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 Policies

Admission to the Aquatic Resources Ph.D. Program normally requires an earned master’s degree or equivalent from an accredited college or university in Biology, Chemistry, Engineering, Geology, or other natural science relevant to the study of aquatic resources. Exceptionally qualified applicants with an earned bachelor’s degree or equivalent from an accredited college or university in these same fields also will be considered for admission to the Aquatic Resources Ph.D. Program.

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/.

Application Deadlines

Students must submit a Doctoral Program Graduate College Application for Admission if they wish to pursue a doctoral degree at Texas State. The Department of Biology requires the submission of additional application materials. Students normally enter the Ph.D. program during either the fall or spring semester. To ensure full consideration for admission to the program, all required application materials must be submitted to the Office of the Graduate College no later than
January 15 for entry the following fall semester, or no later than August 15 for entry in the following spring semester. Admission decisions will normally be made within 45 days of application deadlines. Applications received after the posted deadlines may not be considered for financial support until the following academic year.

Admission Requirements

Students entering the Ph.D. program in Aquatic Resources must have demonstrated evidence of scholarly research and writing. To be considered for admission to the program, each student must submit the following materials to the Office of the Graduate College:

1. A complete application for admission to the Graduate College through ApplyTexas.
2. A non-refundable application fee of $40.00.
3. One official transcript that indicates the completion of a master’s or bachelor’s degree in Biology, Chemistry, Engineering, Geology, or a related natural science discipline from an accredited college or university. For students holding a master’s degree, a grade point average (GPA) of at least 3.25 on all completed graduate work is required. For students holding a bachelor’s degree, a GPA of at least 3.5 on all completed undergraduate work is required.
   a. Non-Texas State graduates must submit a transcript from each college or university (including Texas State, if attended). These must be mailed directly from the institution to the Office of the Graduate College.
   b. Texas State graduates only need to order transcripts from any colleges not listed on the Texas State transcript. The Office of the Graduate College will obtain the Texas State transcript from the Registrar’s office.
4. Official results of the Graduate Record Examination (GRE). Well-qualified applicants should score in at least the 60th percentile on both the verbal and quantitative portions of the GRE. If the GRE was taken within the last five years and prior to the new examination, the following preferred scores will be considered - 1150 or higher (verbal and quantitative combined). This score must be on file in the Office of the Graduate College prior to the evaluation of the student’s application.
5. A current curriculum vitae that summarizes your educational and professional accomplishments.
6. A statement of educational and career goals that describes your professional aspirations and your rationale for pursuing a doctoral degree in Aquatic Resources. Applicants can obtain a Statement of Goals form by contacting the Office of the Graduate College or by downloading it from the Graduate College website: http://www.gradcollege.txstate.edu/
7. Three letters of recommendation that must address the substance and quality of your preparation for doctoral study.
8. An “Intent to Mentor” letter provided by a Texas State faculty member, in which the faculty member must agree to serve as the student's dissertation advisor. Contact with faculty is the primary vehicle for learning of opportunities for research and support and for developing potential avenues of research. The intent of the mentor requirement is to help ensure that students have a successful start to their graduate career. At times it may be necessary for a student to change advisors in the course of their studies; this may be done with the approval of the Graduate Committee and Program Director.

All applicants should refer to the “Admission Documents” section of the Graduate Catalog for more information.
International applicants should refer to the “Admission Information” and “Admission Documents” sections of the Graduate Catalog for additional requirements.

Financial Aid

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

Course Work

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

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 semester 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 semester 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 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 defendable, the Dissertation Defense may 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 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 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 semester. Graded on a credit (CR), non-credit (F) basis.

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 7299A Dissertation. (6-10) Original research and writing in Aquatic Resources, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each semester (including summer) for at least three dissertation hours. Graded on a credit (CR), progress (PR), no-credit (F) basis.

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 semester until admission to Candidacy, although it may not be taken more than three times for doctoral credit without the approval of Graduate Program Director.

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 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 7360A 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 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 7399A Dissertation. (3-5) Original research and writing in Aquatic Resources, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each semester (including summer) for at least three dissertation hours. Graded on a credit (CR), progress (PR), no–credit (F) basis.
**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.

BIO 7599A Dissertation. (6-10) Original research and writing in Aquatic Resources, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each semester (including summer) for at least three dissertation hours. Graded on a credit (CR), progress (PR), no–credit (F) basis.

BIO 7699A Dissertation. (6-10) Original research and writing in Aquatic Resources, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each semester (including summer) for at least three dissertation hours. Graded on a credit (CR), progress (PR), no–credit (F) basis.

BIO 7999A Dissertation. (6-10) Original research and writing in Aquatic Resources, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each semester (including summer) for at least three dissertation hours. Graded on a credit (CR), progress (PR), no–credit (F) basis.

