College of Science

ETAS, Room 125, (501) 569-3151, (501) 569-8017 (fax), ualr.edu/csam/

Professor Ann Bain, Interim Dean

Professor Thomas J. Lynch, Associate Dean

The College of Science (COS) is the home of instruction and research in the many fields of science, mathematics, health science and nursing. Our goals are to enhance the educational opportunities for undergraduate and graduate students, to enhance science and mathematics education in Arkansas, to expand research opportunities for faculty and students, and to strengthen our many partnerships with schools, corporations and government in order to improve the economic strength of our region.

The College provides coursework for preparation of graduates in mathematics, the sciences, health sciences, and nursing. The objectives of COS for our majors are to provide content, attitudes, and skills necessary for careers in science, mathematics, and health science needed to meet the highly technical demands of today's society. Within our graduate programs, we provide advanced training for persons who expect to pursue a career in one of these fields. In addition, many courses within COS are necessary to meet general education requirements and for certain other majors throughout the University.

Program	Certificate or Degree Program	Department
Applied Sciences	Master's (M.S.)	Applied Sciences
Applied Sciences	Doctorate (Ph.D.)	Applied Sciences
Applied Statistics	Graduate Certificate	Mathematics and Statistics
Biology	Master's (M.A.)	Biology
Biology	Master's (M.S.)	Biology
Chemistry	Master's (M.A.)	Chemistry
Chemistry	Master's (M.S.)	Chemistry
Geospatial Technology	Graduate Certificate	Earth Sciences
Health, Human Performance and Sport Management	Master's (M.S.)	Health, Human Performance and Sport Management
Integrated Sciences & Mathematics	Master's (M.S.)	College of Science
Mathematical Sciences	Master's (M.S.)	Mathematics and Statistics

ETAS, Room 575
(501) 569-8009

Applied Science

The Applied Sciences graduate programs are housed in the Department of Applied Science, an interdisciplinary, graduate-only department. The programs offer applied research in a broad set of emphasis areas, including applied chemistry, applied biosciences, applied physics, materials, nanotechnology, computational science, applied mathematics, geophysics, and environmental science.

The applied sciences department offers two degrees, the Doctor of Philosophy and the Master of Science. Each degree has several emphases. Faculty housed in other departments in both the College of Science (COS) and the Donaghey College of Engineering and Information Technology (EIT) participate in the emphasis tracks. For more information and access to the online application process, visit the Department of Applied Science website at ualr.edu/appliedscience.

Master of Science in Applied Sciences

The Master of Science degree is an interdisciplinary program designed to advance a student's knowledge beyond the baccalaureate degree and to teach the student how to approach a research project. This student may either pursue a generic degree in applied sciences, or with sufficient specialized course work, may earn a master's degree in applied physics.

The degree is designed for students with a wide variety of research and/or curricular interests in science and engineering. The thesis option includes a proposal defense and a thesis defense, and provides an opportunity to the student to carry out thesis based research. The non-thesis option includes a comprehensive exam and a project. The student choosing the non-thesis option will have three different alternatives to satisfy the comprehensive exam and project requirement. These alternatives are intended to cater to students who (1) are in the Applied sciences (ASCI) Ph.D. program and want to acquire the ASCI M.S. degree since they satisfy a majority of the cognate requirements, (2) want to complete some of the requirements of the ASCI Ph.D. as a precursor to applying for admission to the Ph.D. program, (3) want to complete a predominately course based Master's degree. The details of the programs are given below.

Admissions Requirements

Applicants must possess a baccalaureate degree in an appropriate scientific discipline, such as chemistry, physics, biology, material science, mathematics, statistics, or earth science. They must have an overall undergraduate GPA of 3.0. Applicants must have a minimum quantitative score 151 and verbal score of at least 138 on the GRE, (or combined 1,000 in the older GRE scoring system with a minimum score of 650 on the quantitative portion) and a minimum score on the writing assessment of a 4.0. Applicants must possess the requisites for their intended area of study. With the approval of the Graduate Coordinator, applicants with a 3.5 GPA or greater on their last 60 hours of graduate and undergraduate credit hours may not be required to take the GRE.

In certain cases, students not meeting these requirements may be admitted on a conditional bases. The conditional student must maintain a minimum GPA of a 3.0 at least nine COS or EIT graduate credits in the first year of study to be fully admitted. Recommendations on a graduate application for admission to the Applied Science's Master of Science program are made with the collective input of the Department of Applied Science faculty. Satisfying minimum requirements for admission by itself does not guarantee admission. Other factors that could be involved include but are not limited to the availability of funding and appropriate faculty mentors.

International Students

In certain cases, students not meeting these requirements may be admitted on a conditional bases. The conditional student must maintain a minimum GPA of a 3.0 at least nine COS or EIT graduate credits in the first year of study to be fully admitted. Recommendations on a graduate application for admission to the Applied Science's Master of Science program are made with the collective input of the Department of Applied Science faculty. Satisfying minimum requirements for admission by itself does not guarantee admission. Other factors that could be involved include but are not limited to the availability of funding and appropriate faculty mentors.

Program Requirements

Course Work

The Master of Science degree requires a minimum of 30 credit hours beyond the baccalaureate degree. The student's plan of study must be developed in conjunction with the Thesis Advisor/Project Instructor and Students Advisory Committee.

If a student receives one C in his/her course work, he/she will be warned that his/her academic performance is unacceptable and that his/her status will be reviewed by the Applied Science faculty, which will suggest corrective action. A student receiving two Cs or either a D or an F in his/her course work will be dismissed from the program, pending review by the Applied Science faculty.

Emphasis in Applied Physics

To earn an emphasis in applied physics, students must take at least nine credit hours from recognized physics courses in either the Applied Science Department or the Physics Department.

Transfer of Credit

A maximum of six credit hours may be transferred from an accredited graduate program. The graduate coordinator will determine applicability of the transfer.

Student Advisory Committee

The Student Advisory Committee will be composed of four members, including the committee chair, who will be the Thesis Advisor/Project Instructor. The chair and two of the three members must be faculty members from COS. The at-large member can be any other UALR graduate faculty or Applied sciences adjunct faculty. The Applied sciences faculty must approve the committee constituency.

Thesis Option

The thesis subject is selected by the student and the Student Advisory Committee at least one year prior to the oral defense. The written thesis format must follow the UALR Graduate School Dissertation and Thesis Guide found on the Graduate School Website.

Thesis Proposal

At least one year prior to the thesis defense, the candidate must present a proposal for his/her thesis work to the advisory committee.

Thesis Defense

Students will present and orally defend their completed master's research before their advisory committees. The defenses will be open to the public and must be announced at least two weeks in advance.

Non-Thesis Option

Comprehensive Exams

After the candidate has completed eighteen credit hours of graded course work, the candidate may attempt the Comprehensive Exams. The comprehensive exam requirement may be passed in no more than two attempts.

The second attempt has to be in the semester immediately following the semester in which the first attempt was made. The student may opt for either of the two options listed below to satisfy the comprehensive exam requirement, but must get prior written approval from their student advisory committee for their choice. These options are:

1. The student may take an oral exam administered by his/her student advisory committee; or
2. The student may take the Doctoral Candidacy Exams. If a student chooses this option, he/she must pass the exams in the three candidacy subjects within the same emphasis area. The student may test only in those candidacy subjects, which he/she has taken as part of the eighteen credit hours of graded course work mentioned above. The Doctoral Candidacy Exam rules will be invoked to determine whether the student has passed or failed.

Project Presentation and Report

The student must complete a project, by means of six credits of Independent Study (ASCI 7X*() with the Project Instructor as the instructor of record. Prior to undertaking the Independent Study courses, the student must present a project plan to the Student Advisory Committee. Upon completion of the Independent Study courses, the student must orally present his/her work to the Student Advisory Committee, and deliver a written project report, in the format specified by the Project Instructor, to the Student Advisory Committee for approval, for which at least two-thirds of the committee members will have to vote in favor of that outcome.

Successful defense of the doctoral proposal and acceptance of a peer-reviewed written document on some completed portion of a project, such as a conference paper or a journal article, with the student as the primary or corresponding author, may serve in lieu of the project presentation and report, with prior written approval from the student advisory committee.

Credit Requirements

The Master of Science degree requires a minimum of 30 credit hours beyond the baccalaureate degree.

Course Credits

A minimum of 18 credit hours in 5000 or 7000 level graded courses within COS or EIT must be taken. A grade of B or greater must be obtained in each course to count towards the minimum course requirement. A maximum of six credit hours of independent study (ASCI 7X89) or special topics (5399, 7399) may be applied to the Master of Science with the following exceptions. Those students who are required to use six hours of independent study (ASCI 7X89) to complete a project under the non-thesis option may apply three additional credits of independent study (ASCI 7389) or special topics (5399, 7399) to the Master of Science.

Thesis/Dissertation or Project Credits

Either a minimum of twelve credit hours of master's thesis (ASCI 8X00) or a minimum of twelve credits of research/dissertation (ASCI 9X00) or a minimum of six credits of independent study (ASCI 7X89) are required.

