (3-0) Examination of the evolutionary implications of behavioral interactions through the assessment of current theory and research related to social behavior, sexual selection and sexual conflict, and mechanisms of behavior. Students will achieve comprehension and familiarity with the historical development of the field of behavioral ecology through discussions and writing.

BIO 7401 Assessment Techniques for Aquatic Resources. (3-3) The rationale for designing and implementing monitoring and sampling programs for aquatic resources is examined. General field and laboratory methods for assessing water quantity, water quality and the status of aquatic ecosystems and their living resources will be introduced. Field trips will be required.

BIO 7402 Molecular Field Techniques. (2-3) 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.

BIO 7405 Statistics and Experimental Design I. (3-0) 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.

BIO 7406 Statistics and Experimental Design II. (3-0) 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 or consent of instructor.
**BIO 7407 Instrumentation for Water Quality Analysis.** (3-3) An introduction to the theory and application of laboratory and field instrumentation and techniques for analysis of water quality. Prerequisite: CHEM 3410 or consent of instructor.

**BIO 7408 Fish Ecology and Conservation.** (3-3) Examination of the linkages and interactions between fish assemblages and communities and their population ecology. Issues related to flowing and pooled water systems and fisheries conservation also are discussed. Field trips may be required.

**BIO 7410 Aquatic Microbial Ecology.** (3-3) Examination of microbial organisms, communities, and interactions affecting the form, structure, and functional aspects of aquatic ecosystems. Field trips may be required. Prerequisite: BIO 2400/3440 (Microbiology) or consent of instructor.

**BIO 7412 Environmental Hydrology.** (3-3) 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.

**BIO 7415 Ichthyology.** (3-3) An introduction to the morphology, taxonomy, natural history, and evolution of fishes. Field trips will be made to collect specimens, and laboratory periods will be devoted to morphological and systematic analyses. Prerequisite: Biology undergraduate zoology course or consent of instructor.

**BIO 7419 Stream Ecology.** (3-3) 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.

**BIO 7421 Landscape Dynamics.** (3-3) Study of processes influencing energy and material flows, interactions and cycling in aquatic ecosystems, including system and spatial analysis of landscapes, aquatic ecosystems, land use characteristics, and associated human impacts. Field trips may be required. Knowledge of calculus recommended. Prerequisite: BIO 7412 or consent of instructor.

**BIO 7422 Wetlands Ecology.** (3-3) Study of the characteristics, classification, conservation and management of marshes and other periodically-inundated ecosystems, emphasizing the interactions of physical, chemical and biological factors. Field trips may be required. Prerequisite: BIO 4416 or consent of instructor.

**BIO 7424 Phycology.** (3-3) Examination of algae (phytoplankton, periphyton) and their structure, taxonomy, ecology and distribution.

**BIO 7426 Ecology and Management of Aquatic Macrophytes.** (3-3) Examination of aquatic macrophytes and their ecology, taxonomy, distribution and management. Field trips may be required.

**BIO 7427 Principles of Population Biology I.** (3-3) Provides a foundation in theory and mathematics of basic population biology. The course is divided into modular components including defining evolutionary significant units, ecology of populations, genetics of populations, and evolutionary genetics. Prerequisites: BIO 4416 and 2450, or permission of instructor.

**BIO 7428 Principles of Population Biology II.** (3-3) 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. Prerequisite: BIO 7427 or permission of instructor.

**BIO 7433 Population Genetics.** (3-2) 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.
BIO 7434 Herpetology. (3-3) 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.

BIO 7440 Aquatic Toxicology. (3-3) Introduction to principles for identifying and assessing the adverse effects of chemicals and other compounds and mixtures on aquatic organisms and ecosystems. Completion of BIO 7402 is recommended prior to enrollment in BIO 7440.

BIO 7447 Microbial Physiology and Genetics. (3-3) 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 and genetics that permit them to be so successful. Prerequisites: BIO 2400 and 2450 or equivalents.

BIO 7466 Phylogenetics. (2-3) 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, 4369 and 5466, or consent of instructor.

BIO 7468 Groundwater Resources. (3-3) 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.

BIO 7469 Introduction to Ecological Modeling. (2-2) 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 or equivalent or consent of instructor.

BIO 7470 Limnology. (3-3) Physical, chemical, and biological factors affecting productivity in lakes, ponds, and streams. Limnology sampling methods, chemical and biological analysis of samples, and hydrographic surveying are included in the laboratory. Prerequisite: One year of chemistry or consent of instructor.

BIO 7471 Reservoir Ecology. (3-3) Study of the physical, geological, chemical, and biological factors that influence and form structural and functional aspects of reservoir ecosystems. Lab focuses on field, laboratory, and mathematical approaches to quantifying and managing these important ecosystems. Field trips may be required. Prerequisite: Biology 4470 or 5470 or consent of instructor.

BIO 7475 Restoration of Polluted Aquatic Resources. (3-3) Overview of methods for treating or restoring aquatic resources degraded by pollution and related anthropogenic impacts. Topics include point and nonpoint source pollution of surface waters and groundwater aquifers, pollution from storage and waste disposal sites, aquatic habitat rehabilitation, and on-site methods. Field trips may be required. Prerequisite: BIO 7356 or consent of instructor.

CHEM 7330 Environmental Chemistry. (3-0) 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 1341/1141, CHEM 1342/1142, CHEM 2341/2141, CHEM 2342/2142 and CHEM 3410, or consent of instructor.

ENG 7314: Specializations in Professional and Technical Communication Topics: Writing and Communicating about Aquatic Resources Issues. (3-0) Provides theoretical and practical information for specialized types of technical and professional communication.

GEO 7316 Remote Sensing and the Environment. (3-0) A detailed examination and implementation of sophisticated approaches for processing satellite digital images with emphasis on environmental applications.
**GEO 7318 GIS and Environmental Geography.** (3-0) This course examines the nature of environmental problems and exploration of 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.

**GEO 7334 Geographic Aspects of Water.** (3-0) This seminar is a critical analysis of developmental and current literature that defines 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.

**HR 7375 Aquatic Health Ecology and Human Disease.** (3-0) Introduction to the health consequences of human-environment interaction and aquatic pollution. Topics to include bacterial and toxic aquatic agents and their relation to human disease. Control of communicable and noninfectious diseases from water resources, and epidemiological principles important to research in waterborne human disease, will be examined.

**PHIL 7323 Environmental Ethics and Sustainable Aquatic Resources.** (3-0) Examination of the ethical implications of environmental use and management policies and practices, with emphasis on sustainable aquatic resources.

**POSI 7310 Resolution of Disputes Involving Aquatic Resources.** (3-0) Analysis of historically significant environmental disputes affecting aquatic resources and establishing precedents for resolution subsequent disputes. Techniques for resolving environmental disputes (e.g., litigation, arbitration, mediation, negotiation) and how science and scientists are used in each procedure. Design of systems for using dispute resolution procedures in appropriate sequence.

**Dissertation**

**BIO 7199A Dissertation in Aquatic Resources.** (1-0) 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 term. Graded on a credit (CR), non-credit (F) basis.

**BIO 7299A Dissertation.** (2-0) 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 term (including summer) for at least three dissertation hours. Graded on a credit (CR), progress (PR), no–credit (F) basis.

**BIO 7399A Dissertation.** (3-0) 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 term (including summer) for at least three dissertation hours. Graded on a credit (CR), progress (PR), no–credit (F) basis.

**BIO 7599A Dissertation.** (5-0) 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 term (including summer) for at least three dissertation hours. Graded on a credit (CR), progress (PR), no–credit (F) basis.

**BIO 7699A Dissertation.** (6-0) 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 term (including summer) for at least three dissertation hours. Graded on a credit (CR), progress (PR), no–credit (F) basis.

**BIO 7999A Dissertation.** (9-0) 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 term (including summer) for at least three dissertation hours. Graded on a credit (CR), progress (PR), no–credit (F) basis.
Graduate Faculty

Core Doctoral Faculty

*Eligible to chair Dissertation Committees and teach doctoral courses*

Bonner, Timothy H., Professor of Biology. B.S., Texas A&M University; M.S., Texas State University; Ph.D., Texas Tech University. (Ichthyology, Fisheries Management)

Dharmasiri, Nihal, Associate Professor of Biology. B.Sc., M.Phil., University of Peradeniya, Sri Lanka; Ph.D., University of Hawaii at Manoa. (Plant Molecular and Developmental Biology)

Forstner, Michael R.J., Professor of Biology and Chief Curator, Vertebrate Collections. B.S., Texas State University; M.S., Sul Ross State University; Ph.D., Texas A&M University. (Genetics, Systematics)

Gabor, Caitlin R., Professor of Biology. B.A., University of California-Santa Barbara; M.S., Ph.D., University of Louisiana at Lafayette. (Environmental and Evolutionary Ecology)

Green, M. Clay, Associate Professor of Biology. B.A., The University of Texas at Austin; M.S., Sul Ross State University; Ph.D., University of Louisiana at Lafayette. (Wildlife Ecology and Ornithology)

Hahn, Dittmar, Professor of Biology and Doctoral Program Director. B.S., M.A., University of Hamburg; Ph.D., Wageningen Agricultural University. (Microbial Ecology)

Martin, Noland H., Associate Professor of Biology. B.S., The University of Texas at Austin; M.S., University of Oregon; Ph.D., Duke University. (Plant Speciation, Hybridization)

McLean, Robert J.C., Professor of Biology. B.Sc., University of Guelph; Ph.D., University of Calgary. (Bacterial Structure and Function, Microbial Ecology)

Nice, Christopher C., Professor of Biology. B.S., University of Minnesota-Twin Cities; Ph.D., University of California-Davis. (Population Genetics, Ecology)

Nowlin, Weston H., Associate Professor of Biology. B.A., Austin College; M.S., Texas Christian University; Ph.D., University of Victoria. (Wetlands Ecology)

Rast, Walter, Professor of Biology. B.A., The University of Texas at Austin; M.S. (Molecular Biology), M.S. (Environmental Science), Ph.D., University of Texas at Dallas. (Limnology, Water Quality, Aquatic Resource Management)

Schwartz, Benjamin F., Associate Professor of Biology. B.S., Radford University; Ph.D., Virginia Polytechnic Institute and State University. (Karst Hydrogeology)

Schwinning, Susan, Associate Professor of Biology. Diploma, University of Göttingen; M.S., University of California-Davis; Ph.D., University of Arizona. (Plant Ecology, Quantitative Ecology)
Tomasso, Joseph R., Professor and Chair of the Department of Biology. B.S., M.S., University of Tennessee at Martin; Ph.D., University of Memphis. (Stress and Environmental Physiology)

Upchurch, Garland R., Jr., Associate Professor of Biology. B.S., University of Nebraska; M.S., Ph.D., University of Michigan. (Paleobotany, Paleoecology, Global Change)

Veech, Joseph A., Associate Professor of Biology. B.S., Texas A&M University; M.S., New Mexico State University; Ph.D., University of Nevada, Reno. (Population and Community Ecology; Wildlife and Conservation Biology)

Weckerly, Floyd, Professor of Biology. B.S., M.S., Eastern New Mexico University; Ph.D., University of Memphis. (Biostatistics, Wildlife Ecology)

Weigum, Shannon E., Assistant Professor of Biology. B.A., Texas A&M University; M.S., Texas State University; Ph.D., The University of Texas at Austin. (Biosensors for Disease Diagnostics)

Zhang, Yixin, Assistant Professor of Biology. B.S., Nanjing Normal University; M.S., Ph.D., Umeå University. (Stream Ecology)

Associate Doctoral Faculty

Eligible to serve on Dissertation Committees and teach doctoral courses

Garcia, Dana M., Professor of Biology. B.S., Texas A&M University; Ph.D., University of California-Berkeley. (Cell Biology, Physiology)

Groeger, Alan W., Associate Professor of Biology. B.S., Purdue University; M.S., Central Michigan University; Ph.D., University of Oklahoma. (Limnology, Aquatic Sciences)

Huston, Michael A., Professor of Biology. B.A., Grinnell College; M.S., Ph.D. University of Michigan. (Landscape Ecology)

Lopes, Vicente L., Professor of Biology. B.S., Federal University of Ceará; M.S., Federal University of Paraíba; Ph.D., University of Arizona. (Watershed Science)

Ott, James R., Associate Professor of Biology. B.S., George Mason University; M.S., North Carolina State University; Ph.D., University of Maryland College Park. (Ecology, Evolutionary Biology)

Simpson, Thomas R., Associate Professor of Biology. B.A., University of Dallas; M.S., Ph.D., Texas A&M University. (Zoology, Wildlife Management)
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Department of Biology

Degree Programs:
M.S. – Master of Science
M.A. – Master of Arts

Master’s Majors and Degrees Offered:
Aquatic Resources, M.S.
Biology, M.A., M.S.
Population and Conservation Biology, M.S.
Wildlife Ecology, M.S.

Master’s Programs

The Department of Biology offers several degree options for students wishing to pursue graduate study at the master’s level. Incoming students may select one of six degree options: the Master of Science with a major in Biology (thesis or non-thesis), the Master of Arts with a major in Biology (thesis), the Master of Science with a major in Aquatic Resources (thesis), the Master of Science with a major in Population and Conservation Biology (thesis), or the Master of Science with a major in Wildlife Ecology (thesis). Thesis-based degrees are usually chosen as preparation for professional careers or advanced graduate work (Ph.D., D.V.M., or M.D.) and by students seeking advanced training for technology-related industries. Non-thesis degrees may be chosen by students preferring broad training in biology without a formal research experience; this plan is often chosen by secondary science teachers wishing to broaden their content training without taking additional education courses.

Master of Science in Biology. The thesis-based Master of Science degree with a major in Biology requires a minimum of 30 semester hours of course work including three one-hour seminars (BIO 5110, 7102, or 7120) or BIO 5295 and two one-hour seminars, two terms of thesis (BIO 5399A/B), and a minimum of 21 additional hours of 5000- or 7000-level Biology course work. The non-thesis Master of Science degree with a major in Biology requires a minimum of 45 semester hours of 5000- or 7000-level course work, including at least one term of an independent study project (BIO 5390) and either three one-hour seminars (BIO 5110, 7102, or 7120) or BIO 5295 and two one-hour seminars. A supporting minor for these degrees may be selected with the approval of the appropriate graduate advisor. For the thesis-based degree, the minor must be in the College of Science and Engineering or Department of Geography; for the non-thesis degree, any graduate minor may be chosen.

Master of Arts in Biology. The thesis-based Master of Arts degree with a major in Biology has the same requirements as outlined above for the Master of Science degree, except it permits substitution of non-science course work for students wishing to have a graduate minor outside of the College of Science.

A maximum of two courses offered in other departments may be substituted for elective course work towards the M.S. and M.A. in Biology degrees with prior approval of the graduate advisor and Dean of the Graduate College. Courses taught outside the department that do not require prior approval are: CHEM 5385-MP; HR 5330, 5331, 5339, 5351; and GEO 5415, 5418, 5419, 7417.

Master of Science in Aquatic Resources. The Master of Science with a major in Aquatic Resources is a thesis-based degree that emphasizes research in aquatic ecosystems and the biological communities that they support. This degree requires a minimum of 31 semester hours of course work including two one-hour seminars (BIO 5110, 7102, or 7120), a two-term sequence of courses in statistics and experimental design (BIO 7405, 7406) and two terms of thesis (BIO 5399A/B).

Graduate students pursuing an M.S. in Aquatic Resources can select one of two areas of concentration for their course work and research: Aquatic Biology or Aquatic Systems. Students in the
Aquatic Biology concentration will focus on the biology and ecology of aquatic organisms and an understanding of the dynamics and management of aquatic ecosystems and must complete a minimum of seven hours of course work chosen from BIO 5336, 5415, 5419, 5470, 7328, 7356, 7422, and 7471. Students in the Aquatic Systems concentration will focus on an understanding of the structure and functioning of aquatic systems as integrated physical, biological, and socioeconomic entities and will emphasize practices aimed at protecting, maintaining, and restoring the health and sustainable use of these resources. This area of concentration encourages investigation of aquatic systems at the level of the watershed, as influenced by atmospheric and terrestrial processes, and requires students to complete a minimum of seven hours of course work chosen from BIO 7312, 7353, 7366, 7419, 7421, 7422, 7468 and 7471. In addition to these requirements, all students pursuing an M.S. in Aquatic Resources must complete sufficient additional semester hours of 5000- or 7000-level elective courses, chosen in consultation with the thesis advisor, thesis committee, and Program Director, to fulfill the course work requirement for the degree.

Master of Science in Population and Conservation Biology. The M.S. with a major in Population and Conservation Biology requires a minimum 30 semester hours of course work and research leading to a thesis. The program represents an interdisciplinary course of study that combines principles of population biology with strong training in measurement and analysis of biological systems augmented with the student’s choice of study in particular specialties. Students are required to complete a minimum of six hours of core courses (BIO 7336, 7346, 7360R, 7367, 7427, 7428, 7433, 7466, or 7469) and a two-term sequence of courses in statistics and experimental design (BIO 7405, 7406). The course of study also includes a two-term sequence of population biology seminars (BIO 7120) and two terms of thesis (BIO 5399A/B), as well as elective courses to be chosen in consultation with the graduate advisor and major professor that allow students to specialize in particular sub-disciplines of the field, including the ecology of populations, population management, conservation biology or evolutionary ecology and genetics.

Master of Science in Wildlife Ecology. The M.S. in Wildlife Ecology is a thesis-based degree with an emphasis on the application of ecological principles to studies in the fields of wildlife ecology and natural resource management. This degree requires a minimum of 30 semester hours of course work including two terms of statistics and experimental design (BIO 7405, 7406), three one-hour seminars (BIO 5110) or BIO 5295 and two one-hour seminars, two terms of thesis (BIO 5399A/B), and a minimum of 13 additional hours of 5000- or 7000-level courses that relate to the student’s area of interest.

Admission Policy

For information regarding admission application requirements and deadlines, please visit the Graduate College website using one of the following links:

Aquatic Resources  www.gradcollege.txstate.edu/aqrm.html
Biology  www.gradcollege.txstate.edu/bio.html
Population & Conservation Biology  www.gradcollege.txstate.edu/pcbio.html
Wildlife Ecology  www.gradcollege.txstate.edu/weco.html

Thesis Students

Students pursuing a master’s degree with thesis should have a thesis committee approved by the end of their first long term of enrollment in the graduate program. The thesis committee comprises three or more individuals and is chaired by the thesis advisor. Committee members should be selected by the student in consultation with the thesis advisor and should be chosen on the basis of what they can contribute to the student’s research and/or graduate studies. Committee members expect to be consulted
about the research project and should contribute guidance and expertise to the project. A “Master’s Thesis Committee Form” can be downloaded from the Biology Department website and must be approved by the chair of the department’s Graduate Committee and the department chair prior to the submission of a Thesis Proposal.

Students working on a thesis are expected to enroll in a thesis course (BIO 5399) each term that they are actively involved in research. Students should enroll in BIO 5399A for their first term of thesis research and in BIO 5399B for all subsequent terms. While enrolled in BIO 5399A the student should prepare a detailed Thesis Proposal that introduces the project to be investigated, summarizes the relevant background literature, and explains the methodology to be used in carrying out the research. A “Master’s Thesis Proposal” form can be downloaded from the department’s website. Submission of an approved Thesis Proposal to the Office of the Graduate College must be completed before the end of the student’s second term of enrollment in BIO 5399. Students pursuing a thesis-based degree must be enrolled in BIO 5399 during the term in which they graduate.

All students completing a thesis are required to present the results of their research in an open seminar attended by the thesis committee members and other interested individuals. Following the public presentation of the thesis, the student must pass a comprehensive examination administered by the thesis committee.

Non-Thesis Students

Students pursuing a non-thesis degree are required to have a major professor by the end of their first long term of enrollment in the graduate program. The major professor will normally be a faculty member specializing in an area of particular interest to the student and is often the individual who supervises the required independent study project. Prior to the final term of enrollment the non-thesis student must, in consultation with the major professor, select a committee that will administer the final comprehensive examination. A “Master’s Non-Thesis Committee Form” can be downloaded from the Biology Department website and must be approved by the chair of the department’s Graduate Committee and the department chair.

Comprehensive Examination

All candidates for master’s degrees in the Department of Biology must pass a comprehensive final examination administered by the student’s committee. The examination may be oral or written and must cover, at a minimum, the student’s field of concentration and the thesis, if one was written. The results of this exam should be reported on the “Comprehensive Examination Report for Master's Degree” form, which can be downloaded from the department’s website and which must be filed in the Office of the Graduate College at least 10 days prior to the date of expected graduation.

Financial Assistance

Assistantships and scholarships are available to qualified applicants on a competitive basis. In order to be considered for assistantships or scholarships, applicants must have their application completed for review before the priority application deadline. The Department of Biology offers a limited number of graduate instructional assistantships to full-time students enrolled in the master’s program. These assistantships are renewable based upon an annual review of each student’s progress and performance. Faculty members may also have funds available to support students as research assistants. Support is normally limited to two years.

The Office of the Graduate College can provide information concerning the availability of graduate scholarships.
Courses Offered

Biology (BIO)

**5100 Professional Development.** (1-0) 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. Graded on a credit (CR), no-credit (F) basis.

**5110 Seminar in Biology.** (1-0) Interactive discussion of timely issues and problems, designed to expose students to the current literature in their fields of interest and its critical analysis.

**5114 Research Experience.** (1-1) This course (concurrent enrollment allowed) allows master’s level graduate students to initiate, conduct, and participate in research in collaboration with graduate faculty of the Department of Biology that is in addition to thesis research conducted under BIO 5399A or 5399B. This course recognizes the collaborative nature of scientific investigation. See also 5214, 5314.

**5166 Medical Microbiology Laboratory.** (0-1) This graduate laboratory-based course will cover pathogenic bacteria emphasizing identification of selected groups of pathogens and the biological basis for virulence. Prerequisites: BIO 2400 and BIO 2450 with minimum grades of C.

**5214 Research Experience.** (2-2) This course (concurrent enrollment allowed) allows master’s level graduate students to initiate, conduct, and participate in research in collaboration with graduate faculty of the Department of Biology that is in addition to thesis research conducted under BIO 5399A or 5399B. This course recognizes the collaborative nature of scientific investigation. See also 5314.

**5295 Fundamentals of Research.** (2-0) Designed to acquaint the beginning graduate student with materials and methods of research in the biological sciences. It is recommended that a graduate student take this course the first term in residence. (F)

**5300 Neurobiology.** (3-0) This course presents the biology of the nervous system with emphasis on the human nervous system. Topics presented in lecture include neuroanatomy, cellular neurobiology, neurophysiology, developmental neurobiology, and neuronal plasticity. (F, odd years). Prerequisites: PHYS 1420 and 1430 or consent of instructor.

**5301 Evolution.** (3-2) Basic genetic principles applied to natural selection, adaptation, populations, and speciation. Consideration is given to the origin of life, nature of chromosomal variation, evolution of genetic systems, and certain other selected topics. Prerequisite: Undergraduate genetics course or its equivalent.

**5304 Wildlife and Recreation: Impact and Management.** (3-0) Students will be introduced to the impact human recreational activities have on wildlife habitats and populations. Management practices to enhance human-wildlife encounters or to minimize detrimental effects on wildlife populations will be presented. (F, even years). Prerequisites: BIO 1430 and 1431 or BIO 1320 and 1421.

**5305 Methods of Nature Study for Teachers.** (3-3) This course provides a comprehensive survey of natural events. It includes laboratory and field work emphasizing observation, collection and discovery of relationships. It is creditable only for those seeking elementary or middle school certification and is required for those seeking grade 4-8 Science or Science/Mathematics teaching certification. This course must be taken the semester immediately prior to student teaching.

**5311 Cancer Biology.** (3-0) Cancer Biology provides a foundation for understanding the complex molecular, biochemical, and cellular processes associated with cancer development. Topics include the role of tumor suppressor genes, oncogenes, DNA repair, apoptosis, ECM, cell-cycle control, cell signaling pathways, immune function and cancer-causing viruses. Emerging diagnostics and/or therapeutics will also be discussed.
5314 Research Experience. (3-3) This course (concurrent enrollment allowed) allows master’s level graduate students to initiate, conduct, and participate in research in collaboration with graduate faculty of the Department of Biology that is in addition to thesis research conducted under BIO 5399A or 5399B. This course recognizes the collaborative nature of scientific investigation.

5318 Topics in Botany. (3-2) Selected topics in plant anatomy, cytology, ecology, morphology, mycology, phycology, physiology, and taxonomy. This course may be repeated once for credit.

5319 Topics in Ecology. (3-3) Selected topics in physiological, population, or community ecology. This course may be repeated once for credit.

5319C Ecotoxicology. (3-0) Topics to be covered include sources, types, and fates of toxicants, organism response to toxicants, toxicant effects at the population, community, and ecosystem levels, and monitoring and risk assessment. Examination of current literature will form the core of the course.

5319F Watershed Management Frameworks and Applications. (3-0) Introduction to integrated watershed assessment and management tools for identifying programmatic water quality and quantity issues and their root causes and solutions, and their practical application. The scientific and socio-economic elements are considered within the context of planning and developing watershed protection plans and programs. Prerequisite: Instructor approval.

5324 Natural History and Conservation of Large Mammals. (3-0) 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.

5335 Fisheries Management. (2-4) An introduction to principles and techniques in fisheries management. Includes the study of artificial reproduction, carrying capacity, productivity, sampling procedures, population estimates, mortality, survival growth rates, and commercial and sport fisheries. (S, even years). Prerequisite: Ichthyology course or consent of instructor.

5350 Topics in Physiology. (3-0) Selected advanced topics in plant, microbial, and animal physiology. This course may be repeated once for credit. Prerequisites: Biology undergraduate zoology course or instructor's permission.

5350G Medical Microbiology. (3-0) This lecture-based course will cover pathogenic bacteria and their ability to cause disease, emphasizing the biological basis for virulence, and research strategies for investigating infectious diseases. Prerequisite BIO 2400 or equivalent. Students may take only one of BIO 5350G or BIO 5445 for credit.

5350H Immunobiology. (3-0) This lecture-based course will cover the biology of the immune system and its relationship to disease, emphasizing B and T cell immunity, immune diseases, hypersensitivities, transplantation, and cancer.