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.
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-San Marcos; 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-San Marcos; 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., Associate 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., Assistant 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., Assistant 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, Associate 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-San Marcos; 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 Ceara; M.S., Federal University of Paraiba; 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)
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 semesters 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 semester 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.

**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-semester sequence of courses in statistics and experimental design (BIO 7405, 7406) and two semesters 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 of two years full-time 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 two-semester core-course sequence (BIO 7427, 7428) and a two-semester sequence of courses in statistics and experimental design (BIO 7405, 7406) in the first year. The course of study also includes a two-semester sequence of population biology seminars (BIO 7120) and two semesters of thesis (BIO 5399A/B), as well as elective courses 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 semesters of statistics and experimental design (BIO 7405, 7406), three one-hour seminars (BIO 5110) or BIO 5295 and two one-hour seminars, two semesters 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

Applicants to any of the master’s programs in Biology should have a bachelor’s degree in biology or a related discipline with a comparable program of course work. All applicants must submit a Graduate College Application for Admission, one official transcript from each university or college attended, and the official scores (verbal and quantitative) of the Graduate Record Examination (GRE) to the Office of the Graduate College. Well-qualified applicants should score in at least the 50th percentile on both the verbal and quantitative portions of the GRE. If you took the GRE within the last five years and prior to the new examination, the following preferred scores will be considered - a preferred score of 1000 (verbal and quantitative combined).

Each applicant must also provide a current curriculum vitae, a statement of goals that describes his or her professional aspirations and rationale for pursuing graduate study in biology, and three letters of recommendation that address the substance and quality of the applicant’s preparation for graduate study. Applicants for any thesis degree must also provide an “Intent to Mentor” letter from a Biology Department faculty member. In this letter, the faculty member must agree to serve as the
student's initial thesis advisor. The purpose of the mentor requirement is to help ensure that students have a successful start to their graduate careers. These materials should also be sent directly to the Office of the Graduate College. A current listing of faculty and their research interests, contact information for both graduate advisors and faculty, and further details on the various master’s programs can be found on the department’s website: http://www.bio.txstate.edu/.

The Department of Biology requires that a student have a minimum GPA of 3.0 on the last 60 undergraduate semester hours taken before receipt of the bachelor’s degree and a preferred GRE combined score (verbal and quantitative) of 1000 or higher for unconditional admission to be considered. Students with grade-point averages below 3.0 may petition the department for conditional admission. Admission in these cases will be decided by the appropriate graduate advisor based on interviews, letters of recommendation, research experience or other considerations that indicate the student’s ability to complete the graduate degree requirements. The graduate advisor will determine if any background deficiencies exist and may require course work in addition to that necessary for a graduate degree to correct these deficiencies.

To receive full consideration, complete applications should be received by June 15 for admission the following fall semester, October 15 for admission the following spring semester, and April 15 for admission the following summer session. The Graduate College will continue to process applications received after these deadlines, however, such applications will be processed on a first-come, first-served basis, with no guarantees of admission for those who apply after the deadline.

**Admission of international students.** International applicants to any of the master’s programs in the Department of Biology must submit all required materials outlined above as well as meet other specific Graduate College admission requirements outlined elsewhere in this catalog and available on the Graduate College website. To receive full consideration, complete applications from international students should be received by June 01 for admission the following fall semester, October 01 for admission the following spring semester, and March 15 for admission the following summer session.

**Thesis Students**

Students pursuing a master’s degree with thesis should have a thesis committee approved by the end of their first long semester 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 semester that they are actively involved in research. Students should enroll in BIO 5399A for their first semester of thesis research and in BIO 5399B for all subsequent semesters. 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 semester of enrollment in BIO 5399. Students pursuing a thesis-based degree must be enrolled in BIO 5399 during the semester 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 semester 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 semester 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 Aid

Assistantships and scholarships are available to qualified applicants on a competitive basis. 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 Collaborative Research. (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.
5214 Collaborative Research. (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 semester 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) Intended for elementary and secondary teachers, this course includes field-oriented study of animals and plants in their environmental settings, with instruction on the use of field trips and natural materials in EC-12 education. Counts toward the Biology Master of Science Education or Master of Science in Interdisciplinary Studies degree programs.

5314 Collaborative Research. (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 pursuing 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.

5390 Problems in the Biological Sciences. (3-3) Open to graduate students on an individual basis by arrangement with the faculty member concerned.

5199A 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 semester in which faculty supervision is received or laboratory facilities are used. Graded on a credit (CR), progress (PR), no-credit (F) basis.

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.

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.

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 Texas science education requirements; safety; research designs, design, conduct, and present both scientific and science education research. Stress is on broad-field structure and integration of major science concepts. Should be taken semester prior to science student teaching. Requires independent scientific and science education research and presentation of findings in a professional context.