Graduation Requirements

- Successful completion of an approved program of study with a minimum GPA of 3.0
- Successful completion of the writing requirements

Thesis Option

- Successful completion of Thesis proposal
- Successful completion of Thesis defense
- Submission of an acceptable thesis to Graduate School

Non-Thesis Option

- Successful completion of Comprehensive Exam
- Successful completion of Project Presentation and Report

Requirement	M.S. (Thesis Option)	M.S. Non-Thesis Option Alternative 1	M.S. Non-Thesis Option Alternative 2	M.S. Non-Thesis Option Alternative 3
Typical Student Audience	This option is intended for those who want to complete a thesis-based research at the Master's level	This alternative is intended for those students who are in the ASCI Ph.D. program and want to acquire the ASCI M.S. degree since they satisfy a majority of the cognate requirements.	This alternative is intended for those Master's students who want to complete some of the requirements of the ASCI Ph.D. program as a precursor to applying for admission to the Ph.D. program.	This alternative is intended for those who want to complete a predominantly course-based Master's degree.

Requirement	M.S. (Thesis Option)	M.S. Non-Thesis Option Alternative 1	M.S. Non-Thesis Option Alternative 2	M.S. Non-Thesis Option Alternative 3
Minimum Graded Course Credits	18 credits A maximum of six independent study (ASCI 7X89) and/or special topics course (5399, 7399) may be applied towards the M.S. requirement.	18 credits-A maximum of six independent study (ASCI 7X89) and/or special topics (5399, 7399) may be applied towards the M.S. requirement.	18 credits-A maximum of three independent study (ASCI 7X89) or special topics (5399, 7399) in addition to the six credits of independent study (ASCI 7X89) credits required for project (see second row and last row) may be applied towards the M.S. requirement.	18 credits-A maximum of three independent study (ASCI 7X89) or special topics credits (5399, 7399) in addition to the six credits of independent study (ASCI 7X89) credits required for project (see second row and last row) may be applied towards the M.S. requirement.
Thesis/Dissertation or Project Credits	12 Master's credits (ASCI 8X00)	12 Doctoral credits (9X00)	Six credits of independent study (ASCI 7X89) for project (see below)	Six credits of independent study (ASCI 7X89) for project (see below)
Thesis Proposal and Defense	Required	Not applicable	Not applicable	Not applicable
Comprehensive Exam	Not applicable	Must pass three candidacy subjects in doctoral candidacy exam	Must pass three candidacy subjects in doctoral candidacy exam	Oral exam administered by student's advisory committee
Project Presentation and Report	Not applicable	1. Successful defense of the doctoral proposal. 2. Published conference paper or journal; student as primary or corresponding author.	Complete project by means of six credits of independent study (ASCI 7X89), make project presentation and submit report.	Complete project by means of six credits of independent study (ASCI 7X89), make project presentation and submit report.

Doctor of Philosophy in Applied Sciences

Faculty participating in the doctoral program is drawn mainly from the Departments of Applied Science, Biology, Chemistry, Earth Science, Mathematics and Statistics, and Physics and Astronomy.

The Doctor of Philosophy in Applied Science is awarded upon completion of a program of advanced study including a significant original dissertation in applied research or design. Work accomplished without the supervision of an Applied Sciences doctoral faculty member will not be accepted in lieu of the dissertation requirements. The research must be relevant to the emphasis area in which the student is pursuing a degree.

All emphases have similar program requirements. Each emphasis has its own candidacy exams, seminar requirement, and specific course requirements, which are described under the Program Requirements for the Doctor of Philosophy.

The following emphasis areas are offered:

Applied Biosciences

The applied biosciences emphasis is a research-oriented academic course of study that encompasses the broad fields of biotechnology and applied biological sciences. Research areas include molecular and cellular biology, phylogeny, evolutionary ecology, genomics, and bioinformatics. ASCI 7192 Biosciences and Bioinformatics Seminar is required each semester the student is enrolled.

Applied Chemistry

The Ph.D. emphasis in applied chemistry provides advanced preparation for careers in government, industrial, and academic research. The curriculum is a blend of traditional and non-traditional, innovative courses that reflect the needs of modern chemistry. The UALR Departments of Chemistry and Applied Science have research-quality instrumentation and computer facilities, give individual attention to each student, and offer high-quality instruction.

Applied Physics

The applied physics doctoral emphasis is designed to prepare students in cutting-edge research areas in Applied Physics, Materials, Earth Sciences, Astronomy, and Astrophysics that include advanced materials, nanotechnology, photovoltaic devices, applied geophysics, seismology, dark matter and galaxies.

Computational Science

The computational science emphasis applies to mathematical modeling, simulation and visualization, and high performance computing to specific scientific discipline. Admission to the Computational Science Emphasis areas require knowledge of discrete mathematics, differential and integrated calculus for single and multi-variable functions, linear algebra, differential equations, mathematical statistics, and knowledge of programming through data structures.

Graduate Assistantships

Graduate assistantships that support teaching and research opportunities are available to qualified full time students. Tuition is paid for 9 credits, and a stipend is provided for living expenses. Students must pay registration fees, buy textbooks, and purchase any necessary support materials. For more information about graduate assistantships, the online application process, and other financial assistance opportunities, visit the Applied sciences website at ualr.edu/appliedscience/. A student supported by a graduate assistantship shall be registered as a full-time student.

Admission Requirements

Applicants must possess a baccalaureate degree in an appropriate scientific discipline such as chemistry, physics, materials science, biology, mathematics, statistics, or earth science. They must have a minimum overall GPA of 3.0 in the graduate and undergraduate credit hours. Applicants must have a minimum quantitative score 155 and verbal score of at least 138 on the GRE (or combined 1,000 in the older GRE scoring system with a minimum score of 700 on the quantitative portion) and a minimum score on the writing assessment of 4.5. Applicants must possess the prerequisites for their intended areas of study. With the approval of the Graduate Coordinator, applicants with a 3.5 GPA or greater on their last 60 of graduate and undergraduate credit hours, may not be required to take the GRE.

Recommendations on a doctoral application for admission to the Applied Science program are made with the collective input of the Applied Science Doctoral faculty. Satisfying minimum requirements for admission by itself does not guarantee admission. Factors that could be involved include, but are not limited to, availability of faculty mentors and financial support in cases where such support is sought by an applicant.

In certain cases, students not meeting these requirements may be admitted on a conditional basis. The conditional student must maintain a minimum GPA of 3.0 in at least 9 COS or EIT graduate credits in the first year of study to be fully admitted.

International Students

International students whose native language is not English and who do not have a degree from a regionally accredited U.S. institution of higher education must also submit a score of at least 79 on internet based Test of English as a Foreign Language (TOEFL) exam or 550 on the paper based or 213 on the computer-based versions. In order to qualify for a teaching assistantship, students whose native language is not English must score a 5.0 on the Test of Spoken English (TSE).

Writing Requirement

An English Writing Proficiency Exam (WPE) will be offered each Spring term by the Department of Applied Science. This exam will assess the student's ability to communicate in a written format. Each student must pass this exam to fulfill graduation requirements. A student who does not pass the WPE is required to take English Writing Proficiency Laboratory (EWPL). The EWPL is offered each Spring term. The student must take the EWPL each Spring term until they pass.

Seminar and Research Ethic Course Requirement

All Ph.D. students are required to register for the Applied Sciences Seminar (ASCI 7190) each semester of residency. Students in the Applied Biosciences emphasis area may choose to register for Applied Bioscience Seminar (ASCI 7192) instead of ASCI 7190.

All Applied Science doctoral students are required to register for and successfully complete the Research Ethics course (ASCI 7118), for any one semester prior to graduating from the program. A student registered for Research Ethics course can be exempt to register for Applied Science Seminar or Applied Bioscience Seminar for that semester upon the approval of Graduate Coordinator.

A maximum of 1-credit of seminar (or Research Ethics) hour per semester can be counted towards the credit requirements of Applied Science PhD.

Laboratory Rotations

All Applied Science doctoral students must register for Introduction to Research in Applied Science (ASCI 7x45), or so called "Laboratory Rotation" in their first semester in the program, and receive a "satisfactory" grade at the end of the rotation. Rotations can be performed with any Applied Science Doctoral Faculty member. Students can receive from one to three credit hours for their rotations by registering for ASCI 7145, 7245, or 7345. At the end of the rotation, the student and the rotation host should meet and discuss progress of the rotation. The student should present the results, either orally or in the form of a written report, to the rotation host. Student also needs to submit a written report to the coordinator of laboratory rotation. If the student has not selected his/her dissertation advisor after the first semester of rotations, the student will be required to register again for ASCI 7x45. Failure to perform adequately in the laboratory rotation may result in termination of state assistantship funding.

A maximum of 2-credits of Laboratory Rotation can be counted towards the credit requirements of Applied Science PhD.