5350I Emerging Infectious Diseases. (3-0) Current topics in the emergence of viral and bacterial diseases in humans. This course will include new diseases, diseases previously seen and increasing in incidence, and diseases not previously seen in this country. This course will be of interest to students who are pursing advanced degrees and courses in microbiology, biochemistry, and cell and molecular biology.

5362 Environmental Impact Analysis. (3-0) Current government regulations regarding environmental impact, content of environmental impact statements, how to proceed with an impact study, application of ecological principles to impact studies, and steps in the review process for environmental impact statements are considered. (SS, odd years). Prerequisite: Consent of instructor.

5366 Medical Microbiology. (3-0) This lecture-based course will cover pathogenic bacteria and their relationship to disease, emphasizing critical evaluation of research literature, disease transmission and the biological basis for virulence. Prerequisites: BIO 2400 and 2450 with minimum grades of C.
5390 Problems in the Biological Sciences. (3-3) Open to graduate students on an individual basis by arrangement with the faculty member concerned.

5402 Earth Science I. (3-4) A study of astronomy and meteorology through observation, description, and interpretation of earth phenomena. Includes field observations, methods of measurement and interpretation of data related to the physical environment and space technology. Requires independent scientific and science education research and presentation of findings in a professional context.

5403 Earth Science II. (3-4) The description and interpretation of earth phenomena considered from the standpoint of geology and oceanography. Includes field observations, methods of sampling and interpretation of data related to the physical environment. Requires independent scientific and science education research and presentation of findings in a professional context.

5408 Science Processes and Research. (3-4) Students will analyze scientific research design, design research, interpret data, and communicate results. Stress will be placed on broad-field structure and integration of major science concepts and research-based science pedagogy. This course must be taken the semester prior to student teaching and is required for those seeking 7-12 Life Science or Science teacher certification. This course may not count as one of the four upper-level Biology courses required of general Biology majors, or one of the three upper-level Biology courses required of Biology minors.

5410 Field Biology of Plants. (3-3) Ecological relationships and natural history of plants, including historical geology, geography, soils, and vegetational regions of Central Texas. (F, SS)

5411 Morphology of the Vascular Plants. (3-3) A phylogenetic survey of living and fossil vascular plants that focuses on external morphology and reproductive biology. Topics include phylogenetic reconstruction, the origin of vascular plants, seed reproduction, and the origin of angiosperms. Emphasis is on broad-scale evolutionary patterns and origin of major taxonomic groups. (S, even years). Prerequisites: Biology undergraduate botany course and General Chemistry I and II, or consent of instructor.

5412 Plant Anatomy. (3-3) A descriptive and functional analysis of seed plants that focuses on internal structure. Topics include recognition and characterization of plant tissues, the structure of plant organs, and organ development. Emphasis is on pattern of tissue organization common to all seed plants and the functional basis for anatomical structure. (S, odd years). Prerequisites: Biology undergraduate botany course, and General Chemistry I and II, or consent of instructor.

5413 Parasitology. (3-4) The biology and biological significance of the common parasites of man and animals. (S). Prerequisite: Biology undergraduate zoology course or consent of instructor.

5415 Ichthyology. (3-3) An introduction to the morphology, taxonomy, natural history, and evolution of fishes. Field trips will be made to collect specimens, and laboratory periods will be devoted to morphological and systematic analyses. (F, SS). Prerequisite: Biology undergraduate zoology course or consent of instructor.

5418 Field Ornithology. (3-3) This course is designed to introduce and provide an advanced knowledge of the application of various field, laboratory, and statistical methods and techniques in the study of avian species. The course will include topics related to survey methodology, sampling design, marking/banding, measurement/sample extraction, and aging/sexing of avian species.

5419 Stream Ecology. (3-3) Class covers ecological theories, concepts, and processes occurring at the population, community, and ecosystem levels of organization in running water. Lab includes sampling methods, description and comparative studies, experiments, critical discussion of literature and experience in writing manuscripts. Prerequisite: Consent of instructor.

5420 Natural History of the Vertebrates. (3-3) Environmental relationships and natural history of vertebrates. Emphasis is on evolution taxonomy, speciation, behavior, and morphology. Laboratory will include field trips for the study and collection of vertebrates in their natural habitats. Students will assemble a representative collection of vertebrates. (S, SS)

5421 Ornithology. (3-3) Introduction to anatomy, behavior, ecology, and identification of the birds of Texas. Laboratory will emphasize field studies of birds and their habitat requirements. (S)
5422 Mammalogy. (3-3) The taxonomy, distribution, ecology, behavior, and evolution of mammals with particular emphasis on wild mammals of the Southwest. Laboratory will emphasize anatomy, identification, preparation of specimens, and field exercises in methods of population analysis. Students may assemble representative mammal collection. (S).

5423 Wildlife Management. (3-3) Application of ecological principles and natural history concepts to the management of wildlife habitats and populations. Laboratory will involve demonstrations and practice exercises with wildlife management techniques and instrumentation, and field trips to observe wildlife management projects. (F).

5424 Topics in Wildlife Biology. (3-3) Concepts in wildlife biology are studied in depth with emphasis on their application to the management of wildlife species. May be repeated once for credit. (F, S). Prerequisites: Biology 4421, 4422, and 4423 or consent of instructor.

5424B Ecology of Infectious Diseases of Wildlife. (3-0) 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.

5426 Immunology. (3-4) A study of the immune response, antigen/antibody reactions, major histocompatibility complex, and immunopathology. (S). Prerequisite: Biology undergraduate cellular biology course or 3442 and organic chemistry, or consent of instructor.

5430 Topics in Mycology. (3-3) Selected topics covering the Kingdom Fungi, including aquatic mycology, marine mycology, ascomycetes, basidiomycetes, macro fungi, and slime molds. May be repeated once for credit.

5434 Herpetology. (3-3) A course treating the origin and evolution of amphibians and reptiles; their reproductive and physiological tactics; taxonomy/systematics; and population biology. Emphasis will be placed on North American species and those groups inhabiting Texas. (F).

5435 Techniques in Wildlife Management. (3-3) The basic methodology of practical wildlife management. This involves techniques in monitoring and data collection related to population dynamics and habitat parameters of wildlife species as well as field research. (S).

5441 Cellular Physiology. (3-3) Advanced cellular biology, including membrane physiology, thermodynamics, energy transduction and distribution, and cellular movement in non-muscle and muscle cells. Laboratory includes discussion of current research and exercises in cellular physiology. (S). Prerequisites: Cell biology, organic chemistry, or consent of instructor.

5442 Experimental Techniques. (3-3) Use of methods and instruments applicable to biological investigations, including colorimetry, UV-spectrophotometry, fluorescence, flame and atomic absorption spectrophotometry, paper, gas, gel filtration and ion exchange chromatography, radioactive counting, and electrophoresis. (F).

5450 Physiological Ecology of Animals. (3-3) Course brings together the principle concepts of environmental physiology of animals. The biological problems associated with living in various ecological realms will be discussed, and the biochemical and physiological adaptations of animals to their diverse habitats will be studied. (S). Prerequisites: Organic chemistry or consent of instructor.

5454 Plant Ecology. (3-3) Functional ecology of terrestrial plants, plant populations, and communities. Laboratory emphasizes quantitative and experimental approaches to plant ecology and the use of field and laboratory physiology equipment. (S). Prerequisites: Undergraduate ecology course, undergraduate plant physiology course, and an undergraduate cellular biology course, or consent of the instructor.

5465 General Entomology. (3-3) Principles of morphology, physiology, and taxonomy of insects. Laboratory time will be devoted to a taxonomic study of the common orders and families of insects. (F). Prerequisite: Biology undergraduate zoology course or consent of instructor.

5466 Phylogenetic Methods. (2-3) Reconstructing phylogenies is important in most fields of biology. Course emphasis is on practical data collection, management, and analysis. Laboratory exercises will introduce phylogenetic and DNA analysis software, and WWW resources. Students will learn how to address questions in their own research using phylogenetic methodologies. Prerequisite: Genetics course or consent of instructor.
5470 Limnology. (3-3) Physical, chemical, and biological factors affecting productivity in lakes, ponds, and streams. Limnology sampling methods, chemical and biological analysis of samples, and hydrographic surveying are included in the laboratory. (F). Prerequisite: One year of chemistry, or consent of instructor.

5471 Reservoir Ecology. (3-3) Study of the physical, geological, chemical, and biological factors that influence and make up reservoir ecosystems. Prerequisites: Limnology course or consent of instructor.

5472 Animal Behavior. (3-3) This course presents all the major facets of the study of animal behavior, giving special attention to its evolution and ecological significance. We will discuss major conceptual models guiding past and present research in the field. Laboratories will emphasize experimental techniques and statistical analysis. Prerequisites: One course in statistics, or consent of instructor.

5480 Cytology and Micro-technique. (3-3) Study of cellular ultra-structure and electron micro technique. Lecture portion of course will cover cytology of all cell types and theoretical aspects of light microscopy and electron microscopy. Laboratory portion will train students to proficiency in microscopy. (F).

5481 Internship in Biological Laboratory Technologies. (0-15) The student will participate in the work of a selected biology unit (private, commercial, or governmental). A research paper reporting the internship experience conducted at the biological unit under the supervision of a faculty member will be required. This course may be credited toward a biology major with prior approval of the graduate advisor and department chair. Graded on a credit (CR), no credit (F) basis.

Thesis Courses

5199B Thesis. (1-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5299B Thesis. (2-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5399A Thesis. (3-0) This course represents a student’s initial thesis enrollment. No thesis credit is awarded until student has completed the thesis in Biology 5399B. Students working toward the M.A. or M.S. with a thesis are expected to enroll in thesis each term in which faculty supervision is received or laboratory facilities are used. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5399B Thesis. (3-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5599B Thesis. (5-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5999B Thesis. (9-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.
Graduate Faculty

Aron, Gary M., Professor of Biology. B.S., M.S., St. John’s University; Ph.D., Pennsylvania State University Park. (Microbiology, Virology)

Bonner, Timothy H., Professor of Biology. B.S., Texas A&M University; M.S., Texas State University; Ph.D., Texas Tech University. (Ichthyology, Fisheries Management)

Castro-Arellano, Ivan, Assistant Professor of Biology. B.S., National Autonomous University of Mexico; M.S., Ph.D., Texas A&M University. (Wildlife Ecology)

Dharmasiri, Nihal, Associate Professor of Biology. B.Sc., M.Phil., University of Peradeniya, Sri Lanka; Ph.D., University of Hawaii at Manoa. (Plant Molecular and Developmental Biology)

Forstner, Michael R.J., Professor of Biology and Chief Curator, Vertebrate Collections. B.S., Texas State University; M.S., Sul Ross State University; Ph.D., Texas A&M University. (Genetics, Systematics)

Gabor, Caitlin R., Professor of Biology. B.A., University of California-Santa Barbara; M.S., Ph.D., University of Louisiana at Lafayette. (Environmental and Evolutionary Ecology)

Garcia, Dana M., Professor of Biology. B.S., Texas A&M University; Ph.D., University of California-Berkeley. (Cell Biology, Physiology)

Green, M. Clay, Associate Professor of Biology. B.A., The University of Texas at Austin; M.S., Sul Ross State University; Ph.D., University of Louisiana at Lafayette. (Wildlife Ecology and Ornithology)

Groeger, Alan W., Associate Professor of Biology. B.S., Purdue University; M.S., Central Michigan University; Ph.D., University of Oklahoma. (Limnology, Aquatic Sciences)

Hahn, Dittmar, Professor and Chair of the Department of Biology. B.S., M.A., University of Hamburg; Ph.D., Wageningen Agricultural University. (Microbial Ecology)

Horne, Francis R., Professor of Biology. B.A., Texas Tech University; M.S., Ph.D., University of Wyoming. (Physiological Research)

Huffman, David G., Professor of Biology. B.A., West Virginia University; M.S., Marshall University; Ph.D., University of New Hampshire. (Fish Parasitology)

Huston, Michael A., Professor of Biology. B.A., Grinnell College; M.S., Ph.D., University of Michigan. (Landscape Ecology)

Kang, Hong-Gu, Assistant Professor of Biology. B.A., M.S., Seoul National University; Ph.D., University of California, Los Angeles. (Plant Immunology, Molecular Cell Biology)

Lemke, David E., Professor of Biology and Curator, Texas State Herbarium. B.S., Bucknell University; Ph.D., The University of Texas at Austin. (Plant Systematics, Flora of Texas)
Longley, Glenn, Professor of Biology and Director, Edwards Aquifer Research and Data Center. B.S., Texas State University; M.S., Ph.D., University of Utah. (Limnology, Pollution Biology)

Lopes, Vicente L., Professor of Biology. B.S., Federal University of Ceara; M.S., Federal University of Paraiba; Ph.D., University of Arizona. (Watershed Science)

Martin, Noland H., Associate Professor of Biology. B.S., The University of Texas at Austin; M.S., University of Oregon; Ph.D., Duke University. (Plant Speciation, Hybridization)

McLean, Robert J.C., Professor of Biology. B.Sc., University of Guelph; Ph.D., University of Calgary. (Bacterial Structure and Function, Microbial Ecology)

Moody, Sandra West, Associate Professor of Biology. B.S.Ed., M.S., University of Houston; Ph.D., Texas A&M University. (Science Education)

Nice, Christopher C., Professor of Biology. B.S., University of Minnesota-Twin Cities; Ph.D., University of California-Davis. (Population Genetics, Ecology)

Nowlin, Weston H., Associate Professor of Biology. B.A., Austin College; M.S., Texas Christian University; Ph.D., University of Victoria. (Wetlands Ecology)

Ott, James R., Associate Professor of Biology. B.S., George Mason University; M.S., North Carolina State University; Ph.D., University of Maryland College Park. (Ecology, Evolutionary Biology)

Schwartz, Benjamin F., Associate Professor of Biology. B.S., Radford University; Ph.D., Virginia Polytechnic Institute and State University. (Karst Hydrogeology)

Schwinning, Susan, Associate Professor of Biology. Diploma, University of Göttingen; M.S., University of California-Davis; Ph.D., University of Arizona. (Plant Ecology, Quantitative Ecology)

Simpson, Thomas R., Associate Professor of Biology. B.A., University of Dallas; M.S., Ph.D., Texas A&M University. (Zoology, Wildlife Management)

Tomasso, Joseph R., Professor of Biology. B.S., M.S., University of Tennessee at Martin; Ph.D., University of Memphis. (Stress and Environmental Physiology)

Upchurch, Garland R., Jr., Associate Professor of Biology. B.S., University of Nebraska; M.S., Ph.D., University of Michigan. (Paleobotany, Paleocoeology, Global Change)

Veech, Joseph A., Associate Professor of Biology. B.S., Texas A&M University; M.S., New Mexico State University; Ph.D., University of Nevada, Reno. (Population and Community Ecology; Wildlife and Conservation Biology)

Weckerly, Floyd, Professor of Biology. B.S., M.S., Eastern New Mexico University; Ph.D., University of Memphis. (Biostatistics, Wildlife Ecology)

Weigum, Shannon E., Assistant Professor of Biology. B.A., Texas A&M University; M.S., Texas State University; Ph.D., The University of Texas at Austin. (Biosensors for Disease Diagnostics)
Westerlund, Julie, Associate Professor of Biology. B.A., The University of Texas at Austin; M.S., University of Minnesota-Twin Cities; Ph.D., The University of Texas at Austin. (Science Education)

Williamson, Paula S., Professor of Biology and Associate Dean of the Graduate College. B.S., Texas State University; M.A., Ph.D., University of California-Santa Barbara. (Conservation Biology, Plant Reproductive Biology, Aquatic Plant Biology)
Department of Chemistry and Biochemistry

Majors and Degrees Offered:
Biochemistry, M.S.
Chemistry, M.A., M.S.

Major Programs

The department offers a program of lectures and research leading to the Master of Science degree and a program of lectures leading to the Master of Arts degree. These programs are designed to train professional chemists, enhance the training of chemistry teachers, and provide adequate background for further advanced study.

**Biochemistry.** The Master of Science with a major in Biochemistry degree requires 30 semester hours of coursework, the completion of a graduate research thesis, and the successful completion of a comprehensive exam. This program is designed for students who have undergraduate degrees in biology, biochemistry, or chemistry and wish to pursue advanced studies in biochemistry.

**Chemistry.** The Master of Science degree with a major in Chemistry requires 30 semester hours of coursework, the completion of a graduate research thesis, and the successful completion of a comprehensive exam. Generally, an undergraduate major in chemistry is required for admission into this program.

The Master of Arts degree with a major in Chemistry requires 30 semester hours of chemistry coursework and the successful completion of a comprehensive exam.

Research Areas

The Graduate faculty conducts research in numerous areas of the six fields of chemistry. Specific research areas include:

<table>
<thead>
<tr>
<th>Field</th>
<th>Research Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Analytical</strong></td>
<td>mass spectrometry, chromatography, electrochemistry, spectral methods;</td>
</tr>
<tr>
<td><strong>Biochemistry</strong></td>
<td>enzyme isolation, enzyme mechanisms, ion-channel regulation, protein structure-function relationships, molecular genetics; gene delivery; nucleic acid biochemistry; ribonucleoprotein complex function and regulation; genomics; proteomics;</td>
</tr>
<tr>
<td><strong>Inorganic</strong></td>
<td>synthesis and structure of high conductivity solid-state electrolyte compounds, boron-nitrogen compounds, bioinorganic chemistry; solid state synthesis; metal complex catalysis; intercalation chemistry; crystallography; synthetic main group organometallic chemistry;</td>
</tr>
<tr>
<td><strong>Organic</strong></td>
<td>Synthetic organometallic chemistry; synthesis of stable carbenes and applications in small molecule activation and catalysis; chemistry of “frustrated” Lewis pairs; heterocyclic chemistry;</td>
</tr>
<tr>
<td><strong>Physical</strong></td>
<td>molecular beam methods and laser spectroscopy; polymer synthesis; nanocomposites; thin organic films, structure-property relationships; electronic polymers.</td>
</tr>
</tbody>
</table>
Research Facilities

Research instruments available include 400 MHz NMR, X-ray Diffractometer, UV and IR spectrophotometers, atomic absorption, liquid and gas chromatographs, electrospray ionization/mass spectrometer, high-speed centrifuges, TGA, DSC, DMA, particle size analyzer, GPC, epi-fluorescent microscope, CO₂ incubators, and multi-well plate readers.

Admission Policy

For information regarding admission application requirements and deadlines, please visit the Graduate College website using one of the following links:

Chemistry  www.gradcollege.txstate.edu/chem.html
Biochemistry  www.gradcollege.txstate.edu/bioch.html

Financial Assistance

Graduate students are encouraged to work as laboratory teaching assistants. Applications can be obtained from the Chemistry and Biochemistry Department office. A limited number of research assistantships are also available at pay similar to that of laboratory teaching assistants. The Office of the Graduate College can provide information about the availability of graduate scholarships. In order to be considered for assistantships or scholarships, applicants must have submitted a completed application for review by the priority application deadline.

Courses Offered

Chemistry (CHEM)

5110 Seminar in Chemistry. (1-0) A course designed to acquaint the graduate student with current research areas in chemistry. May be repeated twice for total of 3 semester hour credit.

5195 Professional Development of Graduate Assistants. (1-0) This course is designed to develop and enhance graduate assistants’ laboratory instruction abilities. Topics covered in the course include effective lecture techniques, laboratory safety, theory and practical knowledge on laboratory experiments and laboratory section management. This course does not earn graduate degree credit. Graded on a credit (CR), no-credit (F) basis.

5285 Laboratory Development Practice. (1-2) This course develops the laboratory instructional abilities of post-baccalaureate students seeking either 8-12 Chemistry or 8-12 Physical Science Teaching Certification. Topics include traditional laboratory techniques and guided inquiry techniques, safety, laboratory management, pedagogical theory and practical knowledge of laboratory experiments.

5295 Professional Development of Graduate Assistants. (2-0) This course is designed to develop and enhance graduate assistants’ laboratory instruction abilities. Topics covered in the course include effective lecture techniques, laboratory safety, theory and practical knowledge on laboratory experiments and laboratory section management. This course does not earn graduate degree credit. Graded on a credit (CR), no-credit (F) basis.
5320 Modern Molecular Modeling. (3-0) The application of computational techniques to molecular modeling. Topics covered include quantum mechanical modeling, force field based molecular modeling, energy minimization, molecular dynamics, vibrational spectra, solution of crystalline structures, diffraction patterns, molecular blends, phase equilibria, crystal morphology, physical property prediction, and mesoscale modeling. Prerequisites: CHEM 3340 or consent of instructor.

5321 Advanced Organic Chemistry. (3-0) Study of the relation of the following topics to structure and reactions of organic compounds: bonding, stereochemistry, acid-base concepts, physical organic chemistry, reactive species, and mechanisms.

5330 Physical Chemistry. (3-0) Fundamentals of physical chemistry are surveyed, emphasizing application in the other chemical sub-disciplines. Topics include classical thermodynamics, kinetics, atomic structure, and molecular spectroscopy.

5333 Spectroscopy. (3-0) Study of various spectrometric techniques in qualitative and structural analysis of chemical substances. Prerequisites: Chemistry 2342 and Chemistry 2142. Students who have completed CHEM 4333 or its equivalent may not take this course for master's credit.

5341 Advanced Inorganic Chemistry. (3-0) Chemical bonding, symmetry, and group theory, coordination chemistry, spectroscopy, magnetism, and organometallic compounds along with some descriptive chemistry. This course does not earn graduate degree credit.

5351 Introduction to Polymers and Polymer Synthesis. (3-0) This course is designed to develop the student’s general understanding of polymer history and importance as well as terminology, structure, and synthesis. The overall scope of the course will be to develop the student’s general knowledge of polymer synthesis and structure. Students who have completed CHEM 4351 or its equivalent may not take this course for master's credit.

5353 Polymer Processing and Characterization. (3-0) This course is designed to explore the areas of polymer processing and characterization. Students will be introduced to extrusion, injection molding, film formation, thermoforming, thermal-mechanical measurements, classical mechanical testing, thermal-optical measurements, and methods for determination of polymer molecular weight. Prerequisites: CHEM 2342 and 5351.

5355 Physical Chemistry of Polymers. (3-0) A study of the physical chemistry of polymers. Subjects covered include thermodynamics, kinetic polymerization, phase relationships, molecular geometry, spectroscopy of polymers, polymer physics and mechanical behavior, polymer blends, rheology, and polymer composites.

5365 Separation Methods in Chemical Analysis. (3-0) The principles of gas chromatography, capillary electrophoresis, and mass spectrometry are discussed with a balance among theory, practice, and application.

5370 Problems in Chemistry. (3-0) Open to graduate students on an individual basis by arrangement with the faculty member concerned. May be repeated once with different emphasis for additional credit.

5375 Biochemistry. (3-0) A course devoted to a study of the chemistry of carbohydrates, lipids, proteins, enzymes, and nucleic acids. A study of enzyme kinetics and thermodynamics of coupled reactions is included.

5381 Physical Biochemistry. (3-0) An introduction to the physical techniques of biochemistry with emphasis on the interpretation of experimental data obtained from electrophoresis, chromatography, immunological methods, ultracentrifugation, spectroscopy and emerging techniques.

5382 Enzymology. (3-0) A study of the chemical and physical properties of enzymes. Topics will include structure-function relationships, elucidation of chemical and kinetic mechanisms, and the role of enzymes in metabolism.

5383 Molecular Biology & Molecular Genetics. (3-0) This course addresses the basic genetic mechanisms of bacteria and eukaryotes and introduces some examples of the biochemical and genetic techniques employed to study cells, tissues, and organisms.
5384 **Current Topics in Biochemistry and Molecular Biology.** (3-0) Course provides students with advanced knowledge in the areas of biochemistry and molecular biology. Topics include signal transduction and the molecular biology of cancer, as well as emerging topics in Genomics, Proteomics, and other new developments in biochemistry. May be repeated once for credit. Prerequisites CHEM 4360 or 5383.

5385-MP **Metabolism.** (3-0) A study of biodegradation and biosynthesis of carbohydrates, lipids, amino acids, proteins, and nucleic acids. Students who have completed CHEM 4385 or its equivalent may not take this course for master's credit.

5386 **Proteins.** (3-0) This course will cover advanced biochemistry topics related to proteins. Topics will include protein structure, structure-function relationships, and current methodologies for examining proteins in addition to current findings in primary literature. Prerequisite: CHEM 5375

5387 **Nucleic Acids Chemistry.** (3-0) This course will cover advanced biochemistry topics related to nucleic acids. Topics will include nucleic acid structures and properties, catalytic nucleic acids, protein-nucleic acid interactions, higher order complexes of protein-nucleic acids, and current methodologies for examining nucleic acids in addition to current findings in primary literature. Prerequisite: CHEM 5383 or equivalent.

5390 **Supramolecular Chemistry.** (3-0) This course is designed to be a survey of the nature of non-covalent interactions between host and guest species. Emphasis will be focused on the rational design of hosts, thermodynamic and kinetic parameters involved in binding and the applications of various binding/recognition phenomena.

5395 **Fundamentals of Research.** (2-3) Course is designed to acquaint the beginning graduate student with materials and methods of chemical research.