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).

5445 Pathogenic Microbiology. (3-4) Pathogenic bacteria and their relationship to disease, emphasizing identification of selected groups of pathogens, epidemiology, and the biological basis for resistance. (F, S). Prerequisite: Biology 3440 or consent of the instructor.

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.

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-San Marcos; 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-San Marcos; 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 of Biology and Doctoral Program Director. B.S., M.A., University of Hamburg; Ph.D., Wageningen Agricultural University. (Microbial Ecology)

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)

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-San Marcos; 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., Associate 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)

Rast, Walter, Professor of Biology. B.A., 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., Assistant 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 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., Assistant 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, Associate 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-San Marcos; 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-San Marcos; M.A., Ph.D., University of California-Santa Barbara. (Conservation Biology, Plant Reproductive Biology, Aquatic Plant Biology)

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

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

Students are required to hold an appropriate undergraduate degree, have a preferred GRE score of ≥ 300, and have a grade point average of at least 3.00 in the last 60 hours of undergraduate course work prior to the baccalaureate degree or 60 hours plus any graduate level course work. In addition, applicants must submit two (2) letters of recommendation, regarding academic potential and undergraduate research experience; and a cover letter discussing career goals and undergraduate experiences. If you took the GRE within the last five years and prior to the new examination, the following preferred scores will be considered - 1000 (verbal and quantitative combined).

Students who do not meet the conditions specified above can be conditionally admitted. Admission recommendations in these cases will be decided by a departmental committee (chaired by the graduate advisor) based on GRE scores, interviews, letters of recommendation, laboratory ability, and the availability of space in the departmental research laboratories. Students who are judged to require additional background knowledge may be required to complete background course work prior to being granted unconditional admission status.

Financial Aid

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.

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 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 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.

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.

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.

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.

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, Associate 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-San Marcos; 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-San Marcos; 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)

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

Lippmann, David Zangwill, Associate Professor of Chemistry and Biochemistry. B.S., M.A., The University of Texas at Austin; Ph.D., University of California-Berkeley. (Physical Chemistry: Thermodynamics, Kinetics)

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)

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)

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:
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 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

Applicants accepted to the program will participate in a diagnostic interview with the graduate advisor. This interview will include a review of test scores, grades and work history. In some cases, additional courses may be added to the degree program.

Applicants to the computer science and software engineering programs are generally required to:
1. Meet the Graduate College’s minimum grade-point average requirement of no less than 2.75 on a 4.0 scale on the last 60 hours leading to the bachelor’s degree.
2. Have a preferred Graduate Record Examination (GRE) score of 286 with no less than 138 on the verbal section and 148 on the quantitative section. If you took the GRE within the last five years and prior to the new examination, the following preferred scores will be considered - 1000 (300 verbal and 600 quantitative). Official GRE scores must be on file in the Office of the Graduate College before an application may be considered. The GRE may be waived if an applicant has a master’s or doctorate degree.

3. Submit official transcripts from all colleges or universities attended.

4. Meet any other requirements of the Graduate College.

5. Meet the application deadlines as indicated in the “Admission Policies” section of the catalog.

6. International students must have the TOEFL score on file in the Office of the Graduate College. International students have additional admission requirements and should reference the “Admission Policies” section of this catalog. International applicants must meet the application deadlines as indicated in the “Admission Policies” section of the catalog.

**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. Please note, international students must meet specific admission requirements, including acceptable TOEFL or IELTS scores. Please refer to the “Categories of Admission” section of the catalog.

**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.

**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. Individuals holding a 4-year bachelor’s degree with a grade-point average of no less than 2.75 on a 4.0 scale on the last 60 hours leading to the degree would be eligible to apply for the program. International students are required to have minimum TOEFL score of 550 (paper-based test).

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-San Marcos
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-San Marcos
Department of Computer Science
Attn: Master’s Program Advisor
601 University Drive
San Marcos, TX 78666
Telephone: (512) 245-3409    FAX: (512) 245-8750
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. Does not count for credit toward any graduate degree. 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.

5318 Design of Programming Languages. (3-0) Covers various aspect 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: Grade of C or higher in CS 4332 or CS 5332.
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 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.


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.

5369U Advanced Data Mining. (3-0) Research in data mining techniques including classification, predication, and cluster analysis. Relationships with fields which data mining draws from like database technology, artificial intelligence, machine learning, and neural networks will also be emphasized. This course cannot be taken for credit if student received credit for CS 4378U. Prerequisite: CS 3358.

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.

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.

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.

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

McKenney, Mark Aaron, Assistant Professor of Computer Science. B.S., M.S., Tulane University; Ph.D., University of Florida. (Spatial Databases, Spatio-temporal Databases, Geoinformatics, Emerging Database Applications)

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, Assistant 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., Beihang University of Aeronautics and Astronautics; Ph.D., University of Florida. (Parallel and Distributed Computing, Wireless Sensor Networks, Internet and Web Technologies, 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)
Department of Engineering Technology

Major and Degree Offered:
Industrial Technology, M.S.T.