Doctor of Philosophy Graded Program Requirements

All emphases require a minimum of 72 credit hours beyond the baccalaureate degree. Specific requirements depend on the emphasis area chosen and are detailed in those sections. A minimum of eighteen (18) credit hours of course-work is required from 5000 and 7000 level courses in COS and EIT. The student's plan of study must be developed in conjunction with his/her doctoral advisor and advisory committee. The Introduction to Research course, ASCI 7145, ASCI 7245, or ASCI 7345, must be taken, and a grade of "credit" must be obtained.

A minimum of 42 credit hours in the 9000-level doctoral research/dissertation is required. The research must be substantial and must extend the state of the art in the student's chosen field through theoretical development, design or process improvement, or experimental technique.

If a student receives one C in his/her course work, he/she will be warned that his/her academic performance is unacceptable and that his/her status will be reviewed by the Doctoral Affairs Committee, which will suggest corrective action. A student receiving two Cs or either a D or an F in his/her course work will be dismissed from the program, pending review by the Doctoral Affairs Committee.

Transfer of Credit

A maximum of six credit hours may be transferred from an accredited graduate program. Transferability of credit is determined by the student's advisory committee based upon the applicability of the course to dissertation work and the students educational goals.

Candidacy Exam

The purpose of the candidacy examination is to determine whether the applicant possesses the attributes of a doctoral candidate. The candidacy exam will be held twice a year after the start of Fall and Spring classes. The candidacy exam is a comprehensive, written test composed of four subject tests, each of which must be passed. The student will be tested on topics selected from the candidacy subject list in his/her emphasis area. The student may attempt the candidacy exam a maximum of two times and must attempt it in consecutive semesters. A student who has not passed all exams after the second offering will be dismissed from the program.

Students must attempt the exam no sooner than the beginning of the second semester in the program. A student must take the exam at the next opportunity after completion of the core in his/her area and, in any event, no later than the beginning of his/her fifth semester in the program. A minimum GPA of 3.0 in graduate course work is required to take the examination.

Candidacy Subjects

Applied Biosciences	Applied Physics
• Organism Functions • Cellular Function • Genetics • Biochemistry and Molecular Biology • Biological Modeling and Analysis • Ecological Interaction • Discipline Specific Applications	• Mechanics • Electricity and Magnetism • Quantum Mechanics • Statistical Thermodynamics • Elastic Wave Theory • Potential Theory • Material Physics • Astrophysics • Discipline Specific Applications
Applied Chemistry	**Computational Science**
• Analytical Chemistry • Inorganic Chemistry • Organic Chemistry • Physical Chemistry • Discipline Specific Applications	• High Performance Computing • Applied Mathematics • Modeling and Visualization • Discipline Specific Applications

Doctoral Advisor

A student's dissertation advisor must be a Doctoral Faculty (approved by Doctoral Affairs Committee, DAC) participating in the Applied Science graduate program. Those students who do not have a Doctoral Advisor by the end of the third semester may be dismissed. Changing Doctoral Advisors after this point is possible, and sometimes advisable, but it usually slows a student's completion of degree requirements. Therefore, this decision should be approached carefully.

Doctoral Advisory Committee

The student's doctoral advisory committee will be composed of five members, including the student's doctoral advisor who will serve as the committee chair. Four of the five members including the chair must be Applied Science doctoral faculty members. The at-large member(s) may be any other person who has graduate faculty status at UALR. This also includes full-time research faculty with graduate faculty status. However, postdoctoral researchers cannot serve in dissertation committees. The Doctoral Affairs Committee (DAC) must approve the committee constituency. When student proposes his/her dissertation committee to DAC, he/she also needs to provide a brief written justification explaining the role of each member in contribution to student's dissertation research. Students are encouraged to form their advisory committee with a majority of faculty members from student's respective emphasis area. Dissertation committees cannot be changed after the proposal defense unless the student has a compelling or extraordinary reason (e.g. leave or retirement of a committee member).

The dissertation subject is selected by the student and the advisory committee at least two years prior to the oral defense of the research. It must be a scholarly contribution to a major field of applied sciences in the student's emphasis area. The written dissertation format must follow the UALR Graduate School Dissertation and Thesis Guide found on the Graduate School website.

Dissertation Proposal

At least two years prior to the dissertation defense, candidate must present a written proposal in either a National Institutes of Health (NIH) or National Science Foundation (NSF) grant proposal format for his/her dissertation work to the advisory committee. The written proposal should be given to the advisory committee at least two weeks in advance of meeting with the committee.

Dissertation Defense

Students will orally defend their dissertation research before their advisory committee. Dissertation should be given to the advisory committee at least two weeks in advance of meeting with the committee. The defense will be open to the public and must be announced at least two weeks in advance.

Summary of Graduation Requirements

- Successful completion of minimum credit requirements
- Successful completion of an approved program of study with a minimum GPA of 3.0
- Successful completion of candidacy examinations
- Successful completion of proposal and oral defense
- Successful completion of dissertation and oral defense
- Successful completion of the writing, research ethics course, laboratory rotation, and seminar requirements

Courses Used in Applied Sciences Emphases

A list of courses in applied science (ASCI) with descriptions is provided on the following pages. Additional courses offered outside the Department of Applied Science are found in the "Master of Science in Biology," the "Master of Science and Master of Arts in Chemistry," the "Master of Science in Computer Science," the "Master of Science in Information Quality," and the "Non-program Courses" sections in this Catalog.

Students admitted to the UALR Graduate School but not the applied sciences program must have the instructor's consent to take any applied sciences (ASCI) course.

Courses in Applied Science

ASCI 5310 Introduction to Signal Processing

Prerequisite: MATH 3322 or equivalent. Introduction to the fundamental concepts in signal processing. Use of the fundamental transform techniques (Laplace transform, discrete Fourier transform, z-transform). Discrete time representation of signals, linear time invariant systems. Correlation, coherence, and time delays. Standard system models (ARMA, ARMAX). FIR and IIR filters. Three hours lecture. Three credit hours.

ASCI 5315 Advanced Dynamics I

Prerequisite: MATH 2453. Kinematics of translating and rotating vectors. Dynamics of systems of particles and rigid bodies. Angular momentum. Newtonian mechanics. Lagrangian mechanics. Examples drawn from the fields of robotics, vehicle motion, and planetary motion. Three hours lecture. Three credit hours.

ASCI 5355 Elastic Wave Theory

Prerequisites: MATH 1451, MATH 1452, MATH 2453 and MATH 3322. Elasticity theory developed as a basic necessity to the theory of seismology. Analysis of stress and infinitesimal strain. Perfect elasticity. Equation of motion in term of displacement. Vibration and waves. Theories of body and surface waves. Ray theory and energy partition.

ASCI 5360 Potential Theory

Prerequisites: MATH 1451, MATH 1452, MATH 2453 and MATH 3322. Solution to Laplace's equation using different boundary and initial conditions. One-, Two- and three-dimensional equations will be analyzed. Various coordinate system (rectangular, cylindrical and spherical) will be used in the solution of the Laplace function, the Associate Legendre function and othogonality of the Legendre function.

ASCI 7145, 7245, 7345 Introduction to Research in Applied Science

First semester orientation course to allow new students in the applied science doctoral program to work in a number of faculty research areas. This course will aid the student in the selection of his/her doctoral research director. Variable credit of one to three hours. Offered on demand.

ASCI 7118 Research Ethics in Science and Eng.

The course uses a case-based method to cover various topics related to professional research ethics. It is intended for entering science and engineering graduate students in the Donaghey College of Engineering and Information Technology (DCEIT). The purpose of the course is to familiarize students with professional ethics related to research and to prepare them to deal with typical ethical situations that may occur in the course of their graduate studies and professional careers.

ASCI 7189, 7289, 7389. Research in Instrumentation

Design, research in basic, applied instrumentation; requires laboratory research project involving instrumentation characterization or development. F,S

ASCI 7190 Applied Science Seminar

Prerequisites: graduate standing, consent of thesis advisor and graduate coordinator. Students, faculty, and invited speakers will present, discuss, and exchange ideas on research topics of general interest. Credit must be received at least one semester before enrollment in the last research semester. One hour session per week. Course may not be repeated for credit. Graded credit-no credit.

ASCI 7191,7291, 7391. Cooperative Education in Applied Science

Prerequisite: full time attendance for one semester in the applied science program with a GPA of 3.00 or better and the approval of the major professor and the graduate coordinator. Complements the classroom experience by allowing the student to apply the concepts of instrumentation in the work place. Minimum of one 10 week summer term. Written report, minimum of 200 hours work per credit hour are required. The exact number of hours, and the nature and responsibilities of the work will be specified in writing by the student, the sponsoring faculty member, and the employer. The course may be repeated for credit. The course cannot be used for credit toward the requirements for an applied science degree.

ASCI 7192 Biosciences and Bioinformatics Seminar

Prerequisites: graduate standing, consent of thesis advisor and graduate coordinator. Students, faculty, and invited speakers will present, discuss and exchange ideas on research topics of general interest in the field of Biotechnology. One-hour session per week. Course may be repeated for credit. Graded: credit/ no credit. Cross-listed with BINF 7192.