**Thesis Courses**

5199B **Thesis.** (1-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5299B **Thesis.** (2-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5399A **Thesis.** (3-0) This course represents a student’s initial thesis enrollment. No thesis credit is awarded until student has completed the thesis in Chemistry 5399B. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5399B **Thesis.** (3-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5599B **Thesis.** (5-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5999B **Thesis.** (9-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.
Graduate Faculty

Beall, Gary W., Professor of Chemistry and Biochemistry and Associate Dean of the College of Science. B.S., Tarleton State; M.S., Ph.D., Baylor University. (Polymer Chemistry: Polymer/Clay Nanocomposites, Computation Chemistry, Colloids, Wastewater Treatment Sorbents)

Betancourt, Tania, Assistant Professor of Chemistry and Biochemistry. B.S. Texas A&M University; M.S., Ph.D., The University of Texas at Austin. (Nanomedicine; Biomaterials; Drug Delivery; Biocensors)

Blanda, Michael Thomas, Professor of Chemistry and Biochemistry and Assistant Vice President for Research and Federal Relations. B.A., Ph.D., Texas A&M University. (Organic Chemistry: Supramolecular, Host-Guest Chemistry of Calixarenes)

Booth, Chad J., Associate Professor of Chemistry and Biochemistry. B.S., Southeastern Louisiana University; Ph.D., University of Southern Mississippi. (Polymer Chemistry: Synthesis, Processing & Thermo-Mechanical Characterization of Polymeric Materials)

Booth, Rachell E., Associate Professor of Chemistry and Biochemistry. B.S., Southeastern Louisiana University; Ph.D., University of Southern Mississippi. (Protein Biochemistry & Molecular Biology; Purification, Characterization, Regulation, and Structure/Function Relationships)

Brittain, William J., Professor and Chair of the Department of Chemistry and Biochemistry. B.S., University of Northern Colorado; Ph.D., California Institute of Technology. (Polymer synthesis, surface-immobilized polymers, nanoparticle modification, organized assemblies)

Easter, David Charles, Professor of Chemistry and Biochemistry. B.S., California Institute of Technology; Ph.D., University of California-Los Angeles. (Physical Chemistry: Molecular Beam Laser of Multiphoton Ionization Spectroscopy; Properties and Dynamics of Molecular Clusters)

Feakes, Debra Arliene, Professor of Chemistry and Biochemistry. B.S., Colorado School of Mines; Ph.D., Utah State University. (Inorganic Chemistry: Synthesis and Biological Application of Polyhedral Borane Compounds)

Gulacar, Ozcan, Assistant Professor of Chemistry and Science Education. B.A. Uludag University, Balikesir, Turkey; M.S., National University of Mongolia; Ph.D., Western Michigan University. (Chemical Education; Problem Solving; Knowledge Structure, Retention and Transfer; Instructional Technology)

Hudnall, Todd, Assistant Professor of Chemistry and Biochemistry. B.S., Texas State University; Ph.D., Texas A&M University. (Main Group Organometallic Chemistry; Synthesis of Novel Stable Carbenes; Small Molecule Activation and Renewable Energy)

Irvin, Jennifer A., Assistant Professor of Chemistry and Biochemistry. B.S., M.S., Texas State University; Ph.D., University of Florida. (Organic Chemistry: Small Molecule and Polymer Synthesis; Electoactive Polymers; Electrochemistry; Alternative Energy; Electrochromics)
Ji, Chang, Associate Professor of Chemistry and Biochemistry. B.S., St. John’s University; M.S., Indiana State University; Ph.D., Indiana University. (Analytical/Organic Chemistry: Chromatography and Mass Spectrometry, Electrochemical Catalysis and Synthesis, Measurement of Henry’s Law Constants of Toxic Pollutants)

Kornienko, Alexander Vladimir, Associate Professor of Chemistry and Biochemistry. B.S., Mendeleev University, Moscow; Ph.D., Tufts University. (Organic Chemistry: Synthetic organic and medicinal)

Lewis, L. Kevin, Professor of Chemistry and Biochemistry. B.S., Ohio University; Ph.D., University of Arizona. (Biochemistry & Molecular Biology: Chromosomal DNA Repair Pathways, Maintenance of Telomere Stability)

Li, Xiaopeng, Assistant Professor of Chemistry and Biochemistry. B.S., Zhengzhou University, China; Ph.D., Cleveland State University. (Analytical Chemistry: Polymers, Supramolecular Chemistry, Supramolecular Polymers, Mass Spectrometry)

Maeder, Corina, Assistant Professor of Chemistry and Biochemistry. B.S., Trinity University; Ph.D., Johns Hopkins University. (Nucleic Acid Biochemistry; Protein Biochemistry; Molecular Biology; Molecular Genetics)

Martin, Benjamin, Associate Professor of Chemistry and Biochemistry. B.S., Truman State University; Ph.D., Pennsylvania State University. (Inorganic Chemistry: High Conductivity Solid State Electrolytes)

Rudzinski, Walter Eugene, Professor of Chemistry and Biochemistry. B.S., University of Detroit-Mercy; Ph.D., University of Arizona. (Analytical Chemistry: Chromatography, Electrochemistry, Measurement of Thermodynamic Parameters of Ion Pairs and Metal Chelates)

Walter, Ronald Bruce, Professor of Chemistry and Biochemistry and University Chair in Cancer Research. A.A., Palm Beach Community College; B.S., M.S., Ph.D., Florida State University. (Molecular Genetics)

Watkins, Linette M., Associate Professor of Chemistry and Biochemistry. B.S., Trinity University; Ph.D., University of Notre Dame. (Biochemistry; Protein Biochemistry; Enzymology, Molecular Biology)

Whitten, Steven T., Assistant Professor of Chemistry and Biochemistry. B.S., University of Nebraska at Omaha; Ph.D., Johns Hopkins University. (Protein Biochemistry; Protein structure-function relationships; Protein structural-thermodynamic relationships)
Department of Computer Science

Majors and Degrees Offered:
Computer Science, M.A., M.S.
Software Engineering, M.S.

Certificate Program Offered:
Texas State Certificate in Computer Science

Major Programs

The Department of Computer Science offers the Master of Science and the Master of Arts degrees with a major in computer science, the Master of Science degree with a major in software engineering, and the Master of Science degree with a major in computer science and a minor in forensic systems. The programs are designed to prepare students for doctoral research, college teaching, careers in computer science and software engineering, and careers in digital forensics. All course work in computer science and software engineering applied to any graduate degrees must be at the graduate (5000) level.

Master of Science

The Master of Science degree with a major in computer science requires:

a. Thesis option (30-semester hour degree): Completion of 12 hours of graduate core courses, an additional 12 hours of graduate computer science electives, and completion of a thesis. The thesis must be accepted by a departmental supervisory committee of graduate faculty members, the department Chair, and the Dean of the Graduate College. The thesis program requires a minimum enrollment of 6 hours in CS 5399A and CS 5399B. Thesis credit requirement information is provided in the “Degree Information” thesis requirements section of the catalog. Students who select a minor may replace 6 graduate hours of computer science electives with 6 graduate hours of an approved minor.

b. Non-thesis option (36-semester hour degree): Completion of 12 hours of graduate core courses and an additional 24 hours of graduate computer science electives. Students who select a minor may replace 9 graduate hours of computer science electives with 9 graduate hours of an approved minor.

The Master of Science degree with a major in computer science and a minor in forensic systems requires:

a. Thesis option (30-semester hour degree): Completion of 18 hours of graduate core courses, 6 hours of an approved interdisciplinary minor, and completion of a thesis. The thesis must be accepted by a departmental supervisory committee of graduate faculty members, the department Chair, and the Dean of the Graduate College. The thesis program requires a minimum enrollment of 6 hours in CS 5399A and CS 5399B. Thesis credit requirement information is provided in the “Degree Information” thesis requirements section of the catalog.

b. Non-thesis option (36-semester hour degree): Completion of 27 hours of graduate core courses and 9 hours of an approved interdisciplinary minor.
The courses for the interdisciplinary minor in forensic systems can be selected from the following group:

ACC 5373, ACC 5390C, CJ 5350, POSI 5374, POSI 5394

The Master of Science degree with a major in software engineering requires:

a. Thesis option (30-semester hour degree): Completion of 21 hours of graduate core courses, an additional 3 hours of graduate computer science electives, and completion of a thesis. The thesis must be accepted by a departmental supervisory committee of graduate faculty members, the department Chair, and the Dean of the Graduate College. The thesis program requires a minimum enrollment of 6 hours in CS 5399A and 5399B. Thesis credit requirement information is provided in the “Degree Information” thesis requirements section of the catalog.

b. Non-thesis option (36-semester hour degree): Completion of 24 hours of graduate core courses and an additional 12 hours of graduate computer science electives.

Master of Arts

The Master of Arts degree with a major in computer science requires:

a. Thesis option (30-semester hour degree): Completion of 15 hours of graduate core courses, an additional 3 hours of graduate computer science electives, an additional 6 hours of an approved minor, and completion of a thesis. The thesis must be accepted by a departmental supervisory committee of graduate faculty members, the department Chair, and the Dean of the Graduate College. The thesis program requires a minimum enrollment of 6 hours in CS 5399A and CS 5399B. Thesis credit requirement information is provided in the “Degree Information” thesis requirements section of the catalog.

b. Non-thesis option (36-semester hour degree): Completion of 15 hours of graduate core courses, an additional 12 hours of graduate computer science electives, an additional 9 hours of an approved minor.

Core Courses

1. Computer science majors:
   a. Complete 12 graduate hours of core course work consisting of one course from each of the following groups:

      Group 1: CS 5329
      Group 2: CS 5346, CS 5391
      Group 3: CS 5306, CS 5310, CS 5332
      Group 4: CS 5318, CS 5338, CS 5351

2. Computer science majors with a minor in forensics systems:
   a. Thesis option: Complete 18 graduate hours of core course work, including CS 5369D and CS 5378, and 12 hours from the following group:

      CS 5306, CS 5310, CS 5329, CS 5346, CS 5369R, CS 5369U, CS 5391

   b. Non-thesis option: Complete the following 27 graduate hours of course work:

      CS 5306, CS 5310, CS 5329, CS 5346, CS 5369D, CS 5369R, CS 5369U, CS 5378, and CS 5391
3. Software engineering majors:
   a. Thesis option: Complete 21 graduate hours of core course work, including CS 5389, CS 5391, CS 5392, CS 5393, CS 5396, and 6 hours from the following group:
      
      CS 5306, CS 5310, CS 5329, CS 5332, CS 5346, CS 5369G
   
   b. Non-thesis option: Complete 24 graduate hours of core course work, including CS 5389, CS 5391, CS 5392, CS 5393, CS 5394, CS 5396, and 6 hours from the following group:
      
      CS 5306, CS 5310, CS 5329, CS 5332, CS 5346, CS 5369G

**Background Requirements**

Students are required to fulfill background course work if they do not have adequate undergraduate computer science background. The background requirements may be reduced if evidence is presented which shows that the applicant has taken equivalent courses elsewhere prior to enrollment at Texas State. Background work must be completed before enrolling in graduate courses.

The minimum undergraduate background requirements for computer science and software engineering majors are:

1. Twenty-nine hours of computer science course work: CS 1428, CS 2308, CS 2318, CS 2420, CS 3339, CS 3358, either CS 4318 or CS 4328, and 6 hours of advanced computer science electives (CS 3000-4000 level). These courses must be completed with no grade less than “C” and no more than two “Cs.”

2. Eleven hours of mathematics course work: three hours of discrete mathematics (MATH 5358 or equivalent) and eight hours of calculus. These courses must be completed with no grade less than “C.”

The minimum undergraduate background requirements for computer science majors with a forensic systems minor are:

1. Twenty-nine hours of computer science course work: CS 1428, CS 2308, CS 2315, CS 2420, CS 2318, CS 3358, CS 4310, CS 4328, and CS 4332. These courses must be completed with no grade less than “C” and no more than two “Cs”.

2. Eleven hours of mathematics course work: eight hours of calculus (MATH 2471 and MATH 2472) and three hours of advanced discrete mathematics (MATH 5358).

3. Three hours of either ENG 3313 or ENG 5313.

**Admission Policy**

For information regarding admission application requirements and deadlines, please visit the Graduate College website using one of the following links:

- **Computer Science**: www.gradcollege.txstate.edu/cs.html
- **Software Engineering**: www.gradcollege.txstate.edu/soen.html

**Non-graduate Degree Credit**

Individuals may apply for “non-degree seeking student” admission through the Graduate College to enroll in computer science background courses before completing the GRE requirement.
Minors

Computer Science. A graduate minor in computer science requires 6 (thesis student) or 9 (non-thesis student) semester hours of graduate credits in addition to the following background course requirements: CS 1428, CS 2308, CS 2318, CS 3358, and 3 hours of discrete mathematics (MATH 5358 or equivalent).

Software Engineering. A graduate minor in software engineering requires 6 (thesis student) or 9 (non-thesis student) semester hours of graduate credit hours in addition to the following background course requirements: CS 1428, CS 2308, CS 2318, CS 3358, and 3 hours of discrete mathematics (MATH 5358 or equivalent). Students pursuing a non-thesis major must take the following three courses (9 hours): CS 5391, CS 5392, and CS 5393. Students pursuing a thesis major must take two courses (6 hours): CS 5391 and either CS 5392 or CS 5393.

Teacher Certification

The university’s undergraduate catalog provides information regarding the available teacher certification programs.

Texas State Certificate in Computer Science

The certificate program in computer science offers a broad-based curriculum in computer science to those working professionals who already have a degree in other fields and who wish to pursue a career in computer science. The certificate program also provides the background courses for students with a baccalaureate degree in a field other than computer science to pursue a master’s degree in computer science or software engineering.

Admission Requirements. For information regarding admission application requirements and deadlines, please visit our website at www.gradcollege.txstate.edu/Prospect_Students/Pgms_Apps/TXST_Cert/html#CS.

Course Requirements. The program requires 40 semester hours for completion. The course requirements include the following courses with at least 15 hours of upper-division computer science courses in residency at Texas State. Courses offered at Round Rock Campus (RRC) will count towards the residency requirements. The computer science graduate advisor may waive or replace specific course requirements if a student has taken equivalent courses at another institution.

No grade less than “C” and no more than two “Cs” in:
- Foundations of Computer Science I (CS 1428)
- Foundations of Computer Science II (CS 2308)
- Assembly Language (CS 2318)
- Data Structures (CS 3358)
- Digital Logic (CS 2420)
- Computer Architecture (CS 3339)
- 6 hours of advanced Computer Science electives (CS 3000+)

Plus one of the following:
- Program Translators (CS 4318)
- Operating Systems (CS 4328)
No grade less than a “C” in the following MATH courses:
- Calculus I (MATH 2471)
- Calculus II (MATH 2472)
- Discrete Mathematics (MATH 5358 or an equivalent course).

Contacts

To obtain more information about master’s programs, to apply for graduate admission, or to apply for the certificate program or “non-degree seeking student” admission, contact:

Texas State University
The Graduate College
601 University Drive
San Marcos, TX 78666
Telephone: (512) 245-2581   Fax: (512) 245-8365
E-mail: gradcollege@txstate.edu
http://www.gradcollege.txstate.edu/

For more information about the graduate programs in computer science and software engineering, contact:

Texas State University
Department of Computer Science
Attn: Master’s Program Advisor
601 University Drive
San Marcos, TX 78666
Telephone: (512) 245-3409   Fax: (512) 245-8750
E-mail: info@cs.txstate.edu
http://www.cs.txstate.edu/

Courses Offered

Computer Science (CS)

5100 Advanced Computer Science Internship. (0-1) This course provides advanced training supervised by computer scientists in internship programs approved by the department. Course cannot be counted toward any graduate degree, is open only to majors in the Department of Computer Science. May be repeated once but not for credit and requires approval of the department chair.

5300 Professional Development of Graduate Assistants. (3-0) This course is designed to develop and enhance the professional and technical skills of graduate teaching and instructional assistants. Topics covered may include, but are not limited to, teaching skills, technical skills, ethical and legal issues, and laboratory management. This course does not earn graduate degree credit. Graded on a credit (CR), no-credit (F) basis.

5301 Programming Practicum. (3-0) Intensive review of programming through data structures. Includes syntax, semantics, problem solving, algorithm development, and in-class exercises. May be repeated once. This course does not earn graduate degree credit. Prerequisite: CS 3358, C or higher, or consent of instructor.

5306 Advanced Operating Systems. (3-0) A study of modern operating systems including network, distributed, or real-time systems. Prerequisites: CS 3358 and 4328.
5310 Network and Communication Systems. (3-0) A study of network and communication systems. Verification and/or implementation of protocols will be required. Prerequisite: CS 3358.

5316 Data Mining. (3-0) This course covers fundamental concepts and techniques plus recent developments in data mining and information retrieval. It provides relevant research training and practice opportunities. May not be taken for credit if student received credit for CS 4315. Prerequisite: CS 3358 with a grade of C or higher.

5318 Design of Programming Languages. (3-0) Covers various aspects of the design of programming languages including principles, methodologies, and a panorama of techniques in formal syntax and formal semantics. Prerequisite: CS 3358.

5326 Advanced Studies in Human Factors of Computer Science. (3-0) Professional level presentation of techniques and research findings related to human-computer interactions. Prerequisite: CS 3358.

5329 Algorithm Design and Analysis. (3-0) Introduction to algorithm design and analysis, computational complexity, NP – completeness theory. Prerequisites: CS 3358, MATH 2472, and MATH 3398 or MATH 5358 with a grade of C or higher.

5331 Crafting Compilers. (3-0) Overview of the internal structure of modern compilers. Research on compilation techniques. Topics include lexical scanning, parsing techniques, static type checking, code generation, dataflow analysis, storage management, and execution environments. Prerequisite: CS 3358 with a grade of C or higher.

5332 Data Base Theory and Design. (3-0) Computer system organization for the management of data; data models, data model theory, optimization and normalization; integrity constraints; query languages; intelligent database systems. Prerequisites: CS 3358 and 4328.

5333 Advanced Database Systems. (3-0) Database related topics will be covered including object-oriented database, intelligent database, distributed database, CASE tools, and DBMS. The design of databases will be covered with an emphasis on the design of conceptual, logical, and internal models. Prerequisite: Grade of C or higher in CS 4332 or CS 5332.

5334 Advanced Internet Information Processing. (3-0) Integration of popular scripting languages (Perl, JavaScript, PHP, and other CGI capable languages) and database programming languages (embedded database programming languages, Java Servlets, and PHP) to provide advanced information processing for Internet applications that demand both database support and sophisticated, application specific information processing. Prerequisite: CS 3358 with a grade of C or higher.

5335 Research in Object-Oriented System Development. (3-0) The course covers the object-oriented methodologies for system analysis, design, implementation, testing, and other aspects of system development. Emphasis will be on using OO methodologies to manage the complexity of complicated software. Other topics like modeling, OODB, and OO languages will also be covered. Prerequisites: Grades of C or higher in CS 3358 and either 4332 or CS 5332.

5338 Formal Languages. (3-0) Advanced topics in automata theory, grammars, Turing machines, decidability, and algorithmic complexity. Prerequisites: CS 3358 and MATH 3398.

5341 Advanced Network Programming. (3-0) Study of advanced concepts and programming skills in computer networks such as advanced TCP/IP, API, multicasting and broadcasting, reliable communications, advanced I/O functions and options. Prerequisite: CS 5310 with a grade of C or higher.

5343 Wireless Communications and Networks. (3-0) Study of the fundamental aspects of wireless communications and wireless/mobile networks, introduction of wireless/mobile networking APIs. Prerequisites: CS 3358 with a grade of B or higher and CS 5310 with a grade of C or higher.

5346 Advanced Artificial Intelligence. (3-0) Knowledge representation; knowledge engineering; parallel and distributed AI; heuristic searches; machine learning and intelligent databases; implementation of systems in high-level AI languages. Prerequisite: CS 3358.
5348 Computer Organization and Design. (3-0) This course covers the dynamic interaction of the computer system building blocks and their management. Course topics include the design of the instruction set, high speed arithmetic, memory hierarchy, and control units. Computer system performance evaluation methodology and techniques are also covered. Prerequisites: CS 3339 and CS 3358.

5351 Parallel Processing. (3-0) Introduction to the design and analysis of parallel algorithms, parallel architectures, and computers. Prerequisites: CS 2420, 3358, and 4328.

5352 Distributed Computing. (3-0) Study of advanced topics in distributed systems: concurrency control and failure recovery, management of replicated data, distributed consensus and fault tolerance, remote procedure calls, naming and security. Prerequisites: CS 3358 and 4328.

5369 Topics in Computer Science. (3-0) Selected topics in computer science from advanced areas of computer software, computer hardware, and software engineering. Material will vary according to the needs and interest of the class. May be repeated with different emphasis for additional credit. Prerequisite: 6 hours senior-level computer science, or consent of instructor.

5369D Advanced Digital Forensics. (3-0) This course provides a comprehensive understanding of the techniques and tools used in criminal and civil investigations that involve computing systems, digital devices and media, and communication networks. The course covers recent research material published in the field. Hands-on experience will be acquired through case studies and projects.

5369E Advanced Embedded Computer Systems. (3-0) Research in the architecture of embedded systems, micro-controllers, their peripherals, languages, and operating systems and the special techniques required to use them. Course will provide in-depth knowledge of implementation of individual projects. Course cannot be taken for credit if student received credit for CS 3468. Prerequisite: CS 3339 or the equivalent.

5369G Web Service Engineering. (3-0) The course introduces concepts, principles, and methodology enabling development of software as a service according to Service-Oriented Architecture; methodology of SOA-based systems development; main technologies used in achieving SOA; and challenges and opportunities that SOA provide. In SOA, software applications are constructed based on independent component services with standard interfaces. Prerequisite: Grade of C or higher in CS 3358.

5369H Designing, Implementing and Evaluating E-Commerce Applications. (3-0) Design, implement, evaluate working E-commerce website using Microsoft ASP.NET Framework and C#. Organization, purpose, operation allowing themes, membership and content management systems, mailing list, and E-commerce store with support for real-time credit card processing, home page personalization, and localization. Prerequisite: CS5326 with C or higher or instructor’s permission.

5369J Advanced Human Computer Interaction. (3-0) This course will cover state of the art human computer interaction topics such as perceptual compression, eye-gaze, and brain computer interfaces with emphasis on the human visual system, eye-tracking, and electroencephalography. Prerequisite: CS 3358.

5369L Machine Learning and Applications. (3-0) Provides broad introduction to machine learning, including learning theory, and recent topics like support vector machines and feature selection. Covers basic ideas, intuition, and understanding behind modern machine learning methods. Discusses applications like face recognition, text recognition, biometrics, bioinformatics, and multimedia retrieval. Prerequisite: CS 3358 grade of C or higher.

5369P Principles of Programming Languages. (3-0) Overview of principles of programming languages including type checking algorithms. Emphasis is on type systems’ theoretical aspects and pragmatics of their use in imperative and functional languages including peculiarities of object-oriented systems. Prerequisites: CS 3358 and Math 3398 with grades of C or higher.

5369R Research in Digital Forensics. (3-0) Students will design and implement computer-based forensic tools applicable to an instructor chosen domain. Prerequisites: CS 5369D or CS 5369F with a grade of C or higher.
5369Y Green Computing. (3-0) Reducing mobile device, cloud computing platform, and supercomputer energy consumption is a paramount, daunting problem. This course covers state-of-the-art green computing research, including energy-efficient hardware and software design, power-aware resource management and storage solutions, green data centers and mobile computing. Cannot be taken for credit if received CS 4379Y credit. Prerequisite: CS 3358 with a grade of C or higher.

5374 Neural Networks. (3-0) A study of neural computing, including basic concepts, algorithms, and applications; back propagation and counter propagation networks; Hopfield networks; associative memories; massively parallel neural architectures; adaptive resonance theory; optical neural networks; connectionist approaches. Prerequisite: CS 3358.

5375 Multimedia Computing. (3-0) A study of the digital representation and processing of major multimedia data types: image, audio, and video. Compression techniques for the three data types, standards, and storage media. Prerequisite: CS 3358.

5376 Enterprise Application Integration. (3-0) Introduction to the integration of all services available on the Web. It emphasizes component-based integration frameworks based on J2EE specification (EJB, Servlets, JMS), inter-organization workflow integration frameworks, and XML framework. Students must have knowledge of object-oriented design, object-oriented programming language, databases, and networking. Prerequisite: CS 3358.

5378 Advanced Computer Security. (3-0) This course covers various aspects of producing secure computer information systems that provide guaranteed controlled sharing. Emphasis is on software models and design, including discovery and prevention of computing systems security vulnerabilities. Current systems and methods are examined and critiqued. Prerequisite: CS 3358 with a grade of C or higher.

5388 Advanced Computer Graphics. (3-0) A study of the algorithms and data structures used in representing and processing visual data. Prerequisite: CS 3358.

5389 Graphical User Interfaces. (3-0) Covers both abstract and practical treatments of using graphics to implement interactive computer/human interfaces. Includes a survey of the major GUI standards and tools. Prerequisite: CS 3358.

5391 Survey of Software Engineering. (3-0) A study of the software life cycle with emphasis on system analysis and design. Methodologies based on data flows and on objects will be surveyed. A component on professional ethics is included. Prerequisite: CS 3358.

5392 Formal Methods in Software Engineering. (3-0) The use of design and specification languages in producing software systems. Emphasis is placed on proving correctness of designs and implementations. Prerequisites: CS 3358 and CS 5391.

5393 Software Quality. (3-0) The latter half of the software life cycle is discussed. Topics include testing, performance evaluation, and software metrics. Appropriate software tools are studied and used. Prerequisite: CS 5391.

5394 Advanced Software Engineering Project. (3-0) Students produce a software project of significant size in a team environment. All aspects of the software engineering course sequence are integrated and put into practice. Prerequisite: CS 5391.

5395 Independent Study in Advanced Computer Science. (3-0) Open to graduate students on an independent basis by arrangement with the faculty member concerned. Course is not repeatable for credit. Prerequisite: CS 3358.