Major Program

The Department of Engineering Technology offers the Master of Science in Technology (M.S.T.) with a major in Industrial Technology.

The M.S.T. is designed to support careers and to provide for career advancement in the management of technical and engineering activity in industry, and in Technology Education.

The M.S.T. is a 36 semester hour degree composed of a 24 semester hour major in Industrial Technology and a 12 semester hour minor/cognate outside Technology. Within the Industrial Technology major students may elect to pursue a Construction, Manufacturing or General specialization, and thesis as well as non-thesis options are available.

The major is comprised of a 12 semester hour core, a 6 semester hour specialization, and 6 semester hours of technology electives. The core curriculum is required of all students. The design component of the core curriculum varies depending upon the student’s elected specialization. Students electing the Construction specialization would fulfill the following core curriculum:

- TECH 5313--Supervision and Coordination of Construction Design
- TECH 5385--Readings in Technology
- TECH 5390--Research in Technology
- TECH 5394--Data Acquisition and Analysis

Those electing the Manufacturing specialization would fulfill a slightly different core curriculum:

- TECH 5310--Computer Aided Drafting and Design
- TECH 5385--Readings in Technology
- TECH 5390--Research in Technology
- TECH 5394--Data Acquisition and Analysis

Students electing the General specialization may incorporate either design course (i.e., TECH 5313 or 5310) into their core curriculum.

Students may elect a Construction, Manufacturing, or General specialization. Students electing the Construction specialization may select six semester hours from the following courses:

- TECH 5361--Contemporary Construction Methods and Techniques
- TECH 5362--Construction Contracts and Estimating
  OR
- TECH 5365--Construction Scheduling and Project Management

Those electing the Manufacturing specialization must complete the following courses:

- TECH 5364--Statistical Applications in Manufacturing Process Control, and either
- TECH 5391--Computer Integrated Manufacturing
  OR
- TECH 5311--Computer Aided Engineering
Students electing the General concentration will work with the graduate advisor to select 6 semester hours which support career objectives.

Students may use the remaining 6 semester hours of technology electives to pursue either the thesis or non-thesis degree options. Those electing the non-thesis option may enroll in any 6 semester hours of technology course work considered relevant to their specialization. Those electing the thesis option must satisfy the thesis requirements of the Graduate College as published in the Graduate Catalog.

For those electing the thesis option, the final six semester hours of their major will be:

TECH 5399A and 5399B Thesis

Technology majors will not be permitted to enroll in TECH 5399B until the Dean of the Graduate College has approved their research proposal.

**Minor/Cognate.** Students may elect to pursue either a 12 semester hour minor or cognate area. A minor is distinguished from a cognate in that all course work must be taken in a single supervising academic department. Some departments offer academic minors while others do not. Students should consult the Graduate Catalog to determine what minors are available.

Students choosing to pursue a cognate may take courses from as many as four different academic departments.

Essentially, a minor is intended to provide the student with a greater depth of content coverage, while a cognate offers greater flexibility and a broader range of course selections. Some students will find a minor the more attractive option while others will prefer a cognate.

**Minor in Industrial Technology** - Graduate students majoring in other academic departments who wish to minor in Industrial Technology may do so provided they have adequate background. A minimum of 12 semester hours of graduate level Technology course work is needed in order to satisfy the requirements of a minor in Industrial Technology. Interested students should contact a Technology Graduate Advisor regarding background requirements and course selections.

**M.B.A. with Technology Specialization** - The Master of Business Administration with a Technology Specialization is offered by the Emmett & Miriam McCoy College of Business Administration in cooperation with the Department of Engineering Technology. This degree program should appeal to the M.B.A. student who seeks career opportunities with companies oriented significantly toward engineering and technology. Students pursuing this degree may complete up to 15 semester credit hours of graduate level Technology courses as a component of the M.B.A. For further details regarding the M.B.A. with a Technology Specialization refer to the “Emmett & Miriam McCoy College of Business Administration ‘Master of Business Administration, M.B.A.’” section of this catalog. The Technology Specialization satisfies the requirements of a minor in Industrial Technology.

**Background Courses.** Generally speaking, those with undergraduate degrees in Industrial Technology, Construction Science and Management, Engineering Technology, or Engineering will face minimal background work. Individuals holding undergraduate degrees in other fields will find it necessary to complete selected background courses to remedy deficiencies. Graduate students are prohibited from taking more than one undergraduate background course after being formally accepted into a master's degree program. Graduate leveling courses (e.g., TECH 5305, 5306, and 5307; see course listings below) may not be counted toward degree credit. In certain cases, it may be necessary to augment graduate leveling courses with the occasional undergraduate background course. Whenever this is necessary special approval must be sought from the Graduate Dean. Background requirements will be determined on a case-by-case basis through consultation with a faculty advisor. New students are encouraged to seek academic advising early regarding background courses.
Admissions Policy. The Department of Engineering Technology employs a two-tiered admission criterion to establish eligibility for admission into the Master of Science in Technology degree program.