ASCI 7295 Practical Topics in Science Management

A survey of practical topics relevant to practicing scientist and engineers such as ethics, project management, and grant writing. While an emphasis is placed on bioinformatics, topics will be if interest to all participating in science and engineering projects. Two credit hours. Cross-listed with BINF 7295.

ASCI 7307 Smart Materials

Prerequisite: ASCI 4320 or equivalent. This course will deal with the unique nonlinear, hysteretic response of smart materials that arise due to coupling between mechanical and thermal or electric or magnetic fields. Specifically, microstructural characteristics and constitutive modeling of shape memory alloys, ferroelectric materials and ferromagnetic materials will be covered. Use of these smart materials in sensor and actuator design will be addressed.

ASCI 7318 Micro- and Nano-Fabrication

Pre-requisites: Consent of instructor. This course will introduce some of the important micro- and nano-fabrication techniques that are mostly used in the areas of microelectronics and nanotechnology. Some of the topics that will be covered include diffusion of impurities, thermal oxidation, ion implantation, optical lithography, thin film deposition, etching, nano-lithography, nano-imprinting, growth of nano-rods and nano-springs by glancing angle deposition, and growth of carbon nano-tubes. During the course, students will become familiar with some of the basic experiments including thin film and glancing angle depositions, etching, and film characterization techniques. The course is intended for graduate students from science and engineering majors.

ASCI 7317 Nano-structural Materials: Physical and Chemical Properties

Prerequisites: SYEN 3372 or PHYS 4340 or CHEM 4340 or equivalent. This course introduces students to the area of nanotechnology and the novel properties of the materials built at the nanoscale. The course will cover the main properties of nano-materials, various methods for synthesis and characterization and the most up-to-date applications from nano-electronics, advanced materials, bio-medicine, etc. The course is designed for graduate students with a background in chemistry, physics, and engineering.

ASCI 7340 Applied Instrumental Optics

Fundamental concepts in design and implementation of optical principles in analytical instrumentation; solving optics engineering problems; includes electromagnetic wave analysis, reflection and refraction, interference and diffraction, optical waveguides, Fourier analysis, coherence and holography. On demand.

ASCI 7341 Electro-Optics Instrumentation

Prerequisite: Applied Science 7340 or equivalent. Physical principles and operating characteristics of electro-optical devices and systems; gas, chemical, solid state and semiconductor lasers; Gaussian beam optics, laser modulators and scanners; imaging devices; thermal and photon detectors; fiber and integrated optics; nonlinear optical devices. Offered on demand.

ASCI 7344 Plant Hormonal Biology

This class will provide fundamental knowledge about major classes of phytohormones (auxins ABA, ethylene, gibberellins, cytokinins) as well as new plant hornones such a brassinosteroid strigolactones jasmonates. The structure and function ofthe all classes of plant hormones will be discussed in some detail and the interactions and crosstalks between different phytohormones will be highlighted. pecial attention will be given to regulation of biosynthesis of phytohormones for biotechnolooical applications and agriculture.

ASCI 7355 Introduction to Geophysics

Prerequisite: MATH 1451. Application of geology and geophysics to study the interior of the earth and the development of its surface features.

ASCI 7365 Advanced Seismology

Prerequisite: MATH 3322. Analysis of seismic waves in a uniform medium from a pressure pulse in a spherical cavity. Solution to Sharpe's problem using Laplace Transform. Wave propagation from sources in layered medium of different physical conditions. Numerical integration of equation of motion. Seismometry. Foca mechanism and source characteristics. Internal structure of the earth. Nuclear testing and other explosions. Offered in spring.

ASCI 7375 Biochemistry of Biological Molecules

Prerequisites: introductory biochemistry course or permission of the instructor. Three, five-week modules providing a critical introduction into the structure and biological functions of nucleic acids, proteins and membranes. Topics in the first section, nucleic acids, include structure-function relationships among DNA, RNA, and proteins during replication, transcription and translation. Topics in the second section, proteins, include the principles of protein folding, function, purification and enzyme kinetics. Topics in the third section, membranes, include mobility of membrane constituents, properties of membrane proteins, mechanisms of membrane transport, membrane synthesis and flow, secretion, receptors and signal transduction.

ASCI 7380 Biomedical Instrumentation

Principles of biomedical instrumentation; special constraints in safety, signal transduction, signal-to-noise ratio; special problems in medical instrument design; includes Food and Drug Administration regulations, electrical processing, data acquisition; medical instrument design case studies; emphasis on theory, common difficulties, present research directions of bio-instrumentation design; requires laboratory assignments, major laboratory project. Three hours lecture. Three credit hours. Offered on demand.

ASCI 7381 Physiological Measurement Techniques

Principles, physiology, physics, instrumentation of modern physiological measurements; includes measurements of electrocardiogram, pulmonary function, metabolic rate, blood flow, human performance; ultrasonic imaging, stress tests, impedance cardiology; emphasis on theory of each technique's measurement difficulties, present research directions; requires proposal of a technique that overcomes some disadvantages of existing methods. Three hours lecture. Three credit hours. Offered on demand.

ASCI 7385 Concepts in Genetic Analysis

Prerequisites: introductory undergraduate genetics or molecular biology course. Methods of genetic analysis including mutant isolation, genetic and physical mapping, receptors genetics, evolutionary mechanisms, molecular variation and genomic evolution.

ASCI 7399 Special Topics in Applied Science

Detailed study in applied science and related areas; may be lecture or lecture and laboratory, depending on specific topics. Variable credit of one to three hours. Offered on demand.

ASCI 7405 Principles of Analytical Instrumentation

Modern analytical instrumentation; physical, chemical basis for measurements; basic signal processing; basic optics; includes specific instrumentation, methods for ultraviolet-visible and infrared spectrophotometry, atomic and mass spectroscopy, nuclear magnetic resonance, x-ray methods, analytical separations.

ASCI 7451 Introduction to Air Contamination Evaluation

Generation, propagation, measurement, evaluation of air contaminants (including aerosols, gases, vapors); principles of sample collection and analysis, direct measurement, statistical analysis and interpretation of results; applications include monitoring and modeling of industrial, community, transportation, indoor environments and sources.

ASCI 8100 - 8600 Master's Thesis

Prerequisites: consent of advisor.

ASCI 9100 - 9600 Doctoral Research/Dissertation

Prerequisites: consent of advisor. One to nine credit hours to be determined at the time of registration.

ASCI 9700 - 9900 Doctoral Research/Dissertation

Prerequisites: consent of advisor. One to nine credit hours to be determined at the time of registration.

Applied Statistics

Graduate Certificate in Applied Statistics

Program requirements for the Graduate Certificate in Applied Statistics Program (15 hours)

Core Courses (9 hours)

STAT 7340 Advanced Statistical Methods I

STAT 7341 Advanced Statistical Methods II

STAT 7342 Introduction to SAS

Elective Courses (6 hours)

Students must take 6 hours at the 5000-level or above. Courses must be related to statistics or directly support statistics. Elective courses can also be statistic courses from a specific discipline offered by other departments. The director of the program must approve elective courses for credit toward the Graduate Certificate in Applied Statistics.

Students who finish the Graduate Certificate in Applied Statistics and chose to get a Master of Science in Mathematical Sciences with an emphasis in Applied Statistics can transfer the 15 hours toward the Master 's degree program.

Courses in Statistics

STAT 7340 Advanced Statistical Methods I

Prerequisite: A grade of C or greater in MATH 1451 and STAT 3352 or equivalent. This course is designed to cover the more common advanced statistical concepts and methods. Probability theory, collecting data, sampling, inference, interval estimation, tests of hypotheses for single mean, two means, proportions, and the use of computer packages.

STAT 7341 Advanced Statistical Methods II

Prerequisite: A grade of B or greater in STAT 7340. This course is designed to cover the more common and advanced statistical concepts and methods. Simple linear regression, multiple linear regression, ANOVA of single factor experiments, ANOVA of multi-factor experiments, non-parametric methods, categorical data analysis, Bayesian decision theory and methods, and the use of computer packages.

STAT 7342 Introduction to SAS

This course is designed to introduce students in all disciplines to conducting data analyses and managing data using the SAS system and SAS programming language. The basics of the SAS language and SAS data sets, reading SAS logs, viewing and printing output, inputting data into SAS, manipulating data and creating new variables using SAS procedures, generating descriptive statistics and frequency distributions using SAS Insight. Performing hypothesise tests and constructing confidence intervals, building categorical models, building and interpreting simple and multiple linear regression models, constructing ANOVA models using SAS procedures and Analyst.

STAT 7343 Programming in SAS

Prerequisite: A grade of B or greater in STAT 7342. This course is designed to introduce students in all disciplines to conducting a deep SAS programming on topics in statistical simulation and computation using the SAS system and SAS programming language. Pseudo-random-variate generation, optimization, Monte Carlo simulation, Bootstrap, and Jackknife methods.