5396 Advanced Software Engineering Processes and Methods. (3-0) The essentials of software engineering processes methods, and tools for the evolutionary design of complex interactive software are discussed. Overviews of other topics like quality concepts, the SEI CMM, information technology, and network technology are covered. Student completes a literature survey of the latest software engineering analysis and design processes, methods, and tools. Prerequisite: CS 5391.
Thesis Courses

5199B Thesis. (1-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5299B Thesis. (2-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5399A Thesis. (3-0) This course represents a student’s initial thesis enrollment. No thesis credit is awarded until the student has completed the thesis in CS 5399B. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5399B Thesis. (3-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5599B Thesis. (5-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5999B Thesis. (9-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

Graduate Faculty

Ali, Moonis, Professor of Computer Science. B.Sc., M.Sc., Ph.D., Aligarh University. (Artificial Intelligence, Knowledge-Based Expert Systems, Intelligent Databases and Interfaces, Natural Language Processing, Neural Networks)

Burtscher, Martin, Associate Professor of Computer Science. B.S., M.Sc., Swiss Federal Institute of Technology (ETH) Zurich; Ph.D., University of Colorado at Boulder. (Program Parallelization, Performance Assessment, Data Compression, Computer Architecture)

Chen, Xiao, Associate Professor of Computer Science. B.Eng., M.Eng., Shanghai University; Ph.D., Florida Atlantic University. (Software Engineering, Distributed Systems)

Durrett, Herman John, Jr., Associate Professor of Computer Science. B.S., University of Houston; Ph.D., University of Colorado; J.D., St. Mary’s University. (Human Factors, Law and Ethics)

Gao, Ju Byron, Associate Professor of Computer Science. B.S., Ph.D., Simon Fraser University. (Data Mining, Databases, Information Retrieval)

Gu, Qijun, Associate Professor of Computer Science. B.S., M.Eng., Beijing (Peking) University; Ph.D., Pennsylvania State University. (Network Security, Wireless Security, Information Assurance)
Guirguis, Mina Samuel, Associate Professor of Computer Science. B.Sc., Alexandria University; M.A., Ph.D., Boston University. (Security Aspects in Computing Systems and Networks, Digital Forensics)

Hwang, Caneo Jinshong, Professor of Computer Science. B.S., M.S., National Taiwan University; Ph.D., Louisiana State University. (Knowledge Engineering, Software Engineering, Database Systems, Algorithms, Ad Hoc Network, Object-Oriented Systems)

Kaikhah, Khosrow, Associate Professor of Computer Science and Advisor for graduate programs. B.S., M.S., Ph.D., University of Rhode Island. (Artificial Intelligence, Expert Systems, Natural Language Processing, Human-computer Interaction, Neural Networks)

Lu, Yijuan Lucy, Associate Professor of Computer Science. B.Eng., Anhui University; Ph.D., University of Texas at San Antonio. (Multimedia Information Retrieval, Machine Learning, Pattern Recognition, Computer Vision, Data Mining, Bioinformatics)

Komogortsev, Oleg Vladimirovich, Associate Professor of Computer Science. B.S., Volgograd State University; M.S., Ph.D. Kent State University. (Human Computer Interaction, Visual Perception, Multimedia, Networking)

Ngu, Hee Hiong Anne, Professor of Computer Science. B.Sc., Ph.D., University of Western Australia. (Information Integration over the Web, Service Oriented Computing, Databases, Scientific Workflows, Agent Technologies)

Peng, Wuxu, Professor of Computer Science. B.Eng., University of Science and Technology of China; Ph.D., Pennsylvania State University. (Distributed/Parallel Computing, Specification and Verification of Communication Protocols, Wireless and Sensor Networks)

Podorozhny, Rodion Mikhailovich, Associate Professor of Computer Science. B.Sc., St. Petersburg State Technical University; M.Sc., University of Massachusetts; Ph.D., The University of Texas at Austin. (Software Engineering, Process Specification Languages, Process Environments, Process Analysis)

Qasem, Apan Muhammad, Associate Professor of Computer Science. B.A., Ohio Wesleyan University; M.S., Florida State University; Ph.D., Rice University. (Compilers, Architecture, Automatic Tuning)

Seidman, Stephen Benjamin, Professor of Computer Science and Dean of the College of Science and Engineering and Professor of Computer Science. B.S., City University of New York; A.M., Ph.D., University of Michigan. (Software Engineering, Computing Education)

Shi, Hongchi, Professor and Chair of the Department of Computer Science. B.S., M.S., Beijing University of Aeronautics and Astronautics; Ph.D., University of Florida. (Parallel and Distributed Computing, Wireless Sensor Networks, Image Processing, Neural Networks)

Tamir, Dan Eliahu, Associate Professor of Computer Science. B.S., M.S., Ben-Gurion University; Ph.D., Florida State University. (Image and Signal Processing, Computer Vision, Data Compression, Data Mining, Clustering, Classification, Pattern Recognition, Computer Architecture, Computer Graphics)
Yang, Guowei, Assistant Professor of Computer Science. M.S., University of Nebraska-Lincoln; Ph.D., The University of Texas at Austin. (Software Engineering)

Zong, Ziliang, Assistant Professor of Computer Science. B.S., M.S., Shandong University; Ph.D., Auburn University. (High Performance Computing, Energy-Efficient Computing, Distributed Storage Systems, Multicore Technology, Parallel Programming, Computation-Intensive Applications)
Department of Engineering Technology

Major and Degree Offered:
Technology Management, M.S.

Major Programs

Technology Management. The Technology Management graduate program at Texas State University is designed for those who seek careers or career advancement in the management of engineering and production activity in the construction and concrete industries, in the semiconductor, cast metals, machining, fabrication, and other manufacturing industries, or in the fields of power generation, environmental management, and occupational health and safety.

The Master of Science in Technology Management is a 36-credit-hour degree. It is comprised of a 30-credit-hour major in technology management plus a 6-credit-hour cognate minor in business management. The major includes 15 hours of core technology courses that are common to all students, regardless of specialization. Students may elect one of three 9-credit-hour specializations in construction management, manufacturing management, or general industrial management. The 6-credit-hour cognate minor allows students to select from such industry-focused business courses as supply chain management, process improvement management, managing business creativity, organizational change management, etc.

All students are required to complete a 6-credit-hour research component. Students may select either a traditional academic thesis or an industry-focused directed project. A thesis is the more appropriate option for full-time students who may have ambitions of further graduate study, while the directed project is the best choice for part-time students who hold jobs in industry.

Core Technology Management Courses - All technology management students must complete the following 15-credit-hour core curriculum:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>TECH 5390</td>
<td>Research in Technology</td>
</tr>
<tr>
<td>TECH 5394</td>
<td>Design of Industrial Experiments</td>
</tr>
<tr>
<td>TECH 5315</td>
<td>Engineering Economic Analysis</td>
</tr>
<tr>
<td>TECH 5365</td>
<td>Industrial Project Management and Scheduling</td>
</tr>
<tr>
<td>TECH 5382</td>
<td>Sustainability in Industrial Management</td>
</tr>
</tbody>
</table>

Specializations - Students may select 9-semester-hours of course work from one of the following specializations:

Construction Management

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSM 5313</td>
<td>Building Information Modeling</td>
</tr>
<tr>
<td>CSM 5360</td>
<td>Construction Company Financial Control</td>
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<td>CSM 5362</td>
<td>Construction Contract Delivery Systems</td>
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<td>CIM 5330</td>
<td>Advanced Concrete Technology</td>
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<td>CIM 5340</td>
<td>Innovation Strategies for the Concrete Industry</td>
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Manufacturing Management

TECH 5310 Product Design and Development
TECH 5311 Computer Aided Engineering
TECH 5364 Statistical Manufacturing Process Control
TECH 5387 Planning Advanced Technology Facilities
TECH 5391 Advanced Manufacturing Systems
TECH 5392 Fundamentals of Microelectronics Manufacturing
TECH 5384 Problems in Technology

Industial Management

TECH 5364 Statistical Manufacturing Process Control
TECH 5385 Readings in Technology
TECH 5387 Planning Advanced Technology Facilities
TECH 5384 Problems in Technology

Upon advice of the graduate advisor, students specializing in either manufacturing management or industrial management may also elect courses offered through the Ingram School of Engineering, and/or other departments in the College of Science and Engineering.

Research Component - All students must complete either a 6-credit-hour thesis or directed project.

TECH 5399A Thesis (Initial thesis enrollment)
TECH 5399B Thesis (Continuing thesis enrollments)
-OR-
TECH 5398 Directed Project (Repeatable for credit)

Cognate Minor - In addition to the 30-credit-hour major, all students must complete a 6-credit-hour cognate minor in business management. Students may select from any of the following management courses.

MGT 5310 Organizational Change Management
MGT 5311 Process Improvement Management in Organizations
MGT 5315 New Venture Management
MGT 5321 Supply Chain Management
MGT 5325 Managing Business Creativity
MGT 5391 Managing the Communication Process

Other courses in the McCoy College of Business may also be elected upon advice of the graduate advisor acting in consultation with the graduate advisor for the College of Business.

Admission Policy

For information regarding admission application requirements and deadlines, please visit the Graduate College website:

Technology Management www.gradcollege.txstate.edu/tmgt.html
Financial Assistance

Graduate Instructional and Research Assistantships. A limited number of paid graduate assistantships are available. Research assistants work with faculty on research and other special projects. Instructional assistants work with undergraduates in laboratory settings. Contact the program’s graduate advisor for details and application instructions.

Graduate College Scholarships and Fellowships. For more information about scholarships, fellowships, financial aid and application deadlines, visit Texas State’s Graduate College Web site at http://www.gradcollege.txstate.edu and click on Financing Your Graduate Education.

Contact Information

Graduate Advisor
Department of Engineering Technology
Texas State University
601 University Drive
San Marcos, TX 78666-4605
Phone: 512.245.2137
E-mail: ab08@txstate.edu

Courses Offered

Concrete Industry Management (CIM)

5330 Advanced Concrete Technology. (3-0) The course will cover hydraulic cements, aggregates, admixtures, and mix design; concrete production, quality control, early-age properties and durability. Concrete distress examination, identification, prevention, and nondestructive testing; advanced concrete technology, high-strength and high performance concrete. Prerequisite: TECH 2342 or equivalent.

5340 Innovation Strategies for the Concrete Industry. (3-0) This course provides students a new set of tools for and experience in finding and developing innovative alternatives for addressing strategic business problems in concrete industry. Students will explore creativity from individual and team perspectives and identify innovation opportunities and roadblocks in organizational settings. Prerequisite: CIM 3340 and CIM 3366 or Instructor’s Approval.

Construction Science and Management (CSM)

5306 Fundamentals of Commercial Building Construction Systems. (3-0) This course is a commercial building construction systems class dealing with soils, site work, heavy foundations, steel, reinforced concrete, pre-cast structures and common assemblies. Commercial MEPs are studied along with CSI master format, as-built/shop drawings, schedule of values, AIA documents, and appropriate building codes. Does not count as degree credit. Prerequisite: CSM 2360.

5313 Building Information Modeling. (3-3) This course covers understanding the supervisory role of construction professionals in the design process including, directing a design team in the integration of construction documents for commercial buildings, coordination of site work, structural, architectural, mechanical, electrical, plumbing plans and contemporary CAD software for 2D & 3D design including Building Information Modeling. Prerequisite: CSM 2313 or consent of instructor.
5360 Construction Company Financial Control. (3-0) Financial accounting and cost controls used at the company level in construction companies are studied. Topics include accounting systems, construction project profit calculations, and financial analysis. Prerequisites: CSM 2360 and 5306, or Instructor’s Approval.

5362 Construction Contract Delivery Systems. (3-0) The course will introduce students to designer/contractor interactions, including conceptual estimating and scheduling, the RFQ/RFP process and legal, insurance, risk allocation issues, along with procurement and selection. Prerequisites: CSM 2360, CSM 5306.

Technology (TECH)

5100 Academic Instruction for Technology. (1-0) The course is seminar based and covers topics related to teaching and employment responsibilities. Completion of this course is required as a condition of employment for graduate assistants. This course does not earn graduate degree credit. Repeatable with different emphasis. Graded on a credit (CR), no-credit (F) basis.

5195 Industrial Internship. (0-4) This course is a supervised experiential learning course in Technology Management. This work integrated learning course helps the student link theory with practice. Repeatable for credit. Prerequisites: 9 hours completed toward the Master of Science in Technology Management degree and the approval of the graduate advisor.

5302 Fundamentals of Construction Contracts and Liability Issues. (3-0) This course introduces students to the legal aspects of design and construction contract documents, including dispute resolution methods and professional ethics commonly used in the construction industry. This course does not earn graduate degree credit. Prerequisite: TECH 2360.

5304 Fundamentals of Construction Estimating. (3-0) Provides the student with a comprehensive introduction to the principles, techniques, technologies, and basic concepts involving methodologies and strategies used in the preparation of various types of construction estimates and bids. This course does not earn graduate degree credit. Prerequisite: TECH 2360.

5305 Fundamentals of Quality Assurance. (3-0) Principles of quality management including probability theory and basic statistics, control charts for attributes and variables, sampling plans, quality audits, and costs. Experiences in basic metrology and data collection for quality control. This course does not count as credit toward a degree.

5307 Fundamentals of Manufacturing Processes. (1-3) Application of metal cutting principles. Includes steel rule dye layout, machine layout, tool life, tool wear, tool geometry and reconditioning, principles of feed rate and speed, material removal rates and power consumption. Machining of steel and castings using various cutting tools. Does not count toward degree credit. Prerequisite TECH 2330.

5310 Product Design and Development. (3-0) This course provides an overview of the new product realization process. The focus is on the steps of systematic product design including problem identification, product planning, conceptual design, and embodiment design. Standard CAD tools are employed for product modeling. Prerequisite: TECH 2310 or instructor’s approval.

5311 Computer Aided Engineering. (2-2) Application of computer hardware and software to the design of products and systems; geometric modeling; engineering computational methods; overview of engineering analysis software which may include finite element analysis, manufacturing simulation, solidification modeling, and rapid prototyping. Prerequisites: TECH 5310 and MATH 2471, or equivalents.

5315 Engineering Economic Analysis. (3-0) This course deals with economic analytical techniques used in engineering decision making. Topics include time value of money, comparing alternatives, depreciation, replacement, and income tax considerations. Prerequisite: MATH 1315 or 1319 or consent of instructor.
5364 Statistical Applications in Manufacturing Process Control. (3-0) Provides the student with in-depth exploration of inferential statistics as applied to manufacturing process control and quality assurance. Topics covered include frequency distributions, quality control charts, and experimental design. Prior experience with introductory level statistics is assumed. Prerequisite: TECH 3364 or MGT 4330 or TECH 5305 or consent of instructor.

5365 Industrial Project Management and Scheduling. (3-0) Introduce students to industrial management system concepts and applications as they relate to management operations; system design, implementation and management; case studies of practices; and application of theory to practical problems.

5382 Sustainability in Industrial Management. (3-0) This class will cover the basic concepts, principles, and techniques relate with sustainability in the fields of engineering and management. Emphasis will be placed on the construction and manufacturing technologies. Case studies will be introduced to understand a broad spectrum of industrial activities.

5384 Problems in Technology. (3-0) Graduate students investigate a special topic by developing a technical problem, researching the topic, and presenting the findings. Plans will be developed on an individual basis with strict faculty supervision. May be repeated for additional credit with permission of the department chair.

5385 Readings in Technology. (3-0) A study of the ethical and moral viewpoints typically associated with American society as related to the development and introduction of new technology and engineering. Past, present, and future issues will be studied with selected readings focusing on industrial related problems and issues.

5387 Planning Advanced Technology Facilities. (3-0) An in-depth study of technical problems encountered in designing, equipping, arranging, and specifying facility requirements for industrial and technical training facilities.

5390 Research in Technology. (3-0) Examination of scientific methods including theory formulation, deductive reasoning, hypothesis generation, observation, inductive reasoning, and theory revision. Categories of research are compared and contrasted as regards methodology. In-depth study of experimental research as it relates to significant industrial problems including considerations of design, internal and external validity, and appropriate analytical technique. Introduction to data analysis and its proper interpretation.

5391 Advanced Manufacturing Systems. (3-0) This course introduces students to various advanced tools, technologies, and strategies in modern manufacturing. An emphasis is placed on the state-of-the-art in factory automation and global manufacturing enterprises. Topics include process automation and control, advanced manufacturing processes, intelligent manufacturing control, and information technology in manufacturing. Prerequisites: TECH 2330 and TECH 5307 or instructor’s approval.

5392 Fundamentals of Microelectronics Manufacturing. (3-0) An introduction to integrated circuit fabrication to include crystal growth, wafer preparation, epitaxial growth, oxidation, diffusion, ion-implantation, thin film deposition, lithography, etching, device and circuit formation, packaging and testing. Significant project includes circuit design/simulation and/or process design. Laboratory component involves actual production/testing of a functional semiconductor device.

5394 Design of Industrial Experiments. (3-0) This course deals with the study of the fundamentals and applications of industrial experiments. Prerequisite: TECH 5390.

5398 Directed Project. (3-0) This course is a formal investigation into a business or industry problem. The directed project is an applied research project that is more extensive than an independent study and less extensive than a thesis. The course culminates in a detailed project report and oral presentation. Prerequisites: TECH 5390 and TECH 5394 and the approval of the graduate advisor.
Thesis Courses

5199B Thesis. (1-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5299B Thesis. (2-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5399A Thesis. (3-0) This course represents a student’s initial thesis enrollment. No thesis credit is awarded until student has completed the thesis in Technology 5399B. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5399B Thesis. (3-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5599B Thesis. (5-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5999B Thesis. (9-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

Graduate Faculty

Bartlett, Laura, Assistant Professor of Engineering Technology. B.S., Ph.D., Missouri University of Science and Technology.

Batey, A.H., Associate Professor and Chair of the Department of Engineering Technology. B.S., M.Ed., Texas State University; Ph.D., University of Maryland.

Habingreither, Robert Bruce, Professor of Engineering Technology and Associate Dean of the College of Science and Engineering. B.A., M.A., Montclair State University; Ed.D., West Virginia University.

Hager, Cassandra J., Senior Lecturer of Engineering Technology. B.S.I.T., M.S.I.T., Texas State University; Ph.D., Texas A&M University.

Sriraman, Vedaraman, Professor of Engineering Technology. B.S., Calcutta University, India; M.S., Indian Institute of Technology; D.Eng., Lamar University.

Talley, Kimberly, Assistant Professor of Engineering Technology. B.S., North Carolina State University; M.S.E., Ph.D., The University of Texas at Austin.

Winck, Gary Joseph, Professor of Engineering. B.S., University of Wisconsin Stout; M.Ed., Ball State University; Ph.D., University of Maryland College Park.

Ingram School of Engineering

Asiabanpour, Bahram, Associate Professor of Engineering. B.S, M.S. Sharif University of Technology; Ph.D., University of Southern California.
Chen, Heping, Assistant Professor of Engineering. B.S, Harbin Institute of Technology, China; M.E., Nanyang Technological University, Singapore; Ph.D., Michigan State University.

Jimenez, Jesus, Associate Professor of Engineering. B.S, M.S., The University of Texas at El Paso; Ph.D., Arizona State University.

McClellan, Stanley, Professor of Engineering. B.S., M.S., Ph.D., Texas A&M University.

Novoa, Clara, Associate Professor of Engineering. B.S., Universidad de los Andes-Bogota, Colombia; M.E., University of Puerto Rico-Mayaguez; Ph.D., Lehigh University.

Stephan, Karl David, Professor of Engineering. B.S., California Institute of Technology; M.Engr., Cornell University; Ph.D., The University of Texas at Austin.

Tate, Jitendra, Associate Professor of Engineering B.S., M.S., University of Pune, India; Ph.D., North Carolina A&T State University.
Ingram School of Engineering

Major and Degree Offered:
Engineering, M.S.

Major Program

The Master of Science degree with a major in Engineering provides a practical, industry-driven focus via a long-term, targeted technical project or thesis related to real-world engineering applications. These projects will be conducted in partnership with local industries and may involve off-campus collaborations. The degree requires a large-scale project or thesis because the abilities to solve problems, innovate and make immediate contributions to industry are best developed by having students confront a large, open-ended problem; perform detailed research on the problem; develop various solutions; choose and implement the best solution; validate their choice; and effectively communicate the process to professional colleagues, executives, and customers.

The program has two options:
1. A traditional thesis option focused on an academic research topic;
2. A directed technical research option focused on a practical, industry-driven project.

Both degree options require a minimum of 34 hours:
- 18 hours of “Engineering Core” courses (9 required, 9 elective)
- 9 hours of “Multidisciplinary Elective” courses
- 7 hours of “General Core,” including 1 hour of seminar and at least 6 hours of thesis or project coursework.

The degree structure is comprised of three separate concentration areas: Electrical Engineering, Industrial Engineering, and Manufacturing Engineering. As part of the application process, students declare a major in one of these three concentrations.

The Engineering Core is divided into a general required course (3 hours), concentration-specific required courses (6 hours), and engineering electives (9 hours). The general required course ENGR 5310 must be taken by graduate students from all three concentrations. Concentration-specific required courses (two, 3 hours each) are listed below for each of the three concentrations:

- Electrical Engineering: EE 5320, EE 5350
- Industrial Engineering: IE 5320, IE 5340
- Manufacturing Engineering: MFGE 5316, MFGE 5326

Engineering electives (three courses, 3 hours each) are specified by the student’s graduate committee for his/her plan of study and are chosen from the following:

- EE 5323, EE 5330, EE 5355, EE 5360, EE 5372, EE 5374, EE 5377, EE 5385
- IE 5310, IE 5330, IE 5343, IE 5345, IE 5347, IE 5397
- MFGE 5318, MFGE 5320, MFGE 5328

The Multidisciplinary Elective courses (9 hours) are specified by the student’s graduate committee and are chosen from a set of engineering-related courses from other disciplines including Business, Technology, Mathematics, Computer Science, Physics, or Chemistry. The list of these multidisciplinary
elective courses (3 hours each) is given below. (Course descriptions for these electives are found elsewhere in the Graduate Catalog.)

- Business Administration: CIS 5358, CIS 5364, CIS 5370, MGT 5311, MGT 5315, MGT 5321, MGT 5390, QMST 5335
- Industrial Technology: TECH 5315, TECH 5390, TECH 5392
- Computer Science: CS 5306
- Mathematics: MATH 5340, MATH 5345, MAH 5376, MATH 5385, MATH 5388
- Physics: PHYS 5326, PHYS 5327
- Material Science, Engineering, and Commercialization: MSEC 7301, MSEC 7302, MSEC 7310, MSEC 7311

The General Core courses consist of ENGR 5100 (1 hour) and at least 6 hours of project courses (ENGR 5398A, etc.) for the project option or at least 6 hours of thesis courses (ENGR 5399A, etc.) for the thesis option.

All students will have a faculty advisor and a graduate committee composed of a minimum of three graduate faculty members (including the faculty advisor). The faculty advisor will provide technical direction for the student’s project/thesis, and the graduate committee will be responsible for approving the project/thesis proposal, receiving project/thesis progress reports, and approving the final project/thesis presentation and written report. Oral thesis defense or oral project presentation will serve as the comprehensive examination.

**Admission Policy**

For information regarding admission application requirements and deadlines, please visit our website at www.gradcollege.txstate.edu/engr.html.

**Financial Assistance**

- **Graduate Instructional and Research Assistantships.** A limited number of paid graduate assistantships are available. Research assistants work with faculty on research and other special projects. Instructional assistants work with undergraduates in laboratory settings. Contact the program’s graduate advisor for details and application instructions.

- **Graduate College Scholarships and Fellowships.** For more information about scholarships, fellowships, financial aid and application deadlines, visit Texas State’s Graduate College Web site at www.gradcollege.txstate.edu and click on *Financing Your Graduate Education.***

**Contact Information**

Graduate Advisor  
Ingram School of Engineering  
Texas State University  
601 University Drive  
San Marcos, TX 78666-4605  
Phone: 512.245.1826  
Fax: 512.245.7771  
E-mail: EngrGradAdvisor@txstate.edu
Courses Offered

Engineering (ENGR)

5100 Seminar in Engineering. (1-0) Graduate students attend seminars by invited speakers presenting relevant topics in academia and industry. The schedule of speakers will be developed each semester with strict faculty supervision. This course may only be taken for credit one time. Restricted to students enrolled in the MS Engineering program.

5101 Academic Instruction for Engineering Graduate Assistants. (1-0) This course is seminar based and covers topics related to teaching and employment responsibilities. Completion of this course is required as a condition of employment for graduate assistants. This course does not earn graduate credit, and is graded on a credit (CR), no-credit (F) basis. Restricted to students enrolled in the MS Engineering program.

5301 Probability, Random Variables, & Stochastic Processes for Engineers. (3-0) This course develops theory underlying analysis and design of systems. Fundamental distributional concepts, applications of statistical methods, and theory of stochastic processes are introduced to create a foundation for mathematical analysis of physical systems involving randomness. Applications to engineering topics are taught, including estimation, control, and systems theory. Prerequisite: IE 3320 or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.

5384 Problems in Engineering. (3-0) Graduate students investigate a special topic by developing a technical problem, researching the topic, and presenting the findings. Plans will be developed on an individual basis with strict faculty supervision. This course may be repeated once for additional credit with permission of the School Director. Restricted to students enrolled in the MS Engineering program and with approval of instructor.

Project Courses

5198B Project. (1-0) This course represents a student's continuing project enrollments. The student continues to enroll in this course until the project is completed. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.

5298B Project. (2-0) This course represents a student's continuing project enrollments. The student continues to enroll in this course until the project is completed. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.

5398A Project. (3-0) This course represents a student's initial project enrollment. No project credit is awarded until the student has completed the project in ENGR 5x98B. This course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.

5398B Project. (3-0) This course represents a student's continuing project enrollments. The student continues to enroll in this course until the project is completed. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.
5598B Project. (5-0) This course represents a student's continuing project enrollments. The student continues to enroll in this course until the project is completed. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.

5998B Project. (9-0) This course represents a student's continuing project enrollments. The student continues to enroll in this course until the project is completed. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.

Thesis Courses

5199B Thesis. (1-0) This course represents a student's continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.

5299B Thesis. (2-0) This course represents a student's continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.

5399A Thesis. (3-0) This course represents a student's initial thesis enrollment. No thesis credit is awarded until the thesis is completed in ENGR 5x99B. This course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.

5399B Thesis. (3-0) This course represents a student's continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.

5399B Thesis. (5-0) This course represents a student's continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.

5999B Thesis. (9-0) This course represents a student's continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.

Electrical Engineering (EE)

5320 Advanced Computer Architecture and Arithmetic. (3-0) This course teaches design and analysis of high-performance computer systems, focusing on quantitative analysis of the latest processors and compilers. Current processor architectures are surveyed for system design. Topics include instruction sets, parallelizing architectures, pipelining, I/O, memory and cache organization, parallel/vector processing, fast arithmetic units design, and implementation using HDL. Prerequisites: EE 3420 and CS 3339 or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.

5323 Digital Image Processing. (3-0) This course provides the necessary fundamental techniques to analyze and process digital images. It covers principles, concepts, and techniques of digital image processing and computer vision. Prerequisites: EE 3420, CS 2308, or approval of instructor. Restricted to students enrolled in the MS Engineering program.
5330 Embedded and Real-Time Computing. (3-0) This course teaches development of embedded computing systems with strong resource constraints. Key concepts include managing constrained memory and processing speed limitations, and programming for soft and hard real-time constraints. Students will learn use of a Real-Time Operating System (RTOS). Prerequisites: EE 3420 and CS 3339, or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.