1. Qualified applicants whose GPA is 2.75 in the most recent 60 semester hours of transcripted course work before the bachelor’s degree or in the last 60 hours of graduate level courses, shall be admitted to the program unconditionally, and the GRE shall not be required.

2. If a particular applicant’s admission GPA fails to meet the standard for unconditional admission (i.e. 2.75 or higher), but is not unreasonably low, the applicant shall be required to take the GRE. The final admission decision shall be delayed until the GRE scores have been received by the Graduate College. Determination of acceptable GRE scores shall be left to the discretion of the Graduate Advisor, and he/she shall scale scores on the GRE to other considerations (e.g., the GPA). In other words, the lower a particular applicant’s admission GPA, the higher the anticipated GRE score ought to be. If in the judgment of the Graduate Advisor, the applicant’s admission GPA, considered in combination with his/her GRE score, is suitable, either conditional or unconditional admission may be extended to the applicant, depending upon the specifics of the particular case.

3. Additionally, students must meet all criteria established by the Graduate College.

Courses Offered

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 credit. Repeatable with different emphasis. Graded on a credit (CR), no-credit (F) basis.

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 count as 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 count as 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.

5306 Fundamentals of Commercial Building Construction Systems. (2-2) 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 TECH 2360.
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.

5313 Building Information Modeling. (3-3) Understanding the supervisory role of construction professionals in the design process. Directing a design team in the integration of construction documents for commercial buildings. Coordination of site work, structural, architectural, mechanical, electrical, and plumbing plans. Contemporary CAD software for 2D and 3D design including Building Information Modeling. Prerequisite: TECH 2313 or consent of instructor.

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.

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. Prerequisite: TECH 2360, 5302, 5304 and 5306.

5361 Contemporary Construction Methods and Techniques. (3-0) Deals with current topics and trends in the construction industry. Construction engineering, including materials, soil and structure testing, estimating, scheduling, utilities, surveying, and site layout is covered. Prepared construction-related computer programs are utilized and evaluated. Prerequisite: TECH 2360 and TECH 5306 or equivalents.

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: TECH 2360, TECH 5306.

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.

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.

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.

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.
5420 Concrete Properties Testing. (3-2) This course analyzes the effects of concrete raw materials on the properties of fresh and hardened concrete. The evaluation of concrete mixture designs and the analysis of the models that explain concrete behavior are also studied. Prerequisite: TECH 2342 or ENG 2300 or instructor’s approval.

Graduate Faculty

Batey, A.H., Associate Professor and Chair of the Department of Engineering Technology. B.S., M.Ed., Texas State University-San Marcos; 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., Lecturer of Engineering Technology. B.S.I.T., M.S.I.T., Texas State University-San Marcos; 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.

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

Winek, Gary Joseph, Professor of Technology. 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, Associate 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.

Ryu, Young Sam, Assistant Professor of Engineering. B.S., M.S., Korea University; Ph.D., Virginia Polytechnic Institute and State University.

Tate, Jitendra, Associate Professor of Engineering B.S., M.S., University of Pune, India; Ph.D., North Carolina A&T State University.
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 University-San Marcos 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 semester) 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 University 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 an additional 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

Applicants to Texas State's doctoral program in Materials Science, Engineering, and Commercialization must have the following:

- Completed a master's degree in Biology, Chemistry, Engineering, Materials Science, Physics, Technology, or a closely related field
- GPA of 3.5 or higher on all completed master's work
- Completion of the Graduate Record Exam (GRE) with a preferred score of 304 or higher (verbal and quantitative combined). Score must be on file in the Office of the Graduate College prior to evaluation of an application. If you took the GRE within the last five years and prior to the new examination, the following preferred score will be considered - 1150 or better (verbal and quantitative combined).
- Letter outlining applicant’s personal history and life goals that are relevant to obtaining a doctoral degree, and in particular, why applicant wants to pursue the commercialization aspect of the MSEC program.
- Three letters of recommendation evaluating the applicant’s skills and potential to be successful in the Materials Science, Engineering, and Commercialization Ph.D. program.
- Current curriculum vita or resume.
- A telephone or on-site interview with Core doctoral faculty.
• Leveling coursework may be required prior to admission into the doctoral program for applicants lacking sufficient background coursework. Any required leveling coursework must be completed with grades of B or better prior to admission.