Biology

Fribourgh Hall, Room 406
(501) 569-3470

Master of Science/ Master of Arts in Biology

The Department of Biology offers a Masters degree with two possible tracks: the thesis option leading to the MS and the nonthesis/coursework option leading to the MA. This program is designed to serve a wide variety of post-baccalaureate educational needs in central Arkansas and serves students with diverse backgrounds and goals. The program provides students with core skills desired by potential and current employers, specific knowledge and techniques relevant to specialized fields within biology, and the opportunity to work independently on a thesis or suite of coursework suitable to each student's aspirations.

The Department of Biology is composed of faculty with access to excellent laboratory and computer facilities. The Department holds affiliations with the University of Arkansas for Medical Sciences and the Gulf Coast Research Laboratory in Biloxi, Mississippi, which expand student's opportunities for study. For more information, visit the program's website at ualr.edu/biology.

Admissions Requirements

Students applying to the Master of Science/Master of Arts program in biology should meet all the requirements for admission to the UALR Graduate School. In addition, the following requirements should be met:

- Baccalaureate degree in an appropriate biological discipline with a minimum GPA of 3.0 on a 4.0 scale
- Upper- level course work in four of the following six areas:
  1. Cell or molecular biology
  2. Ecology
  3. Evolution
  4. Genetics
  5. Physiology or
  6. Organismal biology
- Two, lecture courses in physics and four, lecture courses in chemistry, including inorganic and organic chemistry.
- Combined scores of 300 on the verbal and quantitative sections of the GRE general section.
- GRE tests must have been taken within the last five years.
- International students must present TOEFL scores. Minimum scores for acceptance are 525 on the paper-based test or 195 on the computer-based version, or 72 on the IBT version.

Applicants who do not meet the minimum entrance requirements may be admitted conditionally. In these cases, full admission is contingent upon successful completion of courses to remove any undergraduate deficiencies and completion of 12 graduate credits with a GPA of 3.0 or above.

Application Procedures

Applications for Fall semester entry are due by April 15 and Spring semester entry applications are due by November 1. Application materials include:

- Completed UALR Graduate School application form;
- Formal letter of application written by the applicant, including a personal statement of career interests and objectives;
- Official college transcripts;
- GRE scores; and
- Three letters of recommendation from persons well acquainted with the applicant. Letters from former faculty are expected. Students applying to the thesis track are encouraged to obtain a letter of support from a faculty advisor.

Financial Aid

Graduate assistantships are available to students pursuing the thesis track. These assistantships support teaching and research activities and are available to qualified full-time students. Tuition is paid, and a stipend is provided for living expenses. Financial support is available only to those students making satisfactory progress toward their degree. Students who begin the thesis option and take one or more thesis hours but later elect to switch to the non-thesis (MA) track will not be eligible for financial support. Students must pay registration fees, buy textbooks, and purchase any necessary support materials. To learn about the availability of these assistantships, contact a faculty member in your area of interest or the graduate program coordinator before you plan to apply for admission.

Core Courses

Students will complete the following 13 credit hours:

BIOL 5415 Biometry
BIOL 7310 Experimental Design
RHET 5302, 5304, 5306, 5315, or 5317 Technical/Scientific Writing (These courses will not be required if the student obtains a suitable score on writing proficiency examination in place for the Applied Science PhD program)
BIOL 7191 Graduate Seminar (3 semesters)

Thesis (MS) Option Courses

This option includes the core curriculum and 17 additional hours consisting of 11 credit: hours of course work, including at least 3 credit hours at the 7000 level or above and 6 thesis research hours.

Course Work (MA) Option Courses

This option includes the core curriculum and 23 additional hours, including at least 9 credit hours at the 7000 level or above. Students may not receive credit for thesis research hours under this option.

Cell and Molecular Biology Track

This track is designed to complement the PhD in Applied Sciences (Applied Biosciences). Admissions requirements remain the same as those already existing for the biology MS/MA. Writing skills must be demonstrated either through a graduate technical writing course (see existing core) or through the writing proficiency requirements in place for the Applied Science PhD program. An English Writing Proficiency Exam (WPE) will be offered to all thesis track students each Fall term by the Applied Science Department. Students who select the cell and molecular biology track have two options:

Thesis (MS) Option

The Thesis Option includes 30 semester hours to include the core requirements (described below), 3 hours of seminar and 6 hours of thesis. The remaining hours will be electives.

Core requirements include at least one course each from three of the following six competency areas::

1. Biological analysis and modeling: BIOL 5415 Biometry, BIOL 7420 Phylogenetics,
2. BIOL 7310 Experimental design Cellular functions: BIOL 5401 Cell Biology, BIOL 5413 Immunology, BIOL 5406 Pathogenic Microbiology
3. Organismal functions: BIOL 5403 Comparative Physiology, BIOL 5419 Plant Physiology, 5422 Mammalian physiology
4. Genetics: ASCI 7385 Concepts in Genetic Analysis, ASCI 7387 Genetics
5. Biochemistry and molecular biology: BIOL 5418 Molecular biology, ASCI 7375 Biochemistry of biological molecules
6. Ecological interactions: BIOL 5412 Plant Ecology, BIOL 7311 Behavioral Ecology

Thesis and Advisory Committee

The student's Advisory Committee will be composed of at least three faculty members, including the student's thesis advisor if in the MS track. The student must select a thesis or program advisor by the end of his/ her first semester and assemble an Advisory Committee by the end of his/her second semester. The thesis subject is selected by the student and the Advisory Committee by the end of the second semester. The written thesis format must follow the *UALR Graduate School Dissertation and Thesis Guide* found on the Graduate School website.

Thesis Proposal

At least one year prior to the thesis defense, thesis candidates must present a written proposal for his/her thesis work to the Advisory Committee.

Thesis Defense

Students will present and orally defend their completed master's research before their Advisory Committees. The defenses will be open to the public and must be announced at least two weeks in advance.

Course Work Only Option

The Course Work (MA) Option includes 36 semester hours to include core requirements listed above, 3 hours of seminar, and the remaining courses to be electives.

Exit Examination

All students will be required to complete comprehensive written examinations, compiled and administered by the students' Advisory Committees as an additional exit requirement for the MS degree.

Graduation Requirements

- Successful completion of an approved program of study with a minimum GPA of 3.0;
- Successful completion of comprehensive exit examinations;
- Successful completion of the thesis and oral defense (thesis option); and
- Successful completion of the writing and seminar requirements

Student Progress

Students are expected to make satisfactory progress toward their degree. Satisfactory progress includes appropriate grades in all courses and steady progress toward research goals as determined by the student's advisory committee. Should progress be deemed unsatisfactory, the student will be informed in writing by the program coordinator with copies to the Graduate School Disputes regarding satisfactory progress will be handled by the Biology Graduate Committee.

Transfer Credit

With written approval of the graduate coordinator and the department chair, a student may meet some of the course requirements with UALR graduate courses in chemistry, integrated science and mathematics, and/or applied sciences or from the University of Arkansas for Medical Sciences. Transfer credit from any other program will generally be limited to six hours.

Courses in Biology

BIOL 5199, 5299, 5399, 5499 Special Topics in Biology

Prerequisites: 20 biology hours, consent of instructor (other prerequisites may be required depending on topic). Specialized areas of study in biological sciences. Credit varies with depth of content. One to four hours lecture per week; up to four hours laboratory per week. Offered on demand.

BIOL 5201 AIDS

Prerequisites: BIOL 1401, graduate standing. The disease AIDS; includes cell biology, the disease process, and the social, economic, legal, and political aspects related to the disease and society.

BIOL 5305 Animal Behavior

Prerequisites: BIOL 1401, 2403, eight additional biology hours or consent of instructor. Known behavior of various vertebrate, invertebrate phyla; emphasis on adaptive significance; special attention to mating, defensive, nutritive, social behaviors; ontogeny of behavioral patterns (where known); relationship of behavior to ecology of various animal populations. Three hours lecture per week.

BIOL 5310 Evolution

Prerequisites: four hours of the core science requirement, graduate standing. Basic principles of evolutionary biology: Darwinian Theory, principles of inheritance, microevolution, and speciation processes; includes the evolution of humans.

BIOL 5311 Neurobiology

Prerequisites: 16 hours in biology or consent of instructor; CHEM 1401 or 1403 strongly encouraged. This course examines the functioning of the nervous system, with emphasis on vertebrates-in particular, humans. The course covers the structure and function of neurons as fundamental unit of the nervous system, functional neuroanatomy, and the basis principles of nervous system development. Three hours lecture per week. Three credit hours.

BIOL 5312 Population and Community Ecology

Prerequisites: BIOL 3303 and at least junior standing. Graduate standing required if student enrolled in BIOL 5312. Basic principles of population ecology will be discussed, including niche concept, demography, population growth and regulation, life history patterns, sociality, competition, predation, mutualisms, and control of community structure. Dual-listed in the UALR Undergraduate Catalog as BIOL 4312. Students cannot receive graduate credit for BIOL 5312 if they have previously taken BIOL 4312. Three hours of lecture per week. Three credit hours.

BIOL 5314 Soil Biology

Prerequisites: BS in biology or permission of the instructor. Concepts of soils are presented with emphasis on biological processes and soil/ecosystem relationships. Hands-on laboratory exercises and field exercises will supplement course lectures. Dual-listed in the UALR Undergraduate Catalog as BIOL 4314. This course is not open to students with credit for BIOL 4314. Three hours lecture per week. Three credit hours.