5350 Advanced Electronic Circuit Design. (3-0) This course includes low and high power RF amplifier design techniques, oscillators, FM demodulators, limiters, and mixer design. Additional topics include circuit design to minimize intermodulation and other forms of distortion, and RF and high-speed analog circuits with emphasis on digital-friendly applications. Prerequisite: EE 4350 or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.

5355 Electronic Materials and Devices. (3-0) This course covers theoretical concepts applicable to the understanding of unique properties exhibited by electronic materials, especially by dielectrics, oxide semiconductors, ferroelectrics, pyroelectrics, piezoelectrics, magnetic, and multifunctional and multiferroic materials. The various microelectronic devices and modern novel technologies based on these materials are emphasized. Prerequisite: EE 3350, or equivalent, with a grade of B or higher, or approval of instructor. Restricted to students enrolled in the MS Engineering program.

5360 Thin Film Technology. (3-0) This course covers the theoretical and practical aspects of thin film technology in modern devices. The design and fabrication of thin film heterostructures is discussed. Growth and nucleation of epitaxial thin films with diverse properties and devices with combined properties will be emphasized. Prerequisite: EE 3350 or equivalent, with a grade of B or higher, or approval of instructor. Restricted to students enrolled in the MS Engineering program.

5372 Advanced Networking. (3-0) This course develops important theoretical and application topics related to advanced networking. Theoretical topics are introduced using mathematical treatments, including queuing theory and some random processes. The course includes applications of these topics to communications networks, and focuses on architectures, applications and technologies which affect modern computer and data networks. Restricted to students enrolled in the MS Engineering program.

5374 Introduction to Wireless Communication. (3-0) This course teaches principles and practices in designing and analyzing cellular and other wireless communication systems. Topics include RF propagation modeling, fast and slow fading, modulation, demodulation, coding, and multiple access techniques. Prerequisite: EE 4370. Restricted to students enrolled in the MS Engineering program.

5377 Statistical Signal Processing. (3-0) This course develops the theory and applications of random processes using mathematical treatments, including elementary discrete and continuous time linear systems theory, elementary probability, and transform theory. Topics include applications of random processes to information and communication theory, estimation and detection, control, signal processing, and stochastic systems theory. Prerequisite: ENGR 5310 or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.

5385 Optoelectronic Devices. (3-0) This course introduces the student to the concepts, physical operations, and design criteria of state-of-the-art optoelectronic devices and systems used in research, technology, medicine, communication, and other modern applications. Prerequisites: EE 3355, EE 4350, or equivalent, with a grade of C or higher; or approval of instructor. Restricted to students enrolled in the MS Engineering program.
Industrial Engineering (IE)

5310 Advanced Statistical Design of Experiments for Engineers. (3-0) This course examines the design and analysis of controlled experiments, demonstrating engineering applications of design of experiments (DOE) in the manufacturing and service industries. Topics include full and fractional factorial designs, response surface methodology, and Taguchi methods. In a semester-long project, students apply DOE to improve a real manufacturing process. Prerequisite: ENGR 5310 or instructor's approval. Restricted to students enrolled in the MS Engineering program.

5320 Modeling and Analysis of Manufacturing Systems. (3-0) This course covers the methods for modeling and analyzing manufacturing systems. Critical manufacturing issues that are addressed by these models include sustainable production systems, material handling systems, scheduling, and supply chains. Prerequisites: IE 3320, IE 3340, and MFGE 4396; or instructor's approval. Restricted to students enrolled in the MS Engineering program.

5330 Advanced Quality Control and Reliability Engineering. (3-0) This course provides in-depth knowledge in reliability modeling and maintenance optimization for components and systems. The course also covers advanced quality control techniques including multivariate process control. Methodologies are applied to solve practical problems arising from various industry domains. Prerequisite: ENGR 5310 or approval of instructor. Restricted to students enrolled in the MS Engineering program.

5340 Applied Deterministic Operations Research for Engineers. (3-0) This course introduces students to modeling of linear, non-linear, and integer problems applied to engineering design, manufacturing, service, supply chain, healthcare and electrical systems. Mathematical programming software is emphasized in class exercises, homework, and project. Techniques including revised simplex method, duality theory, sensitivity analysis, and networks are also covered. Prerequisites: CS 1428 and MATH 3377 or approval of instructor. Restricted to students enrolled in the MS Engineering program.

5343 Non-Linear Optimization Techniques for Engineers. (3-0) This course covers engineering applications of mathematical modeling and computational methods for nonlinear programming problems. The primary goal of this course is to present techniques and strategies essential to optimize non-linear models. Prerequisite: IE 3340 or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.

5345 Advanced Optimization. (3-0) This course covers advanced concepts in linear and integer programming. Solution techniques for stochastic and dynamic programming and formulation and solution of decision models in manufacturing, service, supply chain, healthcare and electrical systems are presented. Prerequisite: IE 5340. Restricted to students enrolled in the MS Engineering program.

5347 Modern Heuristic Optimization. (3-0) This course covers heuristic methods that search beyond local optima such as simulated annealing, tabu search, genetic algorithms, ant-colony systems and particle swarm. Papers from the literature, problem-specific heuristics, evaluation methods, and implementations are discussed. Prerequisite: IE 3340 or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.

5397 System Thinking and Analysis. (3-0) This course is an introduction to systems engineering and the systems thinking process, providing important considerations related to the engineering of large scale systems. These considerations include system understanding, modeling and design, the system development process, needs analysis, concept exploration and definition, design, integration and evaluation, and systems engineering management. Prerequisite: ENGR 5310 or approval of instructor. Restricted to students enrolled in the MS Engineering program.
Manufacturing Engineering (MFGE)

5316 Advanced Computer Aided Design and Manufacturing. (3-1) Topics include design process, mathematical presentation of wireframe/surface/solid modes, transformation and manipulation of objects, finite element analysis, data exchange, process planning, fundamentals of multi-axis NC programming for turning and milling processes, fundamentals of CAD/CAM systems, CNC code generation by CAD/CAM software for the CNC, and waterjet machines. Registration requires instructor's approval. Restricted to students enrolled in the MS Engineering program.

5318 Reverse Engineering and Freeform Fabrication. (3-1) The course covers theory, techniques, and applications of Advanced Reverse Engineering and Freeform Fabrication. Topics include reverse engineering generic process, reverse modeling, contact and noncontact scanning, point cloud, geometric modeling, data extraction, rapid prototyping processes, uniform and adaptive slicing, industrial and medical applications, hardware, and software. Co-requisite: MFGE 5316. Registration requires instructor's approval. Restricted to students enrolled in MS Engineering program.

5320 Polymer Nanocomposites. (3-1) This course covers polymer nanocomposites focusing on materials, manufacturing, characterization, and applications. The primary focus is on fiber reinforced polymer nanocomposites. Morphological, Thermal, Mechanical, and Electrical Characterization will be discussed in detail. Applications include fire-resistant, ablative, fatigue-resistant, impact-resistant, and bio-based composites. Registration requires instructor's approval. Restricted to students enrolled in the MS Engineering program.

5326 Advanced Robotics in Manufacturing Automation. (3-0) This course covers principles and techniques involved in advanced robotics. Topics include introduction to robotics, industrial robotics, robot kinematics, path planning, robot dynamics, advanced control, force control, sensors and actuators, mobile robotics, and introduction to nanorobotics. Registration requires instructor's approval. Restricted to students enrolled in the MS Engineering program.

5328 Advanced Control Techniques. (3-0) This course covers advanced control techniques in manufacturing processes. Topics include modeling of dynamic systems, feedback control systems analysis, stability analysis, PID control, optimal control, programmable logic control, design of control systems, transducer and sensor technology, and digital control. Registration requires instructor's approval. Restricted to students enrolled in the MS Engineering program.

Graduate Faculty

Asiabanpour, Bahram, Associate Professor of Engineering. B.S., M.S. Sharif University of Technology, Iran; Ph.D., University of Southern California. (Additive Manufacturing, Fully Dense Freeform Fabrication, Metal Foam Bonding, CAD/CAM, Rapid Product Development, Renewable Energy, and STEM Education)

Aslan, Semih, Assistant Professor of Engineering. B.S., Istanbul Technical University, Turkey; M.S., Ph.D., Illinois Institute of Technology. (Computer Architecture, DSP and Digital Image Processing, Embedded System Design, Hardware Design and Performance Optimization with FPGAs and VLSI, Renewable Energy Systems including Solar and Wind)

Chen, Heping Fred, Assistant Professor of Engineering. B.E., Harbin Institute of Technology, China; M.E., Nanyang Technological University, Singapore; Ph.D., Michigan State University. (Autonomous Mobile Industrial Robots, Intelligent “Smart” Robotics, Embedded Control System for Advanced Robots, Nano-Robotics, Sensor Fusion for Industrial Applications)
Chen, Yihong Maggie, Assistant Professor of Engineering. B.S., M.S., XiDian University, China; Ph.D., Beijing University of Posts and Telecommunications, China; Ph.D., The University of Texas at Austin. (Nano-Electronics, Microwave Photonics, Photonic Beamformer for Phased Array Antenna, Silicon Nanophotonics, Polymer Photonic Devices. Photonic Crystals)

Droopad, Ravindranath, Professor of Engineering. B.Sc., The University of Birmingham, U.K.; Ph.D., Imperial College, U.K. (Semiconductor Materials/Structures for Next-Generation CMOS Devices, Multifunctional Oxides on Semiconductors, Heterointegration of III-V, Oxides and Silicon)

Jimenez, Jesus, Associate Professor of Engineering. B.S., M.S., The University of Texas at El Paso; Ph.D., Arizona State University. (Modeling, Analysis and Optimization of Manufacturing Systems, especially Semiconductor Manufacturing; Discrete-Event & Agent-Based Simulation; Design of Experiments in Six-Sigma Applications; and Green Production Systems and Supply Chains)

Jin, Tongdan, B.S. Northwest Institute of Light Industry (now Shaanxi University of Science and Technology), China; M.S. Beijing Institute of Technology, China; Ph.D., Rutgers University. (Renewable Energy Integration Applied to Manufacturing Sustainability and Smart Grid Systems, Integrated Product-Service Supply Chain Design, Multi-Objective Reliability and Maintenance Optimization under Uncertainty)

Kim, Namwon, Assistant Professor of Engineering. B.S., Kangwon National University, South Korea; Ph.D., Louisiana State University. (Micro/Nano Systems for Biomedical/Analytical Applications, Microfluidics and Optical Measurements, Micro/Nano-Fluidic Systems Transport Phenomena, Advanced Multi-Scale Manufacturing and Surface Modification)

McClellan, Stanley, Professor of Engineering. B.S., M.S., Ph.D., Texas A&M University. (Digital Signal/Image/Speech Processing and Data Compression, Analog/Digital Communications and Information Theory, Distributed Systems Optimization with emphasis on Quality of Service, High-Speed Computer/Network Architectures and Protocols)

Novoa, Clara, Associate Professor of Engineering. B.S., Universidad de los Andes-Bogota, Colombia; M.E., University of Puerto Rico-Mayaguez; Ph.D., Lehigh University. (Operations Research and Supply Chain Engineering, Dynamic and Stochastic Programming, Linear and Integer Programming, Heuristics and Simulation Techniques, Sampling Techniques, Parallel and Distributed Computing for Large-Scale Optimization)


Salamy, Hassan, Assistant Professor of Engineering. B.E., Lebanese American University, Lebanon; M.S., Ph.D., Louisiana State University. (Memory and Code Optimization in Embedded Systems, Compiler Optimization for Embedded Systems, Multi-Core Systems, and High-Performance Computers, SoC and NoC Testability)

Stephan, Karl David, Professor of Engineering. B.S., California Institute of Technology; M.Engr., Cornell University; Ph.D., The University of Texas at Austin. (Atmospheric Physics and Plasmas, Engineering Ethics, Microwave and Millimeter-Wave Devices and Circuits, History of Technology and Science)

Stern, Harold, Professor of Engineering. B.S., The University of Texas at Austin; M.S., Ph.D., The University of Texas at Arlington. (Wireless Communication Systems, Multiple Access Techniques, Adaptive Signal Processing, Device Characterization, Pedagogy and Student Learning Styles, Engineering Ethics, Instructional Technology in Engineering Education)

Tate, Jitendra, Associate Professor of Engineering B.S. and M.S., University of Pune, India; Ph.D., North Carolina A&T State University. (Characterization and Failure Analysis of Polymers, Elastomers, and Composites; Manufacturing of Advanced Thermoset and Thermoplastics Polymer Matrix Composites; Bio-based Composites; Ablative Composites; Polymer Nanocomposites; Fatigue of Composites; Development of Application Oriented Innovative Composite Materials for Energy, Construction, and Aerospace applications; Sustainable Materials, Design, and Manufacturing; Nanotechnology Applications and Safety; Engineering Education)

Viswanathan, Vishu, Professor of Engineering. B.E., Madras University, India; M.Tech., Indian Institute of Technology, Kanpur, India; Ph.D., Yale University. (Digital Speech Processing and Compression, Voice and Audio Quality Enhancement for Hand-Held Devices and Voice Over IP Networks, Voice Input/Output for Communication Devices, Digital Signal Processing Applications)

Yu, Qingkai, Assistant Professor of Engineering. B.E., Xi’an Jiaotong University, China; M.E., China Institute of Atomic Energy, China; M.S., University of Michigan; Ph.D., University of Houston. (Synthesis of Novel Electronic Materials including Nano Carbon and Semiconductor Nanostructures, Nano Sensors and Nano Fabrication)
Interdisciplinary Studies

Major and Degrees Offered:
Interdisciplinary Studies, M.S.I.S.
Science, Mathematics, and Technology Education for Elementary and Middle School Teachers.

Major Programs

The University offers the Interdisciplinary Studies program leading to the degree of Master of Science in Interdisciplinary Studies (M.S.I.S.) and is designed for the mature student whose educational needs will be best met by a nontraditional course of study. The M.S.I.S. degree is available through those departments that offer the Master of Science degree. Interdisciplinary studies programs may be composed of courses selected from any department at Texas State that offers graduate courses. However, the Interdisciplinary Studies program requires that coursework meet the following requirements:

- The degree requires a minimum of 39 semester credit hours;
- Courses must be selected from 3 colleges;
- Courses must be selected from 4 departments, with at least six hours completed in 3 of these departments;
- A maximum of 15 hours of coursework in any one department may be used for degree credit;
- Thesis and non-thesis options are available;
- Any degree plan is tentative until it has been approved by the Dean of the Graduate College.

The degree also requires passing the comprehensive examination(s).

The interdisciplinary studies program does not replace the traditional academic program in any area. Persons whose educational goals are best met by established programs should enroll in those areas. Students who wish to consider a program of interdisciplinary studies should confer with the Interdisciplinary Studies Graduate Advisor in an academic department.

Science, Mathematics, and Technology Education for Elementary and Middle School Teachers

Elementary and middle school teachers may pursue an M.S.I.S. degree. Dr. Sandra West Moody in the Department of Biology should be contacted if the student plans to study through the science, mathematics, and technology education interdisciplinary studies program. A review of elementary and middle school education programs at the undergraduate level indicates that elementary and middle school teachers are required to take a limited number of science, mathematics, and technology courses to complete the requirements of their degree programs. There is a critical need for elementary and middle school teachers with an adequate background in the content of science, mathematics, and technology in order to understand and incorporate the Texas Essential Knowledge and Skills (TEKS) and the National Education Standards in Mathematics and Science into the elementary and middle school curriculum. This graduate program addresses this need and facilitates the learning process by modeling inquiry as a method of discovering science, mathematics, and technology concepts. This method of modeling the TEKS and Standards while teaching the content will help teachers turn the theoretical TEKS and Standards into reality in their individual classrooms. Work/life credit cannot be used for this program.
Admission Policy – Science, Mathematics, and Technology Education for Elementary and Middle School Teachers

For information regarding admission application requirements and deadlines, please visit our website at www.gradcollege.txstate.edu/emst.html.
Ph.D. in Materials Science, Engineering, and Commercialization

Doctoral Major and Degree Offered
Materials Science, Engineering, and Commercialization, Ph.D.

Ph.D. Program

The College of Science at Texas State offers a doctoral program that is expanding existing initiatives to create a cutting-edge materials science, engineering and commercialization program that will contribute to the research, development, and validation of materials to be used in the next generation of electronics, medicines, plastics, sensors, and renewable energy. In addition to receiving departmental-level support, these academic and research capabilities are supported by an institutional ‘top-to-bottom’ commercialization platform. Coupling commercialization with science and engineering, the planned curriculum will infuse an understanding of intellectual property law, skills in business planning, competency in transforming innovations from the lab to commercial production, and the ability to organize and lead interdisciplinary research teams. Therefore, our goal is educate the next generation of scientists and engineers who will perform interdisciplinary research and will emerge as effective entrepreneurial leaders in the advancement of high tech 21st century global discovery and innovation.

Courses are offered in the evenings for the convenience of working professionals. Students are classified as either full-time (nine hours per term) or part-time. All students will be given the opportunity to initiate, complete, present, and publish original research.

Each student develops an appropriate degree plan to meet his/her career and academic goals. The degree plan will include a mix of theoretical, analytical, and elective courses that will prepare students to work independently and in multidisciplinary teams.

Educational Goal

The central educational goal of the Ph.D. program in Materials Science, Engineering, and Commercialization at Texas State is to prepare doctoral students with

- technical skills necessary to conduct high quality research,
- an orientation toward interdisciplinary research,
- a set of business tools and knowledge of business practice, and
- technical project and business management skills.

Graduates from the program will be equipped with

- Technical skills to conduct high quality research. The program is designed to have students plan and carry out cutting edge research in materials science that demonstrates the ability to think through complex problems and arrive at solutions. This goal is supported by a rigorous set of technically oriented coursework that will equip students with the fundamental science knowledge necessary to conduct research. The student will also, in consultation with his research advisor and Dissertation Committee, formulate a research project and produce a proposal for carrying out the research.
- An orientation toward interdisciplinary research.
- A set of business tools and knowledge of business practice. Equipping our graduates with the business skills necessary to become entrepreneurs or leaders in industry is a central goal of the program. This educational goal is not only supported by the core courses in practical and leadership skills in commercialization and entrepreneurship but also other elements dispersed throughout the program. These elements include a three-week intensive workshop to be completed in the summer prior to beginning the program. This introductory bootcamp will outline basic aspects of business and commercialization, and equip students with a common language and basic toolkit. Also a two-week entrepreneur boot camp will be required after the student’s first year in the program. In addition, two of the candidacy requirements solidify business skills. The student will produce a full business plan for a start-up company and defend it orally. The student will write a Small Business Innovation Research/Small Business Technology Transfer Research (SBIR/STTR) proposal. If appropriate, the student will be provided the opportunity to work with a small business on the proposal, and to submit the final document to a funding agency. The students will be further encouraged to submit their business plan to the Texas State Business Plan Competition in an oral presentation before a panel of angel investors, venture capitalists and business owners. In addition, the Commercialization Forum will be a weekly seminar program where the students will be exposed to successful entrepreneurs and business leaders. This Commercialization Forum will be the venue for oral defense of the student business plans. These requirements will ensure that the student has developed the business skills necessary to succeed.

- Technical project and business management skills. The ability to manage complex technical projects and businesses is another skill that is core to this program. This goal is certainly supported by the core courses. In addition, the Commercialization Forum will regularly expose the students to examples of good project management and cases of what not to do in managing projects or businesses. The ability of the student to manage projects can be assessed to some degree by how they manage the business plan, SBIR/STTR proposal, and the implementation of the proposed research plan.

**Admission Policies**

For information regarding admission application requirements and deadlines, please visit our website at www.gradcollege.txstate.edu/msec.html.

**Financial Assistance**

Assistantships and scholarships are available to qualified applicants. The Department of Engineering Technology offers doctoral instructional assistantships and teaching assistantships on a competitive basis to full-time students enrolled in the Materials Science, Engineering, and Commercialization Ph.D. program. An offer of financial support will normally be made at the time that a student is accepted into the program. The Office of the Graduate College can provide further information regarding scholarships.
Course Work

Degree Audit

Each Ph.D. student is issued a preliminary degree audit by the Office of the Graduate College which should be used to plan the student’s course of study. In the first term of enrollment, students should review the degree audit in consultation with their supervising professor and the Program Director.

With admission into the doctoral program, it is expected that students will pursue their course work and research activities in an efficient and timely manner. If it is determined that a student is not making adequate progress toward completion of the doctoral degree requirements, consultations will be undertaken between the student, his or her Ph.D. advisor, the Program Director, and the department Graduate Committee to develop a remediation plan, which may include revising a student’s program of study or research. Failure to successfully remedy documented deficiencies will result in termination of the student’s enrollment in the doctoral program at the discretion of the Graduate Committee. Students removed from the doctoral program in this manner may appeal to the Dean of the Graduate College for reinstatement in the program.

Course Work Requirements

The Ph.D. in Materials Science, Engineering, and Commercialization requires students to complete, at minimum, 55 credit hours. Doctoral students selected for teaching assistantships will be required to enroll in MSEC 7100, Doctoral Assistant Development, during the first three terms that they teach classes.

Each student will develop a degree plan, in consultation with the Doctoral Coordinator and subject to approval by the Doctoral Executive Council, which identifies the appropriate doctoral prescribed electives necessary for achieving the degree. Students must complete 37 credit prior to taking a three-part Advancement to Candidacy Comprehensive Examination. The exam will consist of the following parts: Grant Proposal, Business Plan, and Oral Examination.

Materials Science, Engineering, and Commercialization Ph.D. Program Course Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Semester credit hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctoral Core</td>
<td>22</td>
</tr>
<tr>
<td>Doctoral Prescribed Electives</td>
<td>15</td>
</tr>
<tr>
<td>Dissertation</td>
<td>18 (minimum)</td>
</tr>
<tr>
<td>Total</td>
<td>55 (minimum)</td>
</tr>
</tbody>
</table>

Instructional Assistant Courses

MSEC 7100 Doctoral Assistant Development

Core Courses

- MSEC 7101 Commercialization Forum (1 hour per term for 4 hours total)
- MSEC 7102 MSEC Seminar (1 hour per term for 4 hours total)
- MSEC 7301 Practical Skills in Commercialization and Entrepreneurship
- MSEC 7302 Leadership Skills in Commercialization and Entrepreneurship
- MSEC 7401 Fundamental Materials Science and Engineering
MSEC 7022 Advanced Materials Science and Engineering Concepts

Prescribed Elective Courses:

- MSEC 7103 Research in Materials Science, Engineering, and Commercialization
- MSEC 7201 Principles of Technical Project Management
- MSEC 7303 Research in Materials Science, Engineering, and Commercialization
- MSEC 7304 Collaborative Research/Commercialization Experience
- MSEC 7310 Nanoscale Systems and Devices
- MSEC 7311 Materials Characterization
- MSEC 7312 Thermodynamics and Kinetics for Material Scientists
- MSEC 7315 Quantum Mechanics for Material Scientists
- MSEC 7320 Nanocomposites
- MSEC 7330 Computational Materials Science
- MSEC 7340 Biomaterials
- MSEC 7350 Frontiers of Nanoelectronics
- MSEC 7360 Nanomaterials Processing
- MSEC 7370 Advanced Polymer Science

Dissertation: 18 hours minimum

- MSEC 7199 Dissertation
- MSEC 7299 Dissertation
- MSEC 7399 Dissertation
- MSEC 7599 Dissertation
- MSEC 7699 Dissertation
- MSEC 7999 Dissertation

Advancement to Candidacy

Application for Advancement to Candidacy

Students can download the “Advancement to Candidacy Application” from the Graduate College website or they can obtain a copy from the Doctoral Coordinator. The student should complete and sign the upper portion of the form and return it to the Doctoral Coordinator. When all requirements for admission to candidacy have been met (completion of boot camps or equivalents, core course work, prescribed electives, successful performance on the comprehensive examination, approval of dissertation advisor/committee, and submission of an approved dissertation proposal), the Doctoral Coordinator will forward the Advancement to Candidacy application to the Dean of the Graduate College for review and approval.

The Dean of the Graduate College approves advancement to candidacy once all requirements are met and at the recommendation of the Doctoral Executive Council.

In addition, before advancement to candidacy, students are required to complete the following:

1. Completion of all core courses toward the doctoral degree with a GPA of 3.0 or higher on a 4.0 scale with no grade earned below “B” on any graduate course work to be applied toward the Ph.D. degree.
2. Satisfactory performance on the comprehensive examination.
3. The student must select a dissertation advisor, and that advisor must be approved by the Doctoral Executive Council. The student also must select a dissertation
committee comprised of three additional members of the doctoral faculty and at least
one external member from outside the Department or the University.

(4) The student must choose a topic with the approval of the student’s dissertation
advisor and committee.

(5) The student will submit a title and a written proposal for the dissertation to the
student’s dissertation committee and successfully defend the proposal in an oral
presentation with the dissertation committee. The proposal will include a statement
of the problem to be studied, a discussion of the relevant literature, and the research
method of the proposed dissertation topic.

(6) The Council will make a recommendation to the Graduate Dean who makes the final
decision on the student’s advancement to candidacy. The Graduate College will
notify the student once the decision has been made.

Advancement to Candidacy Time Limit

While encouraged to advance to candidacy at the end of two years, all students will be
expected to have advanced to candidacy by the end of their third year in the program. Full-time,
traditional students must be advanced to candidacy within five years of initiating Ph.D. coursework
applied toward the degree. Requests for a time extension will be submitted to the Doctoral Program
Director by the student’s Ph.D. Research Advisor and must be approved by the Graduate College. Non-
traditional, part-time students may request extensions from the Doctoral Executive Council as long as
they maintain a GPA of 3.5 and are making consistent progress toward fulfilling their degree
requirements. The Doctoral Executive Council will review part-time students’ requests for extensions on
an individual, case-by-case basis.

No credit will be applied toward a student’s doctoral degree for course work completed more
than five 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 doctoral student in the Materials
Science, Engineering, and Commercialization program is required for admission to candidacy. No grade
earned below “B” on any graduate course work may apply toward a Ph.D. degree in Materials Science,
Engineering, and Commercialization 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.