• All international applicants (non-U.S. citizens) must fulfill the Test of English as a Foreign Language (TOEFL) requirement as identified in the “Admission Documents” section of the graduate catalog. Fluency in reading, speaking, and writing English is expected of all accepted students. In order to be eligible for admission into this program, international applicants must submit a TOEFL score of 78 (iBT) or higher or IELTS (Academic) – 6.5 or higher with minimum individual module score of 6.0.
  ▪ iBT (Internet-based TOEFL) - 78 overall
  ▪ pBT (Paper based/institutional TOEFL for Texas State students only) - 550
  ▪ IELTS (Academic) – 6.5 or higher with minimum individual module score of 6.0

Application Deadlines

Applicants must submit an Application for Admission if they wish to pursue a doctoral degree at Texas State. The MSEC program accepts applicants for the fall semester. To ensure full consideration for admission to the program, all required application materials must be submitted to the Office of the Graduate College and to the Department no later than June 15 for entry the following fall. Students who are applying for Doctoral Teaching Assistantships should submit all of their application materials by March. Admission decisions will normally be made within 30 days of application deadlines.

Admission Requirements

Applicants must:

1. Complete an application for admission online through the ApplyTexas Application at https://www.applytexas.org
2. Pay a $40 application fee. A $50 international/evaluation fee is required if the application is considered for admission based on foreign credentials.
3. Submit to the Office of the Graduate College one official transcript from each senior-level post-secondary institution attended. Transcripts must be mailed directly from the university or college attended or submitted in a sealed university envelope with the university's registrar's signature on the back of the envelope. (If you are a Texas State University-San Marcos degree recipient or are currently enrolled, you need to request transcripts from any colleges NOT listed on your Texas State transcript. The Graduate College will provide Texas State transcripts.)
4. Have official scores of your Graduate Record Exam (GRE) on file in the Office of the Graduate College.
5. Submit three letters of recommendation indicating your skills and capacity to be successful in the Ph.D. program.
6. Submit a letter outlining your personal history and life goals that are relevant to obtaining a doctoral degree.
7. Submit current curriculum vita or resume.

Applicants should refer to the “Admission Documents” section for more information.
International applicants should refer to the “Admission Information” and “Admission Documents” sections for additional requirements.

Financial Aid

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 semester 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 semesters 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><strong>Total</strong></td>
<td><strong>55 (minimum)</strong></td>
</tr>
</tbody>
</table>

**Instructional Assistant Courses**

- MSEC 7100 Doctoral Assistant Development

**Core Courses**

- MSEC 7101 Commercialization Forum (1 hour per semester for 4 hours total)
- MSEC 7102 MSEC Seminar (1 hour per semester 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 7402 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 semester 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 semester. 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 semester 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 semester 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 semester 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 semester 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 semester 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.

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.

**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 “Ph.D. Research Advisor/Committee Member Change Request Form” may 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 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. 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 semester. 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.

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 semester. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable for credit. Prerequisite: Acceptance into candidacy.

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.

7299 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 semester. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable for credit. Prerequisite: Acceptance into candidacy.

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 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, MSEC 7399 and MSEC 7699. This course recognizes the collaborative nature of scientific and commercialization enterprise. Repeatable (with MSEC 7103 hours) 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, forcefield 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. (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.

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 semester. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable for credit. Prerequisite: Admission into candidacy.

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.

7599 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 semester. 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 semester. 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. (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 semester. 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. B.S. 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, Wilhelmus 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-San Marcos; 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-San Marcos; 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, Byoung Hak, 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.

Theodoropouloou, Nikoleta, Assistant 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 variety of employment opportunities.

This program is designed for individuals 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 mathematics 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 doctoral 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 teachers of mathematics.

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 semester 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 Requirements

Submit all application material to the Office of the Graduate College:

1. Complete an application for admission online at Apply Texas.
2. Pay a non-refundable application fee of $40.00.
3. One official transcript which indicate the completion of a Bachelor's or Master's degree in Mathematics, Mathematics Education, or a related field, from an accredited college or university:
   a. Non-Texas State Graduates – From each college or university (including Texas State if attended). These must be mailed directly from the institutions to the Office of the Graduate College.
   b. Texas State Graduates – Only need to order transcript from any colleges not listed on the Texas State transcript. The Office of the Graduate College will obtain the Texas State transcript from the Registrar’s office.
4. Have a 3.0 Grade Point Average (GPA) or better on a 4.0 scale on the highest degree earned, or a GRE Mathematics subject test score of 75th percentile or greater.
5. A preferred combined verbal and quantitative score on the Graduate Record Exam (GRE) of 300 or higher. This score must be on file in the Office of the Graduate College prior to the evaluation of the student’s application. If you took the GRE within the last five years and prior to the new examination, the following preferred score will be considered - preferred score of 1100 (verbal and quantitative combined).
6. International students must also submit a minimum 78 total score on the internet-based TOEFL with minimum section scores of 19/reading, 19/listening, 19/speaking, and 18/writing or IELTS (Academic) - 6.5 or higher w/min individual module scores of 6.0.
7. Demonstration of interest in a career as a mathematics educator and potential to contribute to the advancement of professional leadership in education as indicated by an essay of approximately 500 words in length describing the applicant's background and professional goals. This should include a rationale for pursuing a doctoral degree in Mathematics Education.
8. Three letters of recommendation addressing the applicant's professional and academic background.