BIOL 5315 Toxicology

Prerequisites: BS in biology or permission of the instructor. Principles of toxicology are presented with an emphasis on toxicokinetics and toxicity mechanisms. Laboratory testing, risk analysis, and study design requirements are applied to various settings. Lectures will be supplemented with case studies. Dual-listed in the UALR Undergraduate Catalog as BIOL 4315. This course is not open to students with credit for BIOL 4315. Three hours lecture per week. Three credit hours.

BIOL 5401 Cell Biology

Prerequisites: BIOL 1402, 12 additional hours in biology, CHEM 1401 or 1403; microbiology is strongly encouraged. A study of the organization of cells as related to the structure and function of biological molecules. Emphasis is placed on eukaryotic cells. Three hours lecture, three hours laboratory per week.

BIOL 5402 Limnology

Prerequisites: BIOL 1401, 2402, 2403, 3303, CHEM 1403 or equivalent. Physical, chemical characteristics of water; morphometry, physiography of lake, stream basins; ecology, taxonomy of aquatic communities; laboratory includes physical, chemical, biological sampling and analysis methods; field work includes various types of aquatic habitats and sampling methods involved; requires some extended Saturday field trips. Two lectures, one four-hour laboratory per week.

BIOL 5403 Comparative Physiology

Organ function in a wide range of organisms, including vertebrates and invertebrates. A comprehensive survey of functional relationships in more than one group of animals. Three hours lecture, three hours laboratory per week. Four credit hours.

BIOL 5404 Mammalogy

Prerequisites: Biology 3404, 3409, equivalent, or consent of instructor. Classification, distribution, ecology, natural history of mammals; emphasis on Arkansas species; field studies, preparation of study specimens. Two hours lecture, two hours laboratory per week.

BIOL 5405 Ichthyology

Prerequisites: BIOL 1400 or 1401, 3404 or 3409 or equivalent, or consent of the instructor. Classification, phylogeny, morphology, physiology, and ecology of fishes concentrating on North American and Arkansas freshwater fishes. Three hours lecture, three hours laboratory per week.

BIOL 5406 Pathogenic Microbiology

Prerequisites: BIOL 1400 or 1401, 2401, or their equivalents. Survey of pathogenic microbiology, immunology, and virology with emphasis on fundamental principles of each science and their application to the diagnosis and control of human diseases. Three hours lecture, two hours laboratory per week.

BIOL 5407 Herpetology

Prerequisites: BIOL 3404, 3409, or equivalents, or consent of instructor. Classification, anatomy, distribution, ecology, natural history of amphibians and reptiles; emphasis on Arkansas species in field techniques, student projects, laboratory work, curatorial training. Two hours lecture, four hours laboratory per week.

BIOL 5409 Plant Taxonomy

Prerequisites: BIOL 1400 or 1401 2402, or their equivalents. A study of the principles of plant identification, classification, systematics, and nomenclature. Major families of flowering plants with emphasis on the floristics of the immediate area. Two hours lecture, four hours laboratory per week.

BIOL 5410 Fisheries

Prerequisites: BIOL 1400 or 1401, 2403, 3303 or 3409, or their equivalents, or consent of the instructor. A survey of fish management and fish culture principles and techniques including population assessment, habitat improvement, pond culture, commercial fish farming, and an introduction to fish diseases. Three hours of lecture, three hours laboratory per week.

BIOL 5411 Ornithology

Prerequisites: BIOL 2403, 12 additional biology hours. Selected aspects of avian biology; emphasis on ecology, evolutionary biology, natural history, classification of birds; includes lecture, discussion, laboratory, field study.

BIOL 5412 Plant Ecology

Study of plant species ecology (life history and reproductive biology) and vegetation ecology (abundance, structure, dispersion, patterns, and dynamics), with emphasis on quantitative methodology and management principles. Three hours lecture, two hours laboratory per week.

BIOL 5413 Immunology

Immunobiology and immunochemistry of humoral and cellular mechanisms of immunity. Three hours lecture, two hours laboratory per week.

BIOL 5415 Biometry

Prerequisites: 12 hours of biology, environmental health science, or earth science (in combination or singularly), MATH 1302 or higher numbered course, three hours of statistics or consent of instructor, graduate standing. Computer-based course in experimental design, data analysis, and interpretation; objective is the application of statistical procedures relevant to the academic emphasis of students, not statistics per se; especially beneficial to those students planning to seek an advanced degree or to go into quality control or research positions. Offered in spring on even years.

BIOL 5416 Microscopy

Prerequisites: 15 hours of biology, graduate standing. Laboratory in the fundamental theory and practical application of light and electron microscopy including specimen preparation, photomicrography, and digital computer image processing and enhancement; topics include brightfield, darkfield, phase, differential interference contrast, polarized, and epi fluorescent light microscopy and scanning and transmission electron microscopy; emphasizes experimental design and use of the microscope as an experimental tool.

BIOL 5417 Molecular Biology

Prerequisites: nineteen hours in biology including both BIOL 2401 and BIOL 3300; CHEM 1401 or 1403; BS in biology or permission of instructor. Successful completion of either BIOL 3400 or BIOL 4401 is strongly encouraged. A study of molecular biology theory and practice. Emphasis is on the study of model systems to understand the current approaches and laboratory techniques necessary to answer basic questions in current molecular biology. Two hours of lecture and four hours of laboratory per week.

BIOL 5418 Biotechnology

Prerequisites: 19 hours of biology including 2401 and 3300; CHEM 1401 or 1403. BIOL 3400 and 4401/5401 are strongly recommended. BIOL 4417/5417 is also recommended or may be taken concurrently. A study of the applied science of biotechnology designed to introduce students to the elements of a biotechnological career. Topics range from traditional biotechnology such as animal and plant tissue culture to contemporary molecular biotechnology and the use of recombinant DNA technology and genetic engineering in research and industry. Emphasis will be placed on current biomedical, pharmaceutical, and agri/industrial applications. Graduate students must complete and defend a term paper. Two hours lecture, four hours laboratory per week.

BIOL 5419 Plant Physiology

Prerequisites: BIOL 1400 or 1401, 2402, CHEM 2450, or their equivalents, or consent of instructor. Study of water relations, nutrition, and metabolism including photosynthesis, growth, and development. Two hours lecture, four hours laboratory per week.

BIOL 5421 Introduction to Geographic Information Systems

Prerequisites: ERSC 2320 or ENHS 3415 or BIOL 4309, or consent of instructor. This course introduces Geographic Information Systems (GIS) and the use of spatial data for problem-solving in science. The lecture portion of the course focuses on the data models used to represent spatial features and on the processes involved in creating, acquiring, analyzing, and displaying georeferenced information. The laboratory portion of this course employs a project-based methodology including applications from geology, biology, environmental science, and political science to foster basic GIS software proficiency. Two lecture hours per week, four laboratory hours. Four credit hours.

BIOL 5422 Mammalian Physiology

General physiological principles and a treatment of functions and interrelations of mammalian systems. Three hours lecture, tow hours laboratory per week. Four credit hours.

BIOL 5423 Plant Anatomy

Detailed coverage of the microscopic anatomy of all the organs of seed plants and a critical evaluation of the major tissue types found within these plant organs. Two hours lecture, hour hours laboratory per week. Four credit hours.

BIOL 5424 Entomology

Prerequisites: BIOL 3303 or equivalent, or permission of the instructor. A study of insects including their anatomy, physiology, behavior, development, diversity, classification, and economic importance. Two hours lecture, four hours laboratory. Four credit hours.

BIOL 5426 Plant and Human Nutrition

Prerequisites: BS in Biology or permission of the instructor. Plant nutrition refers to the needs and uses of the basic chemical elements in the plants, which are essential for plant growth and development. Thus, plant nutrition is an area of fundamental importance for both basic sciences (Plant physiology, Plant cell and molecular biology, Plant development) and applied sciences (Agronomy, Crop physiology, Horticulture, Human nutrition and health). Human nutrition refers to the needs and uses of the basic chemical elements and compounds in the human body, which are essential for human development and healthy life. The course consists of lectures, laboratory exercises, and case studies. Dual-listed in the hours lecture, and four hours laboratory per week. Four credit hours.

BIOL 5427 Tissue Engineering

Prerequisites: BS in Biology or the permission of the instructor. Tissue engineering (TE) is defined as the development and manipulation of laboratory-grown molecules, cells, tissues, or organs to replace and/or support the function of injured body parts. TE applies the principles and methods of biology, stem cell biology, immunology, life sciences, physical sciences, engineering, cell and drug delivery, nanobiotechnology, and bioinformatics to understand physiological and pathological systems and to modify and create cells and tissues for therapies for structural tissue repair (e.g., skin, bone, cartilage, tendon, muscle, and blood vessel), for enhancing metabolic function (e.g., liver), for improved drug delivery (localized delivery of a drug), and as a vehicle for cell-based gene therapy. Dual-listed in the UALR Undergraduate Catalog as BIOL 4427. The course consists of two hours of lectures and four hours of laboratory per week. This course is not open to students with credit for BIOL 4427. Four credit hours.