Dissertation Proposal

A dissertation proposal prepared by the student and approved by the student’s Ph.D. advisor
and a majority of the 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 “Ph.D.
Dissertation Proposal” form. This form can be downloaded from the Graduate College website or it can
be obtained from the Doctoral Coordinator. A final copy of the dissertation proposal, accompanied by
the signed approval form, must be turned in to the Doctoral Coordinator, who will forward it to the Dean
of the Graduate College for review and final approval.
Advancement to Candidacy Comprehensive Examination

After students have completed all required core and background courses as prescribed in their degree audit, students will be required to pass a comprehensive examination that will assess the student’s preparedness to carry out the proposed plan of dissertation research. Students will be required to take the Advancement to Candidacy Examination no later than his or her fourth term in the program. To be eligible to take the comprehensive examination, students must have a minimum GPA of 3.0 in all the core coursework, including any coursework that is transferred from another institution. The Advancement to Candidacy Examination will consist of two written components and one oral component. Three members of the doctoral faculty will be asked by the Doctoral Coordinator, subject to approval by the other members of the Doctoral Executive Council, to write and grade the examinations each year. All three will be Core or Associate Doctoral Faculty, and at least one of the three must be a member of the Core Doctoral Faculty. Each student will be required to take the Advancement to Candidacy Examination, which will be conducted by his or her Ph.D. Dissertation Committee. All Committee members must be in attendance for candidacy examinations. Results of the Advancement to Candidacy Examination will be reported on the Comprehensive Examination report and submitted to the Graduate College. The Advancement to Candidacy Examination will consist of the following three parts: Grant Proposal, Business Plan, and Oral Examination.

Should a student fail the exam, he or she will have the option of taking a second Advancement to Candidacy Examination, which must be passed by the end of the following term. Failure to pass this exam on two occasions will lead to the student's dismissal from the Ph.D. program.

Recommendation for Advancement to Candidacy

The Dissertation Committee recommends the applicant for Advancement to Candidacy by completing the “Advancement to Candidacy Examination Report” which can be downloaded from the Graduate College website or obtained from the Doctoral Coordinator. The results of the Advancement to Candidacy Examination must be filed in the Office of the Graduate College before the Dean of the Graduate College gives final approval to candidacy. The Doctoral Coordinator is responsible for submitting this report 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 American Chemical Society (ACS) or American Institute of Physics (AIP) G37 Style Manual or in an appropriate professional journal in the designated field, as deemed acceptable by the Dissertation Committee. After being admitted to candidacy, students must be continuously enrolled for dissertation hours each fall and spring term until the defense of their dissertation. If a student is receiving supervision on the dissertation during the summer or the student is graduating in 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 18 semester hours of dissertation research credit.

The student must submit a dissertation abstract for approval by the Dean of the Graduate College before the end of the first term of enrollment in dissertation credits. The student must submit to the Graduate College the approved dissertation and an abstract approved by the dissertation committee for publication in Dissertation Abstracts International. The Graduate Dean must approve the dissertation.
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 18 semester hours of dissertation research and writing credit.

Dissertation Time Limit

Students are expected to complete the dissertation within two years of Advancement to Candidacy. Any exceptions to this time limit require the approval of the Doctoral Program Director and the Dean of the Graduate College. The Doctoral 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. Research Advisor and Dissertation Committee on this matter as appropriate.

Dissertation Committee

The Dissertation Committee will be responsible for administering the Advancement to Candidacy 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. Research Advisor, three other College of Science doctoral faculty members, and one external doctoral graduate faculty member. The student’s Ph.D. Research Advisor will chair the Committee. The student, Doctoral Program Director, and the Dean of the Graduate College will approve the composition of the Dissertation Committee. The Ph.D. Dissertation/Research Advisor Agreement form and the Ph.D. Dissertation Committee Request form must be completed to form the Committee. These forms may be downloaded from the Graduate College’s website.

Committee Changes

Any changes to the Dissertation Committee must be submitted using the Ph.D. Dissertation Advisor/Committee Member Change Request form for approval to the Dissertation Committee Chair, the Doctoral Program Director, and the Dean of the Graduate College. Changes must be submitted no later than 60 days before the dissertation defense.

The student is responsible for obtaining committee members’ signatures on the “Dissertation Advisor Assignment Form” and the “Dissertation Committee Request Form,” which can be downloaded from the Graduate College website or obtained from the Doctoral Coordinator.

Dissertation Defense

The Dissertation Defense will not be scheduled until all other academic and program requirements have been fulfilled. A complete draft of the dissertation will be given to the members of
the Dissertation Committee at least 65 days before the date of commencement during the term in which the student intends to graduate. After committee members have reviewed the draft with the student and provided comments, the student, in consultation with the Ph.D. Research Advisor, will incorporate the recommended changes into a new draft of the dissertation. When each committee member is satisfied that the draft dissertation is defendable, the Dissertation Defense may be scheduled.

The Dissertation Defense will consist of two parts. The first part is a public presentation of the dissertation research. Notice of the defense presentation will be posted at least two weeks in advance. The second part of the defense will immediately follow the public presentation but will be restricted to the student’s Dissertation Committee and entail an oral examination over the dissertation research. Approval of the dissertation requires positive votes from the student’s Ph.D. Research Advisor and a majority of the remaining members of the Dissertation Committee. The results of the Dissertation Defense Report must be filed in the Graduate College before the Dean of the Graduate College gives final approval to the dissertation. This form may be downloaded from the Graduate College’s website.

The student is expected to orally defend the dissertation in an announced public presentation within two years of the official date of being advanced to candidacy.

Approval and Submission of the Dissertation

Following approval and signing of the dissertation by the members of the Dissertation Committee, the student must submit one copy of the dissertation, at least two signature pages, and a copy of the dissertation abstract to the Office of the Graduate College for final approval. All dissertation abstracts must be published in *Dissertation Abstracts International*. Specific guidelines for approval and submission of the dissertation can be obtained from the Office of the Graduate College.

Fee Reduction

Fee Reduction. A master’s or doctoral degree candidate for graduation may be eligible for a one-time fee reduction under V.T.C.A, Education Code, Section 54.054. Please refer to the section titled Fee Reduction in the Additional Fees and Expenses chapter of this catalog for more information.

Courses Offered

**Materials Science, Engineering and Commercialization (MSEC)**

7100 Doctoral Assistant Development. (1-1) The course is designed to equip the doctoral students with skills and an understanding of proper procedures to be effective teaching assistants. This course does not earn graduate degree credit, and is graded on a credit (CR), progress (PR), or no credit (F) basis.

7101 Commercialization Forum. (1-0) The course is a seminar series exposing students to commercialization issues. The series includes as speakers: successful entrepreneurs, businessmen, research directors, production and process control engineers, intellectual property and licensing experts, management consultants, and technology transfer specialists. Second year students will present business plans that they developed. Repeatable four times for credit.

7102 MSEC Seminar. (1-0) This course is an introduction to current topics through reading of scientific literature with presentations by guest lecturers as the basis for weekly discussions. Students participate by choosing current, high-quality research articles for discussion and will present at least one article during the term. Repeatable for credit.
7103 Research in Materials Science, Engineering, and Commercialization. (1-0) This research course is for students in Materials Science, Engineering, and Commercialization who have not yet passed their candidacy exam, typically under supervision of the PhD Research Advisor. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable (with MSEC 7303 hours) for doctoral credit up to 6 hours.

7201 Principles of Technical Project Management. (2-0) This course includes planning, budgeting, identification of risks and risk mitigation approaches, resource allocation, review of milestones and schedules, and evaluating projects to measure success. Responsibilities of project managers in the areas of problem solving, motivating and managing creative technical staff in project and matrix organizations will be included.

7301 Practical Skills in Commercialization and Entrepreneurship. (3-0) This course is the first of a two course series to impart business and commercialization skills by producing a business plan. Key areas covered include intellectual property law, technology transfer and licensing strategies, business plan development, business finance strategies, management structures, project management methods, statistical quality and process control.

7302 Leadership Skills in Commercialization and Entrepreneurship. (3-0) This course is the second of a two course series to impart business and commercialization skills by producing a business plan. Key areas covered include intellectual property law, technology transfer and licensing strategies, business plan development, business finance strategies, management structures, project management methods, statistical quality and process control. Prerequisite: MSEC 7301.

7303 Research in Materials Science, Engineering, and Commercialization. (3-0) This research course is for students in Materials Science, Engineering, and Commercialization who have not yet passed their candidacy exam, typically under supervision of the PhD Research Advisor. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable (with MSEC 7103 hours) for doctoral credit up to 6 hours.

7304 Collaborative Research/Commercialization Experience. (3-0) This course allows Ph.D. level graduate students to initiate, conduct, and participate in a collaborative research or commercialization experience with graduate faculty in addition to research conducted under MSEC 7103, MSEC 7303, MSEC 7199, and MSEC 7399. This course recognizes the collaborative nature of scientific and commercialization enterprise. Repeatable for doctoral credit up to 6 hours.

7310 Nanoscale Systems and Devices. (3-0) This course is an in-depth treatment of physical phenomena in nanoscale structures, and consequences for electronic, photonic, mechanical and other types of devices. The course provides a strong background in devices with applications in nanoelectronics, biomedical systems, micro- and nanoscale manipulation, adaptive optics, and microfluidics.

7311 Materials Characterization. (3-0) This course covers skills and knowledge required for microscopy methods including transmission electron microscopy, scanning electron microscopy, scanning tunneling electron microscopy, atomic force microscopy, and confocal microscopy. It covers x-ray and neutron diffraction techniques including structure analysis, powder and glancing angle diffraction, pole figure, texture analysis, and small angle scattering.

7312 Thermodynamics and Kinetics for Material Scientists. (3-0) This course provides a solid understanding of thermodynamics and kinetics of materials, how the rules of thermodynamics and kinetics relate to real-world phenomena, such as phase transformations, phase diagrams, microstructural evolution, and how to use processing to produce a desired microstructure.

7315 Quantum Mechanics for Materials Scientists. (3-0) This course includes quantum-mechanical foundation for study of nanometer-scale materials, principles of quantum physics, stationary-states for one-dimensional potentials, symmetry considerations, interaction with the electromagnetic radiation, scattering, reaction rate theory, spectroscopy, chemical bonding and molecular orbital theory, solids, perturbation theory, and nuclear magnetic resonance.
7320 Nanocomposites. (3-0) Characteristics of nanoparticles utilized in nanocomposites, techniques for surface modification, methods for nanoparticle dispersion forming nanocomposites, types of nanocomposites, characteristics of nanocomposites, analytical methods for characterization of composites, and common applications will be discussed. Particular attention will be given to the science and theories explaining the unique behavior of nanocomposites.

7330 Computational Materials Science. (3-0) Application of computational techniques to molecular and atomic modeling of materials is discussed along with quantum mechanical modeling, density functional theory approaches, force field based molecular modeling, mesoscale modeling, energy minimization, molecular dynamics, vibrational spectra, crystal structures, phase equilibria, physical property prediction, and electronic structure related to magnetic and electrical properties. Prerequisite: CHEM 3340 or equivalent.

7340 Biomaterials and Biosensors. (3-0) The course covers the growing field of biomaterials science including materials for prosthetics and implants, mimetic materials, biosensors, diagnostic devices, and drug delivery systems. Particular attention will be given to nanomaterials for diagnosis and treatment of diseases including targeted cancer treatments, drug delivery systems, and advanced imaging methods.

7350 Frontiers of Nanoelectronics. (3-0) This course provides an introduction to the operating principles of nanoscale electronic and optical devices. The emphasis is on how leading edge nano-fabrication technology takes advantage of quantum mechanics of reduced sizes and dimensions. Specific examples of devices based on quantum wells, wires, dots and molecular electronics are given.

7360 Nanomaterials Processing. (3-0) The course will cover various aspects of processing of nanomaterials from synthesis through incorporation into consumer goods. Specific topics to be covered in the synthesis of nanomaterials will include CVD, MBE, precipitation, spray drying, hydrothermal, electrochemical, mechanical grinding, phase separation, and shock wave.

7370 Advanced Polymer Science. (3-0) Advanced topics in polymer science are discussed with a focus on high performance polymers such as high impact, conducting, shape memory, high temperature and the underlying phenomena that provide these unusual properties, and advanced polymer topic areas such as flame retardancy, barrier properties, dielectric properties, rheology, and fiber reinforced composites. Prerequisites: CHEM5353 or equivalent.

7401 Fundamental Materials Science and Engineering. (4-0) Fundamentals of chemical kinetics, physical properties, and continuum mechanics will be discussed. Topics include electronic and atomic structure of solids, structure of crystalline materials, structural imperfections, fundamental thermodynamic and kinetic principles and equations for closed and open systems, statistical models, phase diagrams, diffusion, phase transformations, conservation laws, and continuum kinematics. Prerequisite: Three-week Business Boot Camp or equivalent and Corequisite: MSEC 7312 or equivalent.

7402 Advanced Materials Science and Engineering Concepts. (4-0) Fundamentals of quantum mechanics, physics of solid state, and physical electronics and photonics for advanced materials will be discussed. Topics will include quantum basis for properties of solids, lattice vibration, free electron model for magnetism, semiconductors, nanostructures and mesoscopic phenomena, superconductivity, and recent advances in new types of materials. Corequisite: MSEC 7315 or equivalent.

Dissertation

7199 Dissertation in Materials Science, Engineering, and Commercialization. (1-0) Original research and writing in Materials Science, Engineering, and Commercialization, is to be accomplished under direct supervision of the PhD Research Advisor. While conducting dissertation research and writing, students must be continuously enrolled each long term. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable for credit. Prerequisite: Acceptance into candidacy.
7299 Dissertation in Materials Science, Engineering, and Commercialization. (2-0)
Original research and writing in Materials Science, Engineering, and Commercialization, is to be accomplished under direct supervision of the PhD Research Advisor. While conducting dissertation research and writing, students must be continuously enrolled each long term. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable for credit. Prerequisite: Acceptance into candidacy.

7399 Dissertation in Materials Science, Engineering, and Commercialization. (3-0)
Original research and writing in Materials Science, Engineering, and Commercialization, is to be accomplished under direct supervision of the PhD Research Advisor/dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long term. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable for credit. Prerequisite: Admission into candidacy.

7599 Dissertation in Materials Science, Engineering, and Commercialization. (5-0)
Original research and writing in Materials Science, Engineering, and Commercialization, is to be accomplished under direct supervision of the PhD Research Advisor. While conducting dissertation research and writing, students must be continuously enrolled each long term. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable for credit. Prerequisite: Acceptance into candidacy.

7699 Dissertation in Materials Science, Engineering, and Commercialization. (6-0)
Original research and writing in Materials Science, Engineering, and Commercialization, is to be accomplished under direct supervision of the PhD Research Advisor/dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long term. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable for credit. Prerequisite: Admission into candidacy.

7999 Dissertation in Materials Science, Engineering, and Commercialization. (9-0)
Original research and writing in Materials Science, Engineering, and Commercialization, is to be accomplished under direct supervision of the PhD Research Advisor. While conducting dissertation research and writing, students must be continuously enrolled each long term. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable for credit. Prerequisite: Acceptance into candidacy.

Graduate Faculty

Beall, Gary W., Professor of Chemistry and Biochemistry and Associate Dean of the College of Science. B.S., Tarleton State; M.S., Ph.D., Baylor University. (Polymer Chemistry: Polymer/Clay Nanocomposites, Computation Chemistry, Colloids, Wastewater Treatment Sorbents)

Booth, Chad J., Associate Professor of Chemistry and Biochemistry. B.S., Southeastern Louisiana University; Ph.D., University of Southern Mississippi. (Polymer Chemistry: Synthesis, Processing & Thermo-Mechanical Characterization of Polymeric Materials)

Droopad, Ravindranath, Professor of Physics. BS. University of Birmingham; Ph.D. University of London.

Garcia, Dana M., Professor of Biology. B.S., Texas A&M University; Ph.D., University of California-Berkeley. (Cell Biology, Physiology).

Geerts, Willem J., Associate Professor of Physics. M.S.E.E., University of Technology, Eindhoven, The Netherlands; Ph.D., University of Twente, Enschede, The Netherlands.
Hill, Robert C., Associate Professor of Management. B.A. Davidson College; M.B.A. Wake Forest University; Ph.D. Texas A&M University.

Hudnall, Todd, Assistant Professor of Chemistry and Biochemistry. B.S., Texas State University; Ph.D., Texas A&M University. (Main Group Organometallic Chemistry; Synthesis of Novel Stable Carbenes; Small Molecule Activation and Renewable Energy).

Irvin, Jennifer A., Associate Professor of Chemistry and Biochemistry. B.S., M.S., Texas State University; Ph.D., University of Florida. (Organic Chemistry: Small Molecule and Polymer Synthesis; Electroactive Polymers; Electrochemistry; Alternative Energy; Electrochromics).

Ji, Chang, Associate Professor of Chemistry and Biochemistry. B.S., St. John’s University; M.S., Indiana State University; Ph.D., Indiana University. (Analytical/Organic Chemistry: Chromatography and Mass Spectrometry, Electrochemical Catalysis and Synthesis, Measurement of Henry’s Law Constants of Toxic Pollutants).

Lee, Byounghak, Assistant Professor of Physics. B.S., Korea University; Ph.D., Indiana University.

Rudzinski, Walter Eugene, Professor of Chemistry and Biochemistry. B.S., University of Detroit-Mercy; Ph.D., University of Arizona. (Analytical Chemistry: Chromatography, Electrochemistry, Measurement of Thermodynamic Parameters of Ion Pairs and Metal Chelates).

Stephan, Karl David, Professor of Engineering. B.S., California Institute of Technology; M.Engr., Cornell University; Ph.D., The University of Texas at Austin.

Sun, Luyi, Assistant Professor of Chemistry and Biochemistry. B.S., South China Institute of Technology; M.S., Ph.D., University of Alabama. (Materials chemistry; inorganic chemistry; green chemistry; polymeric materials; nano-structured materials; materials for energy related applications).

Tate, Jitendra, Associate Professor of Engineering B.S., M.S., University of Pune, India; Ph.D., North Carolina A&T State University.

Temponi, Cecilia, Professor of Management. B.S., University of Zulia; M.S., Louisiana State University; M.B.A., St. Mary’s University; Ph.D., University of Texas at Arlington.

Theodoropoulou, Nikoleta, Associate Professor of Physics. B.S., University of Athens, Greece, PhD, University of Florida.
Ph.D. in Mathematics Education

Doctoral Major and Degree Offered:
Mathematics Education, Ph.D.

Ph.D. Programs

Offered through the Department of Mathematics at Texas State, this program has a particular strength in the number of courses required in mathematics to complement courses in the teaching and learning of mathematics: Doctoral graduates will have completed a substantial mathematics core in addition to the mathematics education core, thus opening a wide variety of employment opportunities.

This program is designed for people whose career goals will take them into professional leadership roles involving mathematics education within the United States or internationally. Graduates of the program will be prepared for positions as mathematicians or mathematics-education faculty in colleges and universities; as decision makers in state or local education agencies; as researchers in think tanks, corporations, or not-for-profit organizations; as high-ranking staff in foundations or international organizations; or decision-makers within a national ministry of education.

Students beginning the program are expected to have an undergraduate degree in Mathematics, Mathematics Education, or a related field. Students, especially those with a degree in a related field other than Mathematics or Mathematics Education, may need to take background leveling courses. This would be decided on a case by case basis by the appropriate Advisor and would be articulated at the time of admission.

Educational Goal

The educational objectives of the program in Mathematics Education are:

- To develop a well-balanced foundation in mathematics content including in-depth understanding of basic principles.
- To understand the mathematics needed for our rapidly changing technological society.
- To link mathematics content to pedagogy for effective teaching that addresses educational needs through the entire P-20 continuum.
- To understand how to design best and most effective curriculum and ways to deliver this curriculum.
- To contribute to the knowledge in mathematics education by original research.
- To produce Ph.D. graduates who can become the leaders in the state and the nation's educational community concerning the teaching of mathematics appropriate for the demands of the 21st century.
- To produce high-quality teachers of mathematics at all levels.

Teaching Experience

Each student in the Mathematics Education program is expected to have two years teaching experience. A student who has taught for two or more years at full-time status in the public school system will be considered to have met this requirement. A student who has not met this requirement upon admission will be required to gain practical teaching experience before graduation. If a student receives a Teaching Assistantship while in the program, each long term during which the student has a two-course assignment will count as one half of a year of experience. A student who teaches two
summer sessions will be given credit for one long semester. In the event that a student has other forms of practical teaching experience, the Mathematics Education Advisor will determine the amount of credit received on an individual basis.

Admission Policy

For information regarding admission application requirements and deadlines, please visit our website at www.gradcollege.txstate.edu/mathed.html.

Financial Assistance

Almost all doctoral students are expected to receive full financial assistance from the department working as Instructional Assistants or Research Assistants. You must be accepted as a Ph.D. student in order to apply. In addition, you must submit to the department:

- a completed employment application form which can be downloaded from the departmental web site;
- at least one letter of recommendation on your ability to teach, which could be one of the three letters you sent for your admission;
- a current vita.

Please visit the departmental website for more detailed information. The financial aid application deadline is the same as that for graduate admission. Note that only a very limited number of positions are available for spring semesters. Stipends for Research Assistantships depend on the types of research grants. Additional summer support is available as Instructional Assistants or Research Assistants. Contact the department for more information.

In addition to the financial aid from the Mathematics Department, the Graduate College offers a wide variety of graduate assistantships and scholarships, including Texas State Celebrity Classic Scholarships, Texas State Graduate Scholars Program, and College Graduate Scholarships. For more details and how to apply, visit the Mathematics Department website http://www.math.txstate.edu/ or the Graduate College website http://www.gradcollege.txstate.edu/. Please note that the deadlines for these and other scholarships may be different from those for Instructional Assistants of Mathematics.

Course Work

Semester Hour Requirements

The student must complete 60 semester hours of graduate work to meet the minimum requirements for advancement to candidacy and then a minimum of 18 hours of dissertation courses to complete the degree for a minimum of 78 hours. In some cases, a student may need to complete additional hours before being allowed to advance to candidacy. The student must have satisfied the residency requirement of 18 graduate credit hours.

Degree Audit

Each Ph.D. student is issued a preliminary degree audit by the Office of the Graduate College which should be used to plan the student's course of study. In the first term of enrollment, students should review the degree audit in consultation with their supervising professor and the Program.
Director. Doctoral Degree Audits are tailored with the individual student in mind. It is therefore possible for the individual Degree Audit to exceed the number of degree hours identified in the catalog.

**Course Work Requirements**

Each student is required to pass 36 hours of core courses, a minimum of 24 hours of elective courses, and a minimum of 18 hours of dissertation, yielding a minimum of 78 hours in course work. No grade earned below a “B” on any graduate course may apply toward a Ph.D. at Texas State. However, a student’s doctoral program requirements may be modified as a result of a change to their research goals or performance in the qualifying exams.

A. Core Courses ......................................................................................................................... 36 hours

Core courses are divided into two groups. The first group consists of the following ten courses (30 hours). All students are required to pass all of the courses in this group.

- MATH 7302  History of Mathematics/Mathematics Education
- MATH 7303  Analysis I
- MATH 7306  Current Research in Mathematics Education
- MATH 7307  Algebra I
- MATH 7309  Topology I
- MATH 7324  Curriculum Design and Analysis
- MATH 7325  Statistics I
- MATH 7328  Instructional Techniques and Assessments
- MATH 7346  Quantitative Research
- ED 7352   Beginning Qualitative Design and Analysis

The second group of core courses consists of the following four courses. Each student must choose two courses (6 hours) from this group of core courses with approval of the graduate advisor.

- MATH 7321  Graph Theory
- MATH 7331  Combinatorics
- MATH 7356A  Advanced Quantitative Research
- MATH 7356B  Advanced Qualitative Research

B. Elective Courses..................................................................................................................... 24 hours

Each student must choose at least eight courses (24 hours) from the following elective courses. A student may elect, with approval of the student’s dissertation advisor, three hours from other departments in addition to the courses listed here. Note that topics-courses may be repeated provided the topics differ. Students’ choice of courses must be approved by the graduate advisor.

- MATH 7188  Seminar in Mathematics Education
- MATH 7313  Analysis II
- MATH 7317  Algebra II
- MATH 7319  Topology II: Algebraic Topology
- MATH 7321  Graph Theory
- MATH 7331  Combinatorics
- MATH 7335  Statistics II: Linear Modeling
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MATH 7366A  Teaching Post-Secondary Students
MATH 7366B  Teaching K-12 Students
MATH 7366C  Teaching Teachers
MATH 7366D  Teaching Specialized Content
MATH 7371A  Advanced Graph Theory
MATH 7371B  Advanced Combinatorics
MATH 7371C  Combinatorial Number Theory
MATH 7371D  Discrete Optimization
MATH 7371E  Algorithms and Complexity
MATH 7371F  Probabilistic Methods in Discrete Mathematics
MATH 7371G  Combinatorial Networks
MATH 7378A  Problem Solving, Reasoning, and Proof
MATH 7378B  Connecting and Communicating Math
MATH 7378C  Representing Fundamental Math Ideas (Function, Data Analysis, and Enumeration)
MATH 7378D  Math Technologies
MATH 7386  Independent Study in Mathematics Education
MATH 7389  Internship

C. Dissertation ............................................................................................................................ 18 hours

Each student must register for a minimum of 18 hours of dissertation course work.

MATH 7199  Dissertation in Mathematics Education
MATH 7299  Dissertation in Mathematics Education
MATH 7399  Dissertation in Mathematics Education
MATH 7599  Dissertation in Mathematics Education
MATH 7699  Dissertation in Mathematics Education
MATH 7999  Dissertation in Mathematics Education

Qualifying Examination

Typically, after completion of the core courses or by the end of the second year in residence, each student will be required to take written qualifying examinations. To be eligible to take the qualifying examinations, the student normally will have a minimum grade point average of 3.5 on all the core courses including the transferred equivalent courses that the student has completed. A student will choose two of the following topics to be on his or her qualifying examinations: Algebra, Analysis, Topology, Statistics, and Discrete Mathematics. Mathematics Education will be the third topic.