Program faculty will conduct interviews with prospective applicants.

Applicants should refer to the “Admission Documents” section for more information.

Applicants who do not meet the above requirements may apply for conditional admittance. Provisions will be specified by the Doctoral Program Committee in cases where the appeal is granted. International applicants should refer to the “Admission Information” and “Admission Documents” sections for additional requirements.
Financial Aid

Almost all doctoral students are expected to receive full financial assistance from the department working as Instructional Assistants or Research Assistants. To apply, a completed employment application form and at least one letter of recommendation on your ability to teach and/or to do research are required. For more detailed information, please visit the department's website http://www.math.txstate.edu/.

- To apply, you must be accepted as a Ph.D. student. In addition, you must submit (a) at least one letter of recommendation on your ability to teach, which could be one of the three letters you sent for your admission; (b) a current vita. The deadlines are: May 1 for the fall semester, October 1 for the spring semester. 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. Please contact the department for more detailed information.
- Additional summer support is available as Instructional Assistants or Research Assistants. Contact the department for more information.
- 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 semester 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

<table>
<thead>
<tr>
<th>Type of Course</th>
<th>Semester Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Mathematics Education Courses</td>
<td>21</td>
</tr>
<tr>
<td>Core Mathematics Courses</td>
<td>15</td>
</tr>
<tr>
<td>Core Sequence Courses</td>
<td>6</td>
</tr>
<tr>
<td>Prescribed Math Education Electives</td>
<td>12 (minimum)</td>
</tr>
<tr>
<td>Prescribed Education Electives</td>
<td>3 (minimum)</td>
</tr>
<tr>
<td>Free Electives</td>
<td>3 (minimum)</td>
</tr>
<tr>
<td><strong>Course Work Total</strong></td>
<td><strong>60 (minimum)</strong></td>
</tr>
</tbody>
</table>

Dissertation Research and Writing 18 (minimum)

Degree Total 78 (minimum)

Course requirements

Note: Your doctoral program of studies may be modified as a result of a change of your research goals or performance in the qualifying exams.

A. Core Mathematics Education Courses: This 21 hour requirement has two components. The first is a four-course (12 hour) requirement consisting of the following Mathematics Education courses:

- MATH 7306 Current Research in Mathematics Education
- MATH 7302 History of Mathematics/Mathematics Education
- MATH 7324 Curriculum Design and Analysis
- MATH 7328 Instructional Techniques and Assessments

The second part of the Mathematics Education core requirement is a set of three courses (9 hours) to prepare students to be successful in conducting Mathematics Education research. Note that one of these courses is taught in the College of Education.

- MATH 7346 Quantitative Research
- ED 7352 Beginning Qualitative Design and Analysis
- MATH 7356 Advanced Topics in Research (students must choose one of the topics courses that is offered under this heading)

B. Core Mathematics Courses: The following five Mathematics courses are required of all students in the program. This is a 15 hour requirement.

- MATH 7303 Analysis I
- MATH 7307 Algebra I
- MATH 7309 Topology I
- MATH 7321 Graph Theory, or MATH 7331: Combinatorics
- MATH 7325 Statistics I
C. **Core Sequence Courses:** Students will choose at least two of the following courses with the Mathematics Education Ph.D. Advisor's approval. This is a 6 hour requirement.

- 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

D. **Prescribed Mathematics Education Electives:** Each student in the Mathematics Education program will choose 12 hours of Mathematics Education electives. Notice that topics courses may be repeated if topics differ.

- MATH 7188 Seminar in Math Education
- MATH 7378 Topics in Standards
- MATH 7366 Topics in Teaching
- MATH 7386 Independent Study in Mathematics Education
- MATH 7389 Internship

E. **Prescribed Education Electives:** Each student in the Mathematics Education program will choose 3 hours of Education electives from the College of Education. The selection of a course will require approval by the student's dissertation advisor in order to better complement and enhance the student's research interests. Normally, a student will take one of the courses focusing on the theory of learning, although a student with a strong education background and dissertation advisor's approval may select any course in the College of Education. Allowing the students some flexibility to tailor the coursework to their own interests will enhance the experience and allow the student to obtain more in-depth information in one of his or her identified strands.