BIOL 7110 Independent Study

Independent study provides an opportunity for a student to gain depth in a specialized area to support a particular aspect of their research. The specific topic and course of study will vary by student and are to be developed with a faculty member in the department and the student's advisory committee to augment the student's background in a specific area or to fill a gap in knowledge when no regularly-scheduled courses are available. No more than two hours of independent study may be counted toward a graduate degree.

BIOL 7210 Independent Study

Independent study provides an opportunity for a student to gain depth in a specialized area to support a particular aspect of their research. The specific topic and course of study will vary by student and are to be developed with a faculty member in the department and the student's advisory committee to augment the student's background in a specific area or to fill a gap in knowledge when no regularly-scheduled courses are available. No more than two hours of independent study may be counted toward a graduate degree.

BIOL 7191 Graduate Seminar

Prerequisites: graduate standing and consent of graduate coordinator. Students, faculty, and invited speakers present, discuss, and exchange ideas on research topics and methods in biology. MS students required to enroll three times and obtain three hour credit. Graded C/NC.

BIOL 7199, 7299, 7399 Selected Topics in Biology

Prerequisites: Graduate standing or consent of instructor. Advanced studies in specialized areas of biological science, such as cell and molecular biology, microbiology, genetics, organizational biology, ecology, fisheries and wildlife management. One to three hours lecture per week depending on credit hours. Offered on demand.

BIOL 7310 Experimental Design in Biology

Prerequisites: Graduate standing and 4415/5415 Biometry or equivalent. Experimental design in biology is designed to provide students with an appreciation of the utility of a rigorous experimental design and the use of inferential statistics in research with biological systems. Students will be given a background in the statistical requirements of manipulative experiments and will critique research designs in recently published literature.

BIOL 7311 Behavioral Ecology

Prerequisites: BIOL 3303, BIOL 4305/5305 or the equivalent or consent of the instructor. This course is a broad introduction to the field of behavioral ecology and how evolutionary and ecological constraints shape behavioral strategies and tactics. Topics to be addressed include the evolution of life histories, reproductive decisions, resource acquisition and utilization, and the costs and benefits of sociality. Three hours lecture per week. Computer exercises during some scheduled lecture times will include foraging and habitat use models, game theory, and species interaction models.

BIOL 7410 Phylogenetic Analysis

Prerequisite: Graduate standing and completion of two courses (or equivalent) from the following: Biometry (BIOL 4415/5415), Linea Algebra (MATH 3312), Mathematical Models (MATH 3324), Molecular Biology (BIOL 4417/5417). Student may also enroll with the consent of the instructor. A computer based course in phylogenetic analysis of molecular sequence data through the use of both distance and character based models. Parsimony, maximum likelihood, and Bayesian inference are key procedures used to assess, test and characterize molecular evolution. Two hours lecture and four hours laboratory per week. Four credit hours.

BIOL 7499 Selected Topics in Biology

Prerequisites: Graduate standing or consent of instructor. Advanced studies in specialized areas of biological science, such as cell and molecular biology, microbiology, genetics, organismal biology, genetics, ecology, fisheries and wildlife management, Two or three hours lecture per week and 2-4 hours laboratory per week. Offered on demand. Four credit hours.

BIOL 8100, 8200, 8300,8400 Thesis Research

Prerequisite: full admission to the program. Thesis research in biology is designed to provide students with graduate level research experience. Under the directions of the student's major advisor and graduate committee, the student will carry out original research to support his/her thesis.

The Department of Environmental Health Science has no graduate programs; however, many of the department's courses are used in other programs.

Courses in Environmental Health Science

Carl Stapleton, Director, Environmental Health Sciences Program, (501) 569-3501

ENHS 5199, 5299, 5399 Special Topics in Environmental Health Sciences

Prerequisite: graduate standing or consent of instructor. Topics include specialized areas of environmental health sciences. Credit varies depending on depth of content. One to three hours lecture per week. Offered on demand.

ENHS 5410 Environmental Planning

Prerequisites: ENHS 2320, or consent of instructor. The planning process and evaluation methods applicable to various environmental programs are addressed. Resource allocation and procurement topics are included as appropriate to environmental planning. Case studies are presented which include areas such as watershed planning, land use, solid and hazardous wastes, air quality, and energy. Group discussions, role playing exercises, computer exercises and field study tasks will supplement class lectures.

ENHS 5415 Environmental Impact Analysis

Prerequisites: ENHS 3310, ENHS 3340 or 3350, RHET 3316, BIOL 3303 and 3103, STAT 4350, or consent of the instructor. This course provides individuals with knowledge and skills necessary to prepare and review environmental assessments (EAs) and environmental impact statements (EISs). The National Environmental Policy Act (NEPA) and its key components are presented for discussion. Case studies and group discussions are used to supplement class lectures. Field and laboratory exercises appropriate to the environmental impact analysis (EIA) process will be presented and used to prepare an EA for a selected site.

ENHS 5430 Environmental Epidemiology

ENHS 3340 or 3350, BIOL 2401, STAT 4350, or consent of the instructor. The principles of environmental epidemiology are introduced with specific emphasis on its application to various environmental settings. Statistical methods used for analyzing environmental epidemiological data are introduced. Computer applications will be presented in lecture and laboratory sessions. The role of environmental epidemiology in anti- bioterrorism programs will be presented. Lectures will be supplemented with laboratory computer exercises, site visits, and field studies.

Science Laboratory Building, Room 451
(501) 569-3152

CHEMISTRY

The Master of Arts and Master of Science programs in chemistry provide advanced preparation for careers in government or industrial research or for doctoral study. The programs' curricula are a blend of traditional and nontraditional, innovative courses that reflect the needs of modern chemistry. The UALR Department of Chemistry offers research-quality instrumentation and computer facilities as well as individual attention to each student and a high quality of instruction. Please visit the department's website at ualr.edu/chemistry/.

Admission Requirements

- Baccalaureate degree from an accredited institution with a cumulative grade point average of at least 2.75 (4.0 scale), or 3.0 in the last 60 hours
- Entering students will be counseled and placed in appropriate courses based on their performances on placement tests in the four subdisciplines of chemistry.

Program Requirements

Both chemistry degrees require at least 30 graduate chemistry hours, including at least three of four core courses (CHEM 7311 Analytical, 7340 Inorganic, 7350 Organic, 7370 Physical), as determined by the department's graduate programs committee.

The Master of Science requires CHEM 8100-8400 Thesis Research and 7190 Graduate Seminar. The student selects a thesis advisor and a specific thesis research project, then researches, writes, and orally defends a thesis (11 credit hours). For the Master of Arts, 12 approved course hours replace the thesis and seminar hours. The remaining hours are elective and might include graduate chemistry courses of specific interest to the student; up to three graduate chemistry hours transferred from another school; up to three approved graduate hours from another UALR department; or up to six 5000-level hours.

Graduate Assistantships

A limited number of graduate assistantships are available. Contact the program coordinator for information. International applicants for teaching assistantships must have an overall score of at least 50 on the Test of Spoken English. (The testing facility must send scores to the program coordinator).

Graduation Requirements

- Cumulative GPA of at least 3.0 on an approved program of study as outlined above;
- Successful completion of written thesis and oral defense (MS only).

Courses in Chemistry

CHEM 5251 Organic Preparations

Prerequisite: CHEM 3151 or 4250. Advanced experiments in organic chemistry using special apparatus and techniques. Two three-hour laboratories per week. Offered on demand.

CHEM 5321 Biochemistry II

Prerequisites: CHEM 4420 or 5420. Continuation of Biochemistry I, covering energy generation, metabolism of lipids and amino acids, integration of metabolism, DNA replication and repair, transcription, translation, and control of gene expression. Dual-listed in the UALR Undergraduate Catalog as CHEM 4321. Students who have completed CHEM 4321 may not enroll in CHEM 5321. Lecture three hours per week. Three credit hours.

CHEM 5330 History of Chemistry

Prerequisite: CHEM 3350 with C or greater. This course is a survey of the growth and development of chemistry. Lectures will stress connections of modern commiserate to past chemists/scientists and how ideas are passed from generation to generation. The personality and human side of the scientists will be emphasized along with the interactions between science and society. Dual-listed in the UALR Undergraduate Catalog as CHEM 4330. Students who have completed CHEM 4330 may not enroll in CHEM 5330.

CHEM 5340 Inorganic Chemistry

Prerequisite or co-requisite: CHEM 3340, and 3572 or 3371 (3371 may be taken as corequisite). A study of inorganic chemistry with detailed emphasis on chemical bonding of covalent molecules, transition metal complexes and their bonding theories, spectroscopy of inorganic complexes, magnetism, organometallic chemistry with catalysis, and introduction to bioinorganic chemistry. Laboratory will reinforce concepts developed in lecture. Required for BS major. Dual-listed in the UALR Undergraduate Catalog as CHEM 4340. Students who have completed CHEM 4340 may not enroll in CHEM 5340. Lecture two hours and laboratory three hours per week. Three credit hours.