Comprehensive Examination

Students will have an additional written comprehensive examination and an oral examination in Mathematics Education. These examinations will occur within two weeks of each other with the oral examination following the written examination. A student is expected to take these examinations after all other criteria for advancement to candidacy have been met.
Advancement to Candidacy

Application for Advancement to Candidacy

The Dean of the Graduate College approves advancement to candidacy once all requirements are met. Doctoral students must be advanced to candidacy within five years of initiating Ph.D. course work applied toward the degree. Students need to indicate their intent to advance to candidacy during the term they complete the 60 hours of required course work and other departmental requirements. The student will need to pick up the Advancement to Candidacy Form from the department. The student will need to complete the form and return it to the Doctoral Program Director. The Doctoral Program Director will then submit the completed form to the Dean of the Graduate College for review.

The doctoral candidacy requirements include:

1. Completion of all required coursework with the exception of dissertation credit hours.
2. Successful passage of all three qualifying exams.
3. Successful passage of the comprehensive exam.
4. Approval of the dissertation proposal.
5. At least a 3.5 GPA on all doctoral required courses.

Advancement to Candidacy Time Limit

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

Requests for a time extension must be submitted to the Doctoral Program Director, who in turn, submits a recommendation to the Dean of the Graduate College.

Grade-Point Requirements for Advancement to Candidacy

To be eligible for advancement to candidacy, the student must have a minimum GPA of 3.5. No grade earned below a "B" on any graduate course may apply toward a Ph.D. at Texas State. Incomplete grades must be cleared through the Office of the Graduate College before a student can be approved for advancement to candidacy.

Dissertation Proposal

In order to be advanced to candidacy, a student must select a doctoral dissertation advisor and committee, submit a dissertation proposal, and successfully defend the proposal in an oral examination with the dissertation committee. The examination will address the problem definition and scope, the relevant literature, and the research method of the proposed dissertation topic. Information about the formation of the dissertation committee can be found in the "Dissertation Research and Writing" section of this catalog.

Recommendation for Advancement to Candidacy

The Doctoral Program Committee recommends the applicant for advancement to candidacy to the Doctoral Program Director, the Department Chair, and the Dean of the Graduate College. The Dean
of the Graduate College certifies the applicant for advancement to candidacy once all requirements have been met. To be eligible for admission to candidacy, the student must have successfully completed the qualifying and/or comprehensive exam(s), completed all coursework, and successfully defended the dissertation proposal.

Dissertation Research and Writing

All doctoral students are required to complete a dissertation. The dissertation must be an original contribution to scholarship and the result of independent investigation in a significant area. Preparation of the dissertation must follow the latest edition of Kate L. Turabian's *A Manual for Writers*.

Dissertation Enrollment Requirements

**Enrollment.** After being admitted to candidacy, students must be continuously enrolled each term for at least three dissertation hours. 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.

**Hours.** Students must complete a minimum of 18 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. The Mathematics Education Program Director will review the students' annual progress to ascertain his or her progress in pursuing the degree. The Program Director will consult with the student's Ph.D. advisor and Dissertation Committee on this matter as appropriate.

Dissertation Committee

A Dissertation Committee must be formed to oversee the research and writing of the dissertation. The Dissertation Committee will include a dissertation advisor and a minimum of three additional members (one of whom must be an external member).

The members must be chosen from qualified Ph.D. faculty. The dissertation advisor and the committee members must be selected in consultation with the student. The dissertation advisor will chair the Dissertation Committee and must be from the major department. The dissertation advisor and committee members must be approved by the Doctoral Program Director, the department chair, and the Dean of the Graduate College.

The student is responsible for obtaining committee members' signatures on the proper forms and submitting the forms to the department for further routing approval. The forms may be downloaded from the department's website or obtained from the Program Director.

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 "Ph.D. Research Advisor/Committee Member Change Request Form" may be downloaded from the department's website or obtained from the Program Director.
Dissertation Defense

The Dissertation Defense 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 65 days before the date of commencement during the term in which the student intends to graduate. After committee members have reviewed the draft with the student and provided comments, the student, in consultation with the Research 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, Dissertation Defense will be scheduled.

The Dissertation Defense will consist of two parts. The first part is an oral presentation of the dissertation research given as a public seminar. The second part of the defense will immediately follow the public presentation, but is restricted to the student's Dissertation Committee, and will entail an oral examination over the dissertation research. The full committee, including all external members, must be present. Approval of the dissertation requires positive votes from the student's Ph.D. advisor and a majority of the remaining members of the Dissertation Committee. Specific information on the examination and defense procedure can be obtained from the Doctoral Program Director.

Approval and Submission of the Dissertation

Following approval and signing of the dissertation by the members of the Dissertation Committee, the student must submit one copy of the dissertation, at least two additional signature pages, and a copy of the dissertation abstract to the Office of the Graduate College for final approval. All dissertation abstracts must be published in Dissertation Abstracts International. Specific guidelines for approval and submission of the dissertation can be obtained from the Office of the Graduate College.

Fee Reduction

A master's or doctoral degree candidate for graduation may be eligible for a one-time fee reduction under V.T.C.A., Education Code, Section 54.054. Please refer to the section titled Fee Reduction in the Additional Fees and Expenses chapter of this catalog for more information.

Courses Offered

Education (ED)

ED 7352 Beginning Qualitative Design and Analysis. (3-0) Introduces the qualitative paradigm. Includes distinctive features, alternative qualitative traditions, purposeful sampling, common data collection methods, inductive analysis, the role of the researcher, and evaluating qualitative research.

Mathematics (MATH)

MATH 7111 Seminar in Teaching. (1-0) Seminar on individual study projects concerned with selected problems in the teaching of mathematics. This course does not earn graduate degree credit. Graded on a credit (CR), no-credit (F) basis.

MATH 7187 Seminar in Mathematics. (1-0) Students are required to attend weekly research seminars in mathematics and to give at least one research presentation in the seminar during the term. This course is repeatable for credit.
MATH 7188 Seminar in Mathematics Education. (1-0) Students are required to attend weekly research seminars in Mathematics Education and to give at least one research presentation in the seminar during the term. This course is repeatable for credit.

MATH 7301 Studies in Mathematics. (3-0) This course provides basic foundations in Mathematics for students entering the doctoral program in Mathematics Education. This course may be repeated, but does not earn graduate degree credit.

MATH 7302 History of Mathematics. (3-0) A study of the development of mathematics and of the accomplishments of men and women who contributed to its progress.

MATH 7303 Analysis I. (3-0) This course covers foundations of modern analysis. Topics include: sequences, LimSup, LimInf, Sigma Algebras of sets that include open and closed sets, sequences of functions, pointwise and uniform convergence, lower and upper semi-continuity, Borel sets, outer measure, and Lebesgue measure. Prerequisite: MATH 4315.

MATH 7306 Current Research in Math Education. (3-0) This course surveys the various current social, political, and economic trends in local, state, national, and international settings that are related to research in Mathematics Education.

MATH 7307 Algebra I. (3-0) Applications of Algebra and topics in modern algebra, including permutation groups, symmetry groups, Sylow theorems, and select topics from Ring Theory. Prerequisite: MATH 4307.

MATH 7309 Topology I. (3-0) A course in point-set topology emphasizing topological spaces, continuous functions, connectedness, compactness, countability, separability, metrizability, CW-complexes, simplicial complexes, nerves, and dimension theory. Prerequisite: MATH 4330.

MATH 7313 Analysis II. (3-0) This course covers the theory of integration with special emphasis on Lebesgue integrals. Topics include: Lebesgue integral, Bounded Convergence theorem, differentiation and integration, absolute continuity, and Lp spaces. Prerequisite: Math 7303.

MATH 7317 Algebra II. (3-0) A study of the important algebraic structures of rings and fields. Topics covered include rings, ideals, modules, polynomial rings, Euclidean algorithm, finite fields, and field extensions. Topics also include an introduction to Galois Theory with an emphasis on the geometric applications. Prerequisite: MATH 7307.

MATH 7319 Topology II: Algebraic Topology. (3-0) This course covers the fundamental concepts and tools of algebraic topology. Topics include the fundamental group, covering spaces, homotopy type, the higher homotopy groups, singular homology theory, and the computation of homology groups via exact sequences and applications. Prerequisite: MATH 7307 and MATH 7309.

MATH 7321 Graph Theory. (3-0) Topics in this course include trees, connectivity of graphs, Eulerian graphs, Hamiltonian graphs, planar graphs, graph coloring, matchings, factorizations, digraphs, networks, and network flow problems. Prerequisite: MATH 3398.

MATH 7324 Curriculum Design & Analysis. (3-0) This course examines, analyzes, and evaluates the various concepts, topics, methods, and techniques that are related to curriculum design in Mathematics Education for grade levels P-16.

MATH 7325 Statistics I. (3-0) A study of the mathematical and probabilistic underpinnings of the techniques used in statistical inference. Topics covered include sampling, sampling distributions, confidence intervals, and hypothesis testing with an emphasis on both simulations and derivations. Prerequisite: Math 2321, Math 3305.

MATH 7328 Instructional Techniques & Assessments. (3-0) This course examines, analyzes, and evaluates the various concepts, topics, methods, and techniques of instruction in Mathematics Education and the related assessment procedures for each for grade levels P-20.

MATH 7331 Combinatorics. (3-0) This course is a study of fundamental principles of combinatorics. Topics include: permutations and combinations, the Pigeonhole principle, the principle of inclusion-exclusion, binomial and multinomial theorems, special counting sequences, partitions, posets, extremal set theory, generating functions, recurrence relations, and the Polya theory of counting. Prerequisite: MATH 3398.
MATH 7335 Statistics II: Linear Modeling. (3-0) A study of the formulation and statistical methodologies for fitting linear models. Topics include the general linear hypothesis, least-squares estimation, Gauss-Markov theorem, assessment of model fit, effects of departures from assumptions, model design, and criteria for selection of optimal regression models. Prerequisite: MATH 3377 and MATH 7325.

MATH 7346 Quantitative Research Analysis in Mathematics Education. (3-0) This course surveys the various research techniques used in quantitative analysis for mathematics education and covers topics such as experimental design, statistical analysis, and use of appropriate design methodologies to achieve the strongest possible evidence to support or refute a knowledge claim. Prerequisite: MATH 7306 and MATH 7325.

MATH 7356 Advanced Topics in Research. (3-0) This course encompasses investigation, development, and demonstration of competence, design, and execution for Mathematics Education problems. Repeatable with different emphasis.

MATH 7356A Advanced Quantitative Research. (3-0) This course encompasses investigation, development, and demonstration of competence, design, and execution for mathematics education problems in quantitative research. Prerequisite: MATH 7346.

MATH 7356B Advanced Qualitative Research. (3-0) This course encompasses investigation, development, and demonstration of competence, design, and execution for mathematics education problems in qualitative research. Prerequisite: ED 7352.

MATH 7356C Action Research in Mathematics Education. (3-0) This course examines underlying theory and issues in action research model and the development of action research projects. Prerequisites: MATH 7346 or ED 7352.

MATH 7361 Seminar in Advanced Mathematics. (3-0) Material in course will vary with the interest of students and faculty. A detailed study of subject matter may be chosen from advanced areas of analysis; algebra; topology and geometry; applied mathematics; and probability and statistics. This course is repeatable for credit when subject matter varies.

MATH 7366 Topics in Teaching. (3-0) This course examines how to develop and teach specialized student-groups. Repeatable with different emphasis.

MATH 7366A Teaching Post-Secondary Students (Developmental Math, Service Courses, and Majors). (3-0) This course examines how to develop and teach post-secondary students. The course references the recommendations of government agencies and professional organizations and allows for the investigation of research-based models. Prerequisites: MATH 7306.

MATH 7366B Teaching K-12 Students (Elementary, Middle School, and High School). (3-0) This course examines how to develop and teach K-12 students. The course references the recommendations of government agencies and professional organizations and allows for the investigation of research-based models. Prerequisite: MATH 7306.

MATH 7366C Teaching Teachers (In-Service; Pre-Service). (3-0) This course examines how to prepare teachers of mathematics. The course references the recommendations of government agencies and professional organizations and allows for the investigation of research-based models. Prerequisite: MATH 7306.

MATH 7366D Teaching Specialized Content. (3-0) This course will be an in-depth study of a specialized content area in mathematics with an emphasis on teaching. The specific content area will vary by instructor. Examples include Euclidean Simplex Geometry and Discrete Probability Spaces with Implications for Public School Curriculum.

MATH 7366E Developmental Mathematics Curriculum. (3-0) This course surveys the research, development, and evaluation of the scope and sequence of developmental mathematics curriculum. The course references the recommendations of government agencies and professional organizations and allows for the investigation of research-based models. Prerequisite: MATH 7306.
MATH 7371 Topics in Discrete Mathematics. (3-0) In depth study of advanced topics in discrete mathematics, including advanced graph theory, advanced combinatorics, combinatorial number theory, discrete optimization, algorithms and complexity, and probabilistic methods. Repeatable with different emphasis.

MATH 7371A Advanced Graph Theory. (3-0) Topics in this course include Turan's problems, Ramsey theory, random graph theory, extremal graph theory, algebraic graph theory, domination of graphs, distance problems, and applications. Prerequisite: MATH 7321.

MATH 7371B Advanced Combinatorics. (3-0) Topics in this course include Block designs, Latin squares, combinatorial optimization problems, coding theory, matroids, difference sets, and finite geometry. Prerequisite: MATH 7331.

MATH 7371C Combinatorial Number Theory. (3-0) A study of fundamental techniques in combinatorial number theory. Topics will include Waring's problem, additive number theory, and probabilistic methods in number theory. Prerequisite: MATH 7331.

MATH 7371D Discrete Optimization. (3-0) A study of some fundamental techniques in discrete optimization. Topics include discrete optimization, linear programming, integer programming, integer nonlinear programming, dynamic programming, location problem, scheduling problem, transportation problem, postman problem, traveling salesman problem, matroids, and NP-completeness. Prerequisites: MATH 7321 and 7331.

MATH 7371E Algorithms and Complexity. (3-0) A study of some fundamental concepts of computability and complexity. Topics include polynomially bounded problems, NP-complete problems, exponentially hard problems, undecidable problems, and reducibility. Prerequisite: MATH 7331.

MATH 7371F Probabilistic Methods in Discrete Mathematics. (3-0) A study of some fundamental probabilistic techniques used to solve problems in graph theory, combinatorics, combinatorial number theory, combinatorial geometry, and algorithm. Topics include linearity of expectation, alterations, second moment, local lemma, correlation inequalities, martingales, Poisson paradigm, and pseudo-randomness. Prerequisites: MATH 7321 and 7331.

MATH 7371G Applied Discrete Mathematics. (3-0) This course introduces fundamental concepts in logic, Boolean algebra, and binomial coefficients; and applications in different fields such as complexity of algorithms and network theory. Prerequisites: MATH 2472 and MATH 4307 with a grade of “C” or higher, or with departmental approval.

MATH 7371H Combinatorial Networks. (3-0) Combinatorial Networks is an area of study of certain types of networks using combinatorial methods extensively. This course introduces fundamental basics as well as the latest development in this area of research. Prerequisite: MATH 5307/7307 with a grade of “C” or higher.

MATH 7378 Topics in Standards. (3-0) This course examines the basic principles involved in Mathematics Education. Fundamental themes will be reviewed, researched, and discussed. Repeatable with different emphasis.

MATH 7378A Problem Solving, Reasoning, and Proof. (3-0) A study of the fundamental concepts of problem solving, logic, set theory, and mathematical proof and applications of these concepts in mathematics curriculum for grades P-20. Prerequisite: MATH 7306.

MATH 7378B Connecting and Communicating Math. (3-0) This course examines one of the basic principles involved in mathematics education: Connecting and Communicating Mathematics. This fundamental theme will be reviewed, researched, and discussed. Prerequisite: MATH 7306.

MATH 7378C Representing Fundamental Math Ideas (Function, Data Analysis, and Enumeration). (3-0) This course examines the basic principles involved in mathematics education. The process of representing fundamental mathematical ideas will be reviewed, researched, and discussed. Prerequisite: MATH 7306.

MATH 7378D Math Technologies. (3-0) This course examines the basic principles involved in mathematics education: Technology. This fundamental theme will be reviewed, researched, and discussed. Prerequisite: MATH 7306.
MATH 7378E Developmental Mathematics Perspectives. (3-0) This course examines developmental mathematics-specific strands including technological course support and placement tools/decisions. Issues related to the first mathematics core course required of undergraduates will also be addressed. Prerequisite: MATH 7306

MATH 7385 Independent Study in Mathematics. (3-0) Student will work directly with a faculty member and develop in-depth knowledge in a specific topic area of mathematics. Topics vary according to student's needs and demands. Repeatable with different emphasis.

MATH 7386 Independent Study in Mathematics Education. (3-0) Student will work directly with a faculty member and develop in-depth knowledge in a specific topic area of Mathematics Education. Topics vary according to student's needs and demands. Repeatable with different emphasis.

MATH 7389 Internship. (3-0) Students will work under the supervision of a faculty member to gain practical knowledge in Mathematics Education. Student experience can come from industry, government agencies, or other sources but must directly apply to furthering knowledge of mathematics education or its application.

MATH 7396 Mathematics Education Research Seminar. (3-0) Collaborative research projects with faculty through identifying an educational issue, reviewing literature, creating a research question, designing a methodology, analyzing data, drawing conclusions, implications, and creating a draft of a publishable papers. Prerequisite: MATH 7346 OR ED 7352, AND MATH 7356h.

Dissertation

MATH 7199A Dissertation in Mathematics Education. (1-0) Original research and writing in Mathematics Education to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long term. Graded on a credit (CR), no-credit (F) basis.

MATH 7299A Dissertation in Mathematics Education. (2-0) Original research and writing in Mathematics Education to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long term. Graded on a credit (CR), no-credit (F) basis.

MATH 7399A Dissertation in Mathematics Education. (3-0) This course represents a Mathematics Education student's dissertation enrollments. The course can be repeated as necessary. The dissertation credit (18 hours) will not be awarded until the dissertation is submitted for binding. Prerequisite: completion of the core and required concentration courses, or approval of student's dissertation advisor.

MATH 7599A Dissertation in Mathematics Education. (5-0) Original research and writing in Mathematics Education to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long term. Graded on a credit (CR), no-credit (F) basis.

MATH 7699A Dissertation in Mathematics Education. (6-0) Original research and writing in Mathematics Education to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long term. Graded on a credit (CR), no-credit (F) basis.

MATH 7999A Dissertation in Mathematics Education. (9-0) Original research and writing in Mathematics Education to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long term. Graded on a credit (CR), no-credit (F) basis.
Graduate Faculty

**Doctoral Faculty**

*Eligible to chair Dissertation Committees and teach doctoral courses*

Cuevas, Gilbert J., Professor of Mathematics. B.A., M.Ed., University of Miami; M.A.T., Tulane University; Ph.D., University of Miami. (Mathematics Education)

Dean, Nathaniel, Professor and Chair of the Department of Mathematics. B.S., Mississippi State University; M.S., Northeastern University; Ph.D., Vanderbilt University. (Discrete Mathematics, Operations Research)

Jia, Xingde, Professor of Mathematics. B.S., Qufu Normal University; Ph.D., City University of New York. (Combinatorics, Number Theory)

Jiang, Zhonghong, Professor of Mathematics. B.S., M.S., Beijing Normal University; M.S., Ph.D., University of Georgia. (Mathematics Education)

Keller, Thomas Michael, Professor of Mathematics. B.A., M.A., Ph.D., Johannes Gutenberg University of Mainz, Germany. (Group Theory)

Mireles, Selina Vasquez, Professor of Mathematics. B.A., The University of Texas at Austin; M.Ed., Texas State University; Ph.D., The University of Texas at Austin. (Mathematics Education)

Morey, Susan Elaine, Professor of Mathematics. B.S., University of Missouri-Columbia; Ph.D., Rutgers State University. (Commutative Algebra)

Obara, Samuel, Associate Professor of Mathematics. B.Sc., University of Eastern Africa, Baraton; M.Ed., M.A., Ph.D., University of Georgia. (Mathematics Education)

Shen, Jian, Professor of Mathematics. B.S., M.S., University of Science and Technology of China; Ph.D., Queens University. (Combinatorics, Combinatorial Matrix Theory, Probabilistic Methods in Discrete Mathematics)

Sorto, M. Alejandra, Associate Professor of Mathematics. B.S., M.S., The University of Texas at El Paso; M.S., Ph.D., Michigan State University. (Mathematics and Statistics Education)

Warshauer, Max Leon, Regents’ Professor of Mathematics. B.A., University of Chicago; Ph.D., Louisiana State University. (Quadratic Forms, Mathematics Education)

White, Alexander, Associate Professor of Mathematics. B.S., M.S., The University of Texas at El Paso; Ph.D., Michigan State University. (Statistics, Mathematics Education)

*Eligible to serve on Dissertation Committee and teach doctoral courses*

Curtin, Eugene, Professor of Mathematics. B.S., M.S., University College, Dublin; Ph.D., Brown University. (Differential Geometry)

Dix, Julio Guacaneme, Professor of Mathematics. B.A., Universidad de Bogota; M.S., Ph.D., University of Cincinnati. (Numerical Analysis)
Ferrero, Maria Daniela, Associate Professor of Mathematics. B.S., Universidad de la Republica del Uruguay; Ph.D., Technical University of Cataluna. (Graph Theory)

Fischer, Joyce F., Associate Professor of Mathematics. B.A., M.A., Texas State University; Ph.D., The University of Texas at Austin. (Mathematics Education)

Gu, Weizhen, Professor of Mathematics. B.S., Hangzhou University, China; M.S., Ph.D., Louisiana State University. (Graph Theory, Combinatorics)

McCabe, Terence William, Assistant Professor of Mathematics. B.S., M.A., Texas State University; Ph.D., University of North Texas. (Differential Equations)

Passty, Gregory B., Professor of Mathematics and Assistant Dean of the College of Science and Engineering. B.A., M.A., Ph.D., University of Southern California. (Non-linear Functional Analysis)

Snyder, David Fred, Associate Professor of Mathematics. B.A., Ph.D., University of Tennessee. (Geometric and Algebraic Topology, Mathematical Modeling)

Strickland, Sharon, Assistant Professor of Mathematics. B.A., Agnes Scott College; M.Ed., Texas State University; Ph.D., Michigan State University. (Mathematics Education)

Thickstun, Thomas Lusk, Professor of Mathematics. B.A., Ph.D., University of California-San Diego. (Topology)

Welsh, Stewart Chalmers, Professor of Mathematics. B.S., Ph.D., University of Glasgow, Scotland. (Bifurcation Theory, Differential Equations)

Eligible to teach doctoral courses

Gronberg, Sharon M., Senior Lecturer of Mathematics. B.A., Augsburg College; M.S., Midwestern State University; Ph.D., The University of Texas at Austin. (Mathematics Education)

Treinen, Ray, Assistant Professor of Mathematics. Ph.D., Wichita State University. (Applied Mathematics)
Department of Mathematics

Major and Degree Offered:
Applied Mathematics, M.S.
Mathematics, M.Ed., M.S.
Middle School Mathematics Teaching, M.Ed.

Major Programs

The Department of Mathematics offers the Master of Science degree with a major in Mathematics or with a major in Applied Mathematics and the Master of Education degree with a major in Mathematics or with a major in Middle School Mathematics Teaching. Students are advised to contact the mathematics graduate advisor for full program details.

Master of Science. The Master of Science degree with a major in Mathematics consists of 24 hours plus a thesis (6 hours minimum) or a minimum of 36 hours without a thesis. Non-thesis master of science students who select the degree option which includes a minor will have a minimum of 27 hours in the major and a minimum of nine hours in the minor.

Master of Science students may select a minor or non-minor degree option. Those choosing the non-minor may select, in consultation with the graduate advisor, all their degree courses from the mathematics curriculum. The minor should be selected from the list of approved minors.

The Master of Science degree with a major in Applied Mathematics consists of 24 hours of mathematics plus a thesis.

Master of Education. The Master of Education degree with a major in Mathematics consists of 27 hours of mathematics without a thesis, plus a minimum of nine hours in the minor. The minor should be selected from the list of approved minors.

The Master of Education degree with a major in Middle School Mathematics Teaching consists of 21 hours of mathematics for teacher education (MTE) classes and MATH 5303, plus 12 hours of Curriculum and Instruction classes.

Admission Policy

For information regarding admission and application requirements and deadlines, please visit the Graduate College website using one of the following links:

- Applied Mathematics: www.gradcollege.txstate.edu/apma
- Mathematics: www.gradcollege.txstate.edu/mathed
- Middle School Mathematics Teaching: www.gradcollege.txstate.edu/msmt

Goals

The program courses are designed to develop studies appropriate to preparing students for doctoral research, community college teaching, public school teaching, or careers in applied mathematics.
Faculty

The faculty has specialists in algebra, analysis, applied mathematics, bifurcation theory, differential equations, differential geometry, non-linear functional analysis, number theory, graph theory, combinatorics, mathematics education, quadratic forms and topology. The library collection is extensive in both journals and reference works with current journals available.

Financial Assistance

Mathematics graduate students are encouraged to work as assistant instructors. The stipends for these assistantships are comparable to national norms and generally require teaching two courses per term. Information may be obtained by writing the department chair. The Office of the Graduate College can provide information on the availability of graduate scholarships.

Courses Offered

Mathematics (MATH)

5111 Graduate Assistant Training. (1-0) This course is concerned with techniques used in the teaching of mathematics. This course is required as a condition of employment for graduate teaching and instructional assistants. This course does not earn graduate degree credit. Repeatable with different emphasis. Graded on a credit (CR), no-credit (F) basis.

5301 Partial Differential Equations. (3-0) Theory and application of partial differential equations; derivation of the differential equation; use of vector and Tensor methods; equations of the first order; wave equations; vibrations and normal functions; Fourier series and integral; Cauchy's methods, initial data; methods of Green; potentials; boundary problems; methods of Riemann-Volterra; characteristics. Prerequisites: MATH 3323 and consent of the instructor.

5303 History of Mathematics. (3-0) A study of the development of mathematics and of the accomplishments of men and women who contributed to its progress. Cannot be used on a degree plan for M.S. degree. Prerequisite: A grade of at least C in MATH 2472.

5304 Topics in Mathematics for the Secondary Teacher. (3-0) A study of the current trends and topics found in the secondary school mathematics curriculum with the goal of improving the mathematical background of the secondary teacher. Course content will be flexible and topics will be selected on the basis of student needs and interests. Cannot be used on degree plan for M.S. degree. Prerequisite: A grade of C in Mathematics 2472.