F. **Free Electives:** Three hours of coursework for the Mathematics Education program are elected from graduate programs at Texas State, but the selection requires approval from the student's dissertation advisor. Possible electives include additional coursework selected from Mathematics Education as well as coursework from the College of Education or from other graduate programs at Texas State. Up to 9 hours of Ph.D. level coursework from other departments at Texas State (for example, Education) may be used to meet elective requirements if approved by the Doctoral Program Committee and the dissertation advisor.

G. **Dissertation:** A student must register for a minimum of 18 hours of Dissertation coursework.

- MATH 7399 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.
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 semester 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.

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 semester 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 semester 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 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 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 count for 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 semester. 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 semester. This course is repeatable for credit.

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 semester. Graded on a credit (CR), no-credit (F) basis.

MATH 7299A 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 semester. Graded on a credit (CR), no-credit (F) basis.

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 the course does not earn graduate degree credit and cannot be used for 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.

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. (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 semester. Graded on a credit (CR), no-credit (F) basis.

MATH 7999A 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 semester. Graded on a credit (CR), no-credit (F) basis.

**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-San Marcos; 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)

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)

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-San Marcos; 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-San Marcos; Ph.D., University of North Texas. (Differential Equations)

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

Singh, Sukhjit, Professor of Mathematics. B.A., Arizona State University; M.A., Ph.D., Pennsylvania State University Main. (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-San Marcos; 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)
Department of Mathematics

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

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 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

Students applying to the Mathematics master’s programs must have a GPA of 2.75 on the last 60 hours of undergraduate course work leading to the baccalaureate degree as well as, a bachelor’s degree in a related field, and must submit a preferred GRE score of 300 (verbal and quantitative combined) in order to be considered for regular admission. If you took the GRE within the last five years and prior to the new examination, the following preferred score will be considered - preferred score of 900 (verbal and quantitative combined).

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 Aid

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 semester. 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 of fractals, projective geometry, Euclidean geometry, and non-Euclidean geometry. Prerequisite: A grade of at least C in MATH 2472.

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.

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.

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.

5599B 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 predictions; 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-San Marcos; 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-San Marcos; 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-San Marcos; 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-San Marcos; 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-San Marcos; 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, 5331, 5339, 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

Regular Admission. Unconditional admission is usually given to students who meet the University’s requirements for regular admission and who have in addition a 3.00 GPA or better on a 4.0 scale for undergraduate upper-division (junior and senior level) physics and whose programs include credit for upper division courses in modern physics, mathematical physics or equivalent, classical mechanics, electromagnetic field theory, and quantum mechanics. Students who meet these expectations, except that the GPA as described above is less than 3.00 but is at least a 2.50 and who have a preferred Graduate Record Examination (GRE) General score of 302 (verbal and quantitative combined) on file in the graduate office when the application is considered, may also be granted unconditional admission. If the GRE was taken within the last five years and prior to the new examination, the following preferred scores will be considered - 1100 (verbal and quantitative combined).
Conditional Admission. Students who meet the above expectations except for credit in coursework for one of the areas specified may be granted conditional admission with the requirement of background course work to make up the deficiency.

Exceptions. Students not meeting the expectations for regular admission or conditional admission stated above but who do meet the University’s requirements for regular admission may petition the department for admission.

Financial Aid

Assistantships are available on a limited basis, and applications should be submitted by June 1. Inquiries and/or applications for assistantships should be mailed to:

Chair, Department of Physics  
Texas State University-San Marcos  
601 University Drive  
San, Marcos, Texas 78666

The Office of the Graduate College can provide information about the availability of graduate scholarships.

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. Justification: 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. Justification: 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 Theoretical Physics. (3-0) A survey of methods in theoretical 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 3312 and 4315.
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 *Advance 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.

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.* (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.

**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.

**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.

Justification: This is a graduate leveling 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.

### Graduate Faculty

**Donnelly, David W.**, Professor and Chair of the Department 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., University of Twente, Enschede, The Netherlands.

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

**Olson, Donald Wallace**, Professor of Physics. B.S., Michigan State University; Ph.D., University of California-Berkeley.

**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**, Assistant Professor of Physics. B.S., University of Athens, Greece, PhD, University of Florida.
Interdisciplinary Studies

Major and Degrees Offered:
Interdisciplinary Studies, M.A.I.S., 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 degrees of Master of Arts in Interdisciplinary Studies (M.A.I.S.) or 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.A.I.S. degree is available through those departments that offer the Master of Arts degree, and 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 students with a GPA of 2.75 on the last 60 hours of undergraduate course work leading to the baccalaureate degree, no GRE is required to be considered for regular admission.

If the student’s GPA is below 2.75 on the last 60 hours of undergraduate course work leading to the baccalaureate degree, the student must submit a GRE score in order to be considered for conditional admission.