CHEM 5342 Environmental Chemistry

Prerequisites: CHEM 3350 and CHEM 2310 with grade of C or greater. A survey of environmental chemistry. Topics covered will include: Composition of the atmosphere and behavior; energy and climate; principles of photochemistry and surfactants; harloorganics and pesticides, water and air pollution (tropospheric and stratospheric) and connections to climate change; elemental and molecular environmental chemistry in geological media; water cycle and water treatment; principles of nuclear chemistry and radiochemistry; nuclear environmental chemistry; and evaluation of energy sources that are sustainable. dual-listed in the UALR UNdergraduate Catalog as CHEM 4342 may not enroll in CHEM 5342. Lecture three hours per week. Three credit hours.

CHEM 5350 Intermediate Organic Chemistry

Prerequisite: CHEM 3351. Reaction mechanisms; correlation of structure with reactivity; literature survey of recent advances in the field. Three hours lecture per week. Offered on demand.

CHEM 5360 Medicinal Chemistry

Prerequisites: General Organic Chemistry I and II, CHEM 3350 and 3351, General Organic Laboratory 1 CHEM 3151, and General Organic Laboratory II CHEM 3151 or Qualitative Organic Analysis Laboratory CHEM 3250, all with grades of C or greater. This course will serve as an introduction to the chemistry and theory of drug action that includes general drug design, drug-receptor interactions, drug design through enzyme inhibition, pharmacokinetics, and drug metabolism. Additionally, the mechanism of specific drug classes will be examined. Lecture three hours per week. Three credit hours. This course cannot be used as a substitute for the Biochemistry requirement of the ACS certified degree.

CHEM 5380 Introduction to Polymer Chemistry

Prerequisites: CHEM 3151 and 3351 or 4250 (recommended but not required: Chemistry 3170, 3271, 3371, 3470, 3572). Coordination of theoretical, practical aspects; includes history, types of polymerizations, kinetics, molecular weight, physical properties including thermal and spectroscopic characterization, biopolymers, engineering resins. Two hours lecture, three hours laboratory per week. Offered in spring on even years.

CHEM 5399 Special Topics in Chemistry

Prerequisite: consent of instructor. Topics may include chemical carcinogenesis, environmental chemistry, solid state chemistry, radiochemistry, macromolecules, surface chemistry, quantum chemistry, others. Three hours lecture per week. Offered on demand.

CHEM 5411 Instrumental Analysis

Prerequisites: CHEM 2310 and 2311; PHYS 1322 or 2322. Most common modern instrumental methods of analysis; includes topics in spectroscopy, electrochemistry, chromatography. Three hours lecture, one four-hour laboratory per week. Offered in fall.

CHEM 5420 Biochemistry I

Prerequisites: CHEM 2510, 3151, 3351. Basic chemistry and metabolism of proteins, lipids, carbohydrates, nucleic acids; action of vitamins, hormones, enzymes. Three hours lecture, three hours laboratory per week. Offered in spring.

CHEM 7190 Graduate Seminar

Prerequisites: graduate standing, consent of thesis advisor and graduate coordinator. Students, faculty, and invited speakers will present, discuss, and exchange ideas on research topics of chemical interest. Required of the MS student. Credit must be received at least one semester before enrollment in the last research semester. One hour session per week. Course may not be repeated for credit. Graded credit/no credit. Offered in fall and spring.

CHEM 7240 Inorganic Preparations

Prerequisite: CHEM 4411/5411 or equivalent. Techniques of synthesis and identification of inorganic compounds. Six hours laboratory per week. Offered on demand.

CHEM 7311 Advanced Analytical Chemistry

Prerequisite: CHEM 4411/5411 or equivalent. Complex solution equilibria and selected topics in spectroscopy, electro-analytical techniques, separations procedures. Three hours lecture per week.

CHEM 7317, 7318, 7319 Selected Topics in Analytical Chemistry

Prerequisite: consent of instructor. Topics may include electro-analytical techniques, modern functional group analysis, instrumental design and control, others. Offered on demand.

CHEM 7340 Advanced Inorganic Chemistry

Prerequisite: CHEM 4340/5340 or equivalent. Advanced theoretical concepts; includes atomic structure, molecular and solid structures, bonding, ligand field theory, organometallic chemistry, metals chemistry, reaction mechanism. Three hours lecture per week.

CHEM 7347, 7348, 7349 Selected Topics in Inorganic Chemistry

Prerequisite: CHEM 4340/5340. Topics may include magnetochemistry, X-ray crystallography, chemistry of diamond-like semiconductors, chemistry of rare earth elements, chemistry of boron and its compounds, reaction mechanisms, others. Three hours lecture per week. Offered on demand.

CHEM 7350 Organic Reaction Mechanisms

Prerequisites: CHEM 3350 or equivalent, 3351 or equivalent. Reaction mechanisms of classical organic reactions; includes ionic and free radical addition and substitution, oxidation, reduction, elimination reactions. Three hours lecture per week. Offered in fall.

CHEM 7351 Modern Synthetic Reactions

Prerequisites: CHEM 3350 or equivalent, 3351 or equivalent. Modern organic reactions, their applications in synthesis. Three hours lecture per week. Offered on demand.

CHEM 7357, 7358, 7359 Selected Topics in Organic Chemistry

Prerequisites: CHEM 3350, 3351. Topics may include natural products, stereochemistry, photochemistry, heterocyclic compounds, free radicals, carbenes, polymers, others. Three hours lecture per week. Offered on demand.

CHEM 7370 Physical Principles of Chemical Reactivity

Prerequisites: CHEM 3371 or equivalent, 3470 or equivalent. Chemical, physical properties of selected species in terms of thermodynamics, kinetics, molecular structure; examples in scientific literature illustrate how physical chemistry principles may be applied to chemical reactivity. Three hours lecture per week. Offered in spring.

CHEM 7371 Chemical Thermodynamics

Prerequisites: CHEM 3371, 3470. Application of the three laws of thermodynamics to chemical systems; relates spontaneity and equilibrium in gaseous, heterogeneous-phase, and solution reactions to thermal, electrochemical measurements. Three hours lecture per week. Offered on demand.

CHEM 7372 Chemical Kinetics

Prerequisites: CHEM 3371, 3470. Chemical reaction rates; includes determination of empirical rate laws, collision and transition state theories, activation energy and catalysis, reaction mechanisms, kinetic intermediates. Three hours lecture per week. Offered on demand.

CHEM 7377, 7378, 7379 Selected Topics in Physical Chemistry

Prerequisites: CHEM 3371, 3470. Topics may include quantum chemistry, statistical thermodynamics, semi-empirical molecular orbital calculations, molecular spectroscopy and photochemistry, states of matter, mathematical methods in chemistry, others. Three hours lecture per week. Offered on demand.

CHEM 7390 Selected Topics for Teachers

Prerequisites: experience in teaching secondary science and/or consent of instructor (based on assessment of student's chemistry background). For secondary science teachers to improve and extend their knowledge of basic chemical concepts. These concepts are related to modern chemical topics wherever possible. Laboratory emphasizes techniques for conducting classroom demonstrations. Two hours lecture, three hours laboratory per week. Offered on demand.

CHEM 8100-8400 Thesis Research

Prerequisites: consent of coordinator, thesis advisor. Scholarly investigation of a selected chemical problem, culminating in a written thesis with oral defense; student presents a seminar on the research in the last course/hours, typically during the final semester, to faculty and fellow students. Eleven hours required for MS degree. May not be applied to the MA degree. Variable credit. Credit/no credit grade based on written progress reports.

Geospatial Technology

ETAS, Room 575
(501) 569-8009

Graduate Certificate in Geospatial Technology

Geospatial Technology (GT) is an expanding and evolving field that requires a background in the concepts and skills of geographic information systems (GIS), global positioning systems (GPS) and remote sensing (RS). There is a growing demand for programs to provide training in GT in many fields, including geology, geography, biology, environmental science, agriculture, urban planning, business, engineering, and criminal justice (forensic science). Certificate programs accomplish the goals of providing training and certification for technicians and working professionals to meet the needs of the workforce and professional development in the geospatial disciplines. This certificate focuses on the fundamental concepts, applications, and technology of GIS, GPS, and RS.

GT is one of the fastest growing information science disciplines. Although geographical by nature, the growth of GIS can be partially attributed to its application by a wide variety of businesses and governmental agencies. As such, the use of GIS is becoming more ubiquitous in careers falling outside the traditional definition of geoscience. Employment skills in fields such as criminology, marketing, engineering, and agriculture as well as more traditional geospatial fields such as land use planning, site location, geology, and environmental monitoring rely heavily on GIS in day-to-day work. The certificate program offered by the Department of Earth Science is designed to provide the GIS skills necessary for both geologists and professionals working outside the traditional bounds of a geology degree. By completing the GIS certificate program, students will be prepared to enter a highly technical and growing career field.

Upon completion of the certificate requirements, students will be able to:

- Perform