5305 Advanced Course in Probability and Statistics. (3-0) Advanced topics in probability and statistics. May be repeated once with different emphasis for additional credit. Prerequisite: Mathematics 3305.

5306 Ring Theory. (3-0) A course in ring theory. Commutative and non-commutative rings, examples, and applications adapted to the needs of the class. Prerequisite: A grade of at least a C in MATH 4307 or a grade of at least a B in MATH 5384.

5307 Modern Algebra. (3-0) Topics in modern algebra. Material will be adapted to the needs of the class. Prerequisite: A grade of at least a C in MATH 4307 or a grade of at least a B in MATH 5384.

5311 Foundations of Differential Equations. (3-0) A critical study of the foundations of differential equations, operator spaces, and such basic topics. Recent developments in this field will be investigated and independent investigation will be encouraged. Prerequisite: A grade of at least a C in MATH 3373 and either 3380 or 5382.
5312 Functions of a Complex Variable. (3-0) Modern developments in the field of complex variables. Prerequisite: A grade of at least a C in MATH 3373; either 3380 or 5382; and 4315 or departmental approval.

5313 Field Theory. (3-0) Topics in field theory, separable extensions, and Galois Theory. Prerequisite: A grade of at least a C in MATH 4307 or a grade of at least a B in MATH 5384.

5314 Number Theory. (3-0) Topics in algebra selected from quadratic forms, elementary number theory, algebraic or analytic number theory, with material adapted to the needs of the class. Prerequisite: A grade of at least a C in MATH 4307 or a grade of at least a B in MATH 5384.

5317 Problems in Advanced Mathematics. (3-0) Open to graduate students on an individual basis by arrangement with the mathematics department. A considerable degree of mathematical maturity is required. May be repeated with different emphasis. This course does not count toward any degree in the Department of Mathematics.

5319 The Theory of Integration. (3-0) A course in the theory of integration with special emphasis on the Lebesgue integrals. A course in the theory of real variables, with a knowledge of point set theory, is desirable as a background for this course. A considerable amount of mathematical maturity is required. Prerequisite: A grade of at least a C in MATH 4315 or departmental approval.

5329 General Topology. (3-0) Point-set topology with an emphasis on general topological spaces; separation axioms, connectivity, the metrization theorem, and C-W complexes. Prerequisite: A grade of at least a C in MATH 4330 or departmental approval.

5331 Metric Spaces. (3-0) Point-set topology with an emphasis on metric spaces and compactness but including a brief introduction to general topological spaces. Prerequisite: A grade of at least a C in MATH 4330 or departmental approval.

5336 Studies in Applied Mathematics. (3-0) Topics selected from optimization and control theory, numerical analysis, calculus of variations, boundary value problems, special functions, or tensor analysis. May be repeated with different emphasis for additional credit. Prerequisites: Six hours of advanced mathematics pertinent to topic and consent of the instructor.

5340 Scientific Computation. (2-2) This course will involve the analysis of algorithms from science and mathematics, and the implementation of these algorithms using a computer algebra system. Symbolic numerical and graphical techniques will be studied. Applications will be drawn from science, engineering, and mathematics. Prerequisite: MATH 3323 or consent of instructor.

5345 Regression Analysis. (3-0) This course introduces formulation and statistical methodologies for simple and multiple regression, assessment of model fit, model design, and criteria for selection of optimal regression models. Students will develop skills with the use of statistical packages and the writing of reports analyzing a variety of real-world data. Prerequisite: MATH 2472.

5350 Combinatorics. (3-0) This course covers permutations, combinations, Stirling numbers, chromatic numbers, Ramsey numbers, generating functions, Polya theory, Latin squares and random block design. Prerequisite: MATH 3398 or consent of instructor.

5355 Applied and Algorithmic Graph Theory. This course is designed to emphasize the close tie between the theoretical and algorithmic aspects. The topics may include basic concepts such as connectivity, trees, planarity, coloring of graphs, matchings, and networks. It also covers many algorithms such as Max-flow Min-cut algorithm, maximum matching algorithm, and optimization algorithms for facility location problems in networks. Prerequisite: MATH 5388 or MATH 3398.

5358 Applied Discrete Mathematics. (3-0) Boolean algebra, counting techniques, discrete probability, graph theory, and related discrete mathematical structures that are commonly encountered in computer science. Prerequisite: A grade of at least C in MATH 2472.

5360 Mathematical Modeling. (3-0) This course introduces the process and techniques of mathematical modeling. It covers a variety of application areas from the natural sciences. Emphasis is placed on deterministic systems, stochastic models, and diffusion. Prerequisite: MATH 3373, MATH 3323, and MATH 5301, or consent of instructor.
5373 Theory of Functions of Real Variables. (3-0) This course will discuss those topics that will enable the student to obtain a better grasp of the fundamental concepts of the calculus of real variables and the more recent developments of this analysis. Prerequisite: A grade of at least a C in MATH 4315 or departmental approval.

5376 Topics in Applied Statistics. (3-0) This course is designed to introduce a wide range of topics in applied statistics, including, but not limited to, experimental design, stochastic modeling, time series, and computational statistics. Prerequisite: Approval of instructor.

5376A Design and Analysis of Experiments. (3-0) This course introduces fundamental concepts in the design of experiments, justification of linear models, randomization and principles of blocking. It also discusses the construction and analysis of basic designs including fractional replication, composite designs, factorial designs, and incomplete block designs. Prerequisite: Approval of instructor.

5376B Analysis of Variance. (3-0) This course introduces basic methods, one-way, two-way ANOVA procedures, and multifactor ANOVA designs. Prerequisite: Approval of instructor.

5381 Foundations of Set Theory. (3-0) A formal study of the theory of sets, relations, functions, finite and infinite sets, set operations and other selected topics. This course will also train the student in the understanding of mathematical logic and the writing of proofs. Prerequisite: A grade of at least C in Mathematics 2472.

5382 Foundation of Real Analysis. (3-0) A course covering the foundations of mathematical analysis. Topics include: real numbers, sequences, series, and limits and continuity of functions. Prerequisite: MATH 5381.

5384 Geometric Approach to Abstract Algebra. (3-0) Definitions and elementary properties of groups, rings, integral domains, fields and vector spaces with great emphasis on the rings of integers, rational numbers, complex numbers, polynomials, and the interplay between algebra and geometry. Prerequisite: MATH 5381.

5386 Knots and Surfaces, An Introduction to Low-Dimensional Topology. (3-0) Knot polynomials and other knot invariants. The topological classification of surfaces and topological invariants of surfaces. Prerequisite: A grade of at least C in MATH 2472.

5388 Discrete Mathematics. (3-0) This course covers topics from: basic and advanced techniques of counting, recurrence relations, discrete probability and statistics, and applications of graph theory. Prerequisites: A grade of at least C in MATH 2472.

5390 Statistics. (3-0) This course will cover not only some of the basic statistical ideas and techniques but also the mathematical and probabilistic underpinnings of these techniques with an emphasis on simulations and modeling. The planning, conducting, analysis, and reporting of experimental data will also be covered. Prerequisite: A grade of at least C in MATH 2472.

5392 Survey of Geometries. (3-0) A study of topics in geometry including geometrical transformations, the geometry fractals, projective geometry, Euclidean geometry, and non-Euclidean geometry. Prerequisite: A grade of at least C in MATH 2472.

Thesis Courses

5199B Thesis. (1-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5299B Thesis. (2-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5399A Thesis. (3-0) This course represents a student’s initial thesis enrollment. No thesis credit is awarded until student has completed the thesis in MATH 5399B. Graded on a credit (CR), progress (PR), no-credit (F) basis.
5399B Thesis. (3-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5599B Thesis. (5-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5999B Thesis. (9-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

Mathematics for Teacher Education (MTE)

5301 Topics in Mathematics for the Middle School Teacher. (3-0) This topics course is designed to provide the general 4th-8th grade teacher with the content knowledge necessary to effectively teach mathematics at the middle school level.

5301E Visual Models for Middle School Mathematics. (3-0) This course uses visual models to motivate understanding of the fundamental concepts underlying middle school mathematics. Pedagogical techniques to engage middle school students will also be addressed including inquiry-based instructional methods utilizing these visual models.

5301F Implementing New Mathematics Curriculum. (3-0) In this course we will investigate the keys to successfully implementing new curriculum. Two main aspects considered are: 1) the mathematical content knowledge required for a new curriculum and 2) how to build a community of practice which provides support during the implementation process.

5302 Topics in Teaching Mathematics for the Middle School Teacher. (3-0) This topics course is designed to provide the general 4th-8th grade teacher with the pedagogical content knowledge necessary to effectively teach mathematics at the middle school level.

5311 Quantitative Reasoning. (3-0) This course will focus on numerical reasoning and problem solving with particular attention being placed on strategies for solving problems, methods for mental computation and computational estimation, and algorithmic processes being taught in a student-centered atmosphere where teachers are free to take risks.

5313 Geometry and Measurement. (3-0) This course will focus on using spatial reasoning to investigate the concepts of direction, orientation, shape and structure; using mathematical reasoning to develop and prove geometric relationships; using logical reasoning and proof in relation to the axiomatic structure of geometry; using measurement of geometry concepts to solve real-world problems.

5315 Algebraic Reasoning. (3-0) This course will focus on using algebraic reasoning to investigate patterns, make generalizations, formulate mathematical models, and make predications; using properties, graphs, and applications of relations and function to analyze, model and solve problems; and making connections among geometric, graphic, numeric and symbolic representation of functions and relations.

5317 Math Modeling. (3-0) This course will focus on modeling problems, applying appropriate mathematical analysis and drawing conclusions from the analysis; solving problems recursively, using linear and non-linear functions and using geometry and discrete mathematics to solve problems in Science, Music, and Art. Prerequisite: MTE 5315.

5319 Concepts of Calculus. (3-0) A first course in differential and integral calculus. The student will explore the slope of secant lines, average velocity, limit, instantaneous velocity, derivative, slope of a curve at a point, area under a graph, integrals, fundamental theorem of calculus, and applications. Prerequisite: MTE 5317 or consent of department chair.
5321 Probability and Statistics. (3-0) This course will deal with using graphical and numerical techniques to explore data, characterize patterns, and describe departures from patterns; designing experiments to solve problems; understanding the theory of probability and its relationship to sampling and statistical inference and its use in making and evaluating predication. Prerequisite: MTE 5315.

5323 Logic and Foundations of Mathematics. (3-0) This course will consist of an introduction to fundamental mathematical structures and techniques of proof. Topics will include: logic, set theory, number theory, relations, and functions. Emphasis will be placed on communication about mathematics and construction of well-reasoned explanations. Prerequisite: MTE 5313 and 5319.

Graduate Faculty

Acosta, Maria T., Associate Professor of Mathematics. B.S., Universidad La Gran, Colombia; M.S., State University of New York at Fredonia; M.S., Ph.D., University of Arizona. (Algebra)

Bandy, Carroll, Professor of Mathematics. B.S., Arkansas Tech University; M.S., University of Arkansas; Ph.D., University of Houston. (Topology)

Conrad, Matthias, Assistant Professor of Mathematics. B.S., University of Hamburg, Germany; M.S., Ph.D., University of Lubeck, Germany. (Applied Mathematics, Numerical Analysis)

Cuevas, Gilbert J., Professor of Mathematics. B.A., M.Ed., University of Miami; M.A.T., Tulane University; Ph.D., University of Miami. (Mathematics Education)

Curtin, Eugene, Professor of Mathematics. B.S., M.S., University College, Dublin; Ph.D., Brown University. (Differential Geometry)

Dean, Nathaniel, Professor and Chair of the Department of Mathematics. B.S., Mississippi State University; M.S., Northeastern University; Ph.D., Vanderbilt University. (Discrete Mathematics, Operations Research)

Dix, Julio Guacaneme, Professor of Mathematics. B.A., Universidad de Bogota; M.S., Ph.D., University of Cincinnati. (Numerical Analysis)

Edgell Jr., John James, Professor of Mathematics. B.S., Lamar University; M.A., Sam Houston State University; Ph.D., The University of Texas at Austin. (Mathematics Education)

Ferrero, Maria Daniela, Associate Professor of Mathematics. B.S., Universidad de la Republica del Uruguay; Ph.D., Technical University of Cataluna. (Graph Theory)

Fischer, Joyce F., Assistant Professor of Mathematics. B.A., M.A., Texas State University; Ph.D., The University of Texas at Austin. (Mathematics Education)

Gronberg, Sharon M., Senior Lecturer of Mathematics. B.A., Augsburg College; M.S., Midwestern State University; Ph.D., The University of Texas at Austin. (Mathematics Education)

Gu, Weizhen, Professor of Mathematics. B.S., Hangzhou University, China; M.S., Ph.D., Louisiana State University. (Graph Theory, Combinatorics)
Jia, Xingde, Professor of Mathematics. B.S., Qufu Normal University; Ph.D., City University of New York. (Combinatorics, Number Theory)

Jiang, Zhonghong, Professor of Mathematics. B.S., M.S., Beijing Normal University; M.S., Ph.D., University of Georgia. (Mathematics Education)

Keller, Thomas Michael, Professor of Mathematics. B.A., M.A., Ph.D., Johannes Gutenberg University of Mainz, Germany. (Group Theory)

McCabe, Terence William, Assistant Professor of Mathematics. B.S., M.A., Texas State University; Ph.D., University of North Texas. (Differential Equations)

Mireles, Selina Vasquez, Associate Professor of Mathematics. B.A., The University of Texas at Austin; M.Ed., Texas State University; Ph.D., The University of Texas at Austin. (Mathematics Education)

Morey, Susan Elaine, Professor of Mathematics. B.S., University of Missouri-Columbia; Ph.D., Rutgers State University. (Commutative Algebra)

Nankervis, Bryan, Senior Lecturer of Mathematics. B.A., M.S., Texas State University; Ph.D., The University of Texas at Austin. (Mathematics Education)

Obara, Samuel, Associate Professor of Mathematics. B.Sc., University of Eastern Africa, Baraton; M.Ed., M.A., Ph.D., University of Georgia. (Mathematics Education)

Passty, Gregory Bohdan, Professor of Mathematics Assistant Dean of the College of Science and Engineering. B.A., M.A., Ph.D., University of Southern California. (Non-linear Functional Analysis)

Shen, Jian, Professor of Mathematics. B.S., M.S., University of Science and Technology of China; Ph.D., Queens University. (Combinatorics, Combinatorial Matrix Theory, Probabilistic Methods in Discrete Mathematics)

Singh, Sukhjit, Professor of Mathematics. B.A., Arizona State University, M.A., Ph.D., Pennsylvania State University. (Topology)

Snyder, David Fred, Associate Professor of Mathematics. B.A., Ph.D., University of Tennessee. (Geometric and Algebraic Topology, Mathematical Modeling)

Sorto, M. Alejandra, Associate Professor of Mathematics. B.S., M.S., The University of Texas at El Paso; M.S., Ph.D., Michigan State University. (Mathematics and Statistics Education)

Spellmann, John Winston, Professor of Mathematics. B.A., Texas Lutheran University; M.A., Ph.D., Emory University. (Differential Equations)

Strickland, Sharon, Assistant Professor of Mathematics. B.A., Agnes Scott College; M.Ed., Texas State University; Ph.D., Michigan State University. (Mathematics Education)

Thickstun, Thomas Lusk, Professor of Mathematics. B.A., Ph.D., University of California-San Diego. (Topology)
Torrejon, Ricardo Marcelo, Professor of Mathematics. B.S., University of Concepcion; M.S., Ph.D., University of Iowa. (Non-linear Functional Analysis)

Warshauer, Max Leon, Regents' Professor of Mathematics. B.A., University of Chicago; Ph.D., Louisiana State University. (Quadratic Forms, Mathematics Education)

Wayment, Stanley Glen, Professor of Mathematics. B.S., Brigham Young University; M.S., Stanford University; M.S., Ph.D., University of Utah. (Analysis)

Welsh, Stewart Chalmers, Professor of Mathematics. B.S., Ph.D., University of Glasgow, Scotland. (Bifurcation Theory, Differential Equations)

White, Alexander, Associate Professor of Mathematics. B.S., M.S., The University of Texas at El Paso; Ph.D., Michigan State University. (Statistics, Mathematics Education)

Zhao, Qiang, Associate Professor of Mathematics. B.S., Southwest Agricultural University, China; M.A., University of North Florida; Ph.D., University of Missouri-Columbia. (Statistics)
Department of Physics

Major and Degrees Offered:
Physics, M.S.
Materials Physics, M.S.

Major Programs

Physics, M.S., Thesis Option. The standard program that leads to a 30-hour Master of Science degree requires six hours of thesis, PHYS 5312 and PHYS 5331, nine to 12 hours in physics, six to nine hours in another science (mathematics, computer science, chemistry, or biology) or, if a no minor option is selected, six to nine hours in physics and/or other sciences with prior approval. The Physics Department offers an especially strong opportunity for thesis research in experimental solid state and materials physics.

Physics, M.S., Non-thesis Option. The 36-hour Master of Science degree program without a thesis is also available. This optional program requires six hours of course work in lieu of the thesis and six hours of additional course work in physics.

Materials Physics, M.S. The Materials Physics M.S. is a thesis only degree which stresses experimental materials physics primarily related to the semiconductor and other high tech materials industries. The program leads to a 35-hour Master of Science degree in Materials Physics. The Materials Physics M.S. degree requires six hours of thesis, PHYS 5110 (taken twice), PHYS 5320, PHYS 5324, and PHYS 5398. In addition 18 elective hours must be chosen from PHYS 5312, 5314, 5322, 5326, 5327, 5328, 5329, 5331, 5370, with up to nine hours of free electives permitted (with prior departmental approval).

Research. Research is an important component of our graduate program. Faculty research interests include historical astronomy and astronomical computing, magnetic and semiconductor materials fabrication and analysis, thin film electrical characterization, scanning probe microscopy, and infrared spectroscopy. Major research instrumentation includes magnetron and dual ion beam sputtering vacuum systems, scanning electron microscope with energy dispersive spectroscopy capabilities, atomic force microscope, scanning tunneling microscope, thin film optical characterization equipment, high resolution x-ray analysis equipment, vibrating sample magnetometer, FTIR spectrometer, and a Molecular Beam Epitaxy thin film growth system. For the latest on research interests and activities, visit our website: http://www.txstate.edu/physics/.

Admission Policy

For information regarding admission application requirements and deadlines, please visit the Graduate College website using one of the following links:

Physics  www.gradcollege.txstate.edu/phys.html
Materials Physics  www.gradcollege.txstate.edu/mphys.html

Financial Assistance

Assistantships are available on a limited basis, and applications should be submitted by the posted priority application deadline. Inquiries and/or applications for assistantships should be mailed to:
Courses Offered

Physics (PHYS)

5110 Seminar in Physics. (1-0) A course designed to acquaint the graduate student with current research areas in physics. May be repeated twice for total of three semester hour’s credit.

5302 Electricity and Magnetism. (3-0) An introduction to the electromagnetic field theory of classical physics for static fields. Topics included will be the electrostatic field, polarization and dielectrics, electrostatic energy, magnetic field of steady currents, magneto static energy, and magnetic properties of matter. This is a graduate leveling course in Electricity and Magnetism (stacked with PHYS 4310). This course does not earn graduate degree credit.

5303 Quantum Mechanics. (3-0) An introductory course on quantum mechanics. Hamiltonian operator and Schroedinger equation, harmonic oscillator, matrix formulation of quantum mechanics, uncertainty principle, potential barrier problems, and the hydrogen atom. This is a graduate leveling course in Quantum Mechanics (stacked with PHYS 4312). This course does not earn graduate degree credit.

5312 Quantum Mechanics II. (3-0) A study of quantum mechanics including combination of two or more quantum mechanical systems, addition of angular momentum, time independent perturbation theory, and time dependent perturbation theory.

5313 Mathematical Methods of Physics. (3-0) This course is a survey of mathematical methods of physics as they apply to areas in classical mechanics, quantum mechanics, electrodynamics, and nuclear physics.

5314 Statistical Mechanics. (3-0) A study of statistical mechanics including a brief review of equilibrium thermodynamics, fundamentals of statistical mechanics, transport processes, fluctuations from equilibrium, phase transitions and critical phenomena, and quantum fluids.

5320 Solid State Physics. (3-0) A study of electronic properties of materials using classical and quantum mechanical models, simple band theory of a solid and some device. Also included is an introduction to band theory applied to other properties of solids such as magnetism, dielectric functions, transport properties, and superconductivity. Prerequisites: PHYS 5312.

5322 Semiconductor Device Microfabrication. (3-0) An in-depth overview of the physics and technology of VLSI and ULSI silicon semiconductor device microfabrication. Topics including electronic material preparation, thin film growth, silicon oxidation and etching, lithography processing, impurity diffusion, ion implantation and yield analysis will be covered.

5324 Thin Film Materials Laboratory. (0-9) An intensive laboratory introduction to the physics and materials fabrication and characterization. At the discretion of the instructor, laboratory projects introducing techniques such as sputtering, furnace/oven preparation, scanning probe microscopy, scanning electron microscopy, energy dispersive spectroscopy, four point probe transport methods, magnetometry and x-ray analysis may be offered. This course is preparatory for students seeking to apply for an experimental materials physics master’s thesis project. This course may be repeated with permission from the instructor.
5326 Electrical Characterization of Materials and Devices. (2-6) A laboratory/lecture course introducing electric characterization methods important to semiconductor materials and devices. Various measurement techniques and methods will be reviewed. Students will learn to work with industrial equipment. Prerequisite: PHYS 2425.

5327 Microelectronics Device Physics. (3-0) The application of solid state physics for describing important examples of thin film device operation with a special emphasis on semiconductor devices. Additional topics may include photon and phonon effects on electronic properties, quantum phenomena, many body effects in solids, carrier transport properties, micro-electromechanical systems, and materials interface issues.

5328 Advanced Solid State Physics. (3-0) Review of models of a solid and energy band theory. Additional topics may include interaction of electromagnetic waves with solids, lattice vibrations and phonons, many body effects in solids, device physics, quantum phenomena, carrier transport properties, current device configurations, and materials interface problems. Prerequisite: PHYS 5320.

5329 Microelectronics Reliability Physics. (2-4) An introduction to the physical mechanisms governing the important failure modes of semiconductor integrated circuit devices and other emerging thin film devices. The application of materials physics characterization techniques for detecting the signatures of these failure mechanisms will also be reviewed. Prerequisites: PHYS 5324 and PHYS 5328, or instructor permission.

5331 Electromagnetic Field Theory. (3-0) Introduction to electrodynamics at the graduate level. Topics include applications of special functions to problems in electrostatics and magnetostatics, time varying fields, Maxwell’s equations, electromagnetic energy, Maxwell’s stress tensor, radiation, and special theory of relativity.

5340 Advanced Dynamics. (3-0) Classical mechanics at an advanced level. Topics covered may include special relativity in classical mechanics, Hamilton equation of motion, canonical transformations, and Hamilton-Jacobi theory.

5370 Problems in Advanced Physics. (3-0) Open to graduate students on an individual basis by arrangement with the Department of Physics. May be repeated with prior approval of the department.

5395 Fundamentals of Research. (0-6) Course is available to graduate students only at the invitation of the department. May be repeated with prior approval of the department.

5398 Industry Internship. (0-40) Supervised work experience in an appropriate high tech industry. Students will be required to keep a daily journal and make a final presentation (both written and oral) describing their accomplishments. Graded on a credit (CR), no credit (F) basis.

5401 Classical Mechanics. (3-1) Fundamentals of classical mechanics focusing on the physical description of the behavior of single and multiple particle systems. Topics include advanced problem-solving strategies for systems with position and velocity-based forces, simple harmonic oscillators, non-inertial reference systems, gravitation and central forces, and rigid body motion. This course is graduate level course in Classical Mechanics (stacked with PHYS 3414). This course does not earn graduate degree credit.

5404 Experimental Methods. (3-1) Experiments in modern physics, with emphasis on demonstrating quantum effects and introducing nuclear physics.

Thesis Courses

5199B Thesis. (1-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5299B Thesis. (2-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.
5399A Thesis. (3-0) This course represents a student’s initial thesis enrollment. No thesis credit is awarded until student has completed the thesis in Physics 5399B. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5399B Thesis. (3-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5599B Thesis. (5-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

5999B Thesis. (9-0) This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.

Graduate Faculty

Close, Eleanor W., Senior Lecturer of Physics. B.A., Bryn Mawr College; M.S., University of Washington; Ed.D., Seattle Pacific University.

Close, Hunter G., Assistant Professor of Physics. B.A., Rice University; M.A., Indiana University; M.S., Ph.D., University of Washington.

Donnelly, David W., Professor of Physics. B.A., University of California-Berkeley; Ph.D., University of California-Santa Barbara.

Droopad, Ravindranath, Professor of Physics. B.S., University of Birmingham; Ph.D., University of London.

Galloway, Heather C., Professor of Physics and Director of University Honors Program. B.S., The University of Texas at Austin; M.A., Ph.D., University of California-Berkeley.

Geerts, Wilhelmus J., Associate Professor of Physics. M.S.E.E., University of Technology, Eindhoven, The Netherlands; Ph.D. Physics, University of Twente, Enschede, The Netherlands.

Holtz, Mark W., Professor of Physics. B.S., Bradley University; Ph.D., Virginia Polytechnic Institute.

Lee, Byounghak, Assistant Professor of Physics. B.S., Korea University; Ph.D., Indiana University.

Mount, Jennifer, Senior Lecturer of Physics. B.S., Texas State University; Ph.D., The University of Texas at Austin.

Myers, Thomas, Professor and Interim Chair of the Department of Physics, Director Materials Science Engineering and Commercialization Program, and Associate Dean of the College of Science. B.S., Ph.D., North Carolina State University.

Olson, Donald Wallace, Professor of Physics. B.S., Michigan State University; Ph.D., University of California-Berkeley.

Piner, Edwin L., Professor of Physics. B.S., Ph.D., North Carolina State University.

Scolfaro, Luisa, Senior Lecturer of Physics. B.S., M.S., Ph.D., University of Sao Paulo, Brazil.
Spencer, Gregory F., Associate Professor of Physics. B.S., University of South Florida; M.S., University of Illinois at Urbana-Champaign; Ph.D., University of Florida.

Theodoropoulou, Nikoleta, Associate Professor of Physics. B.S., University of Athens, Greece; Ph.D., University of Florida.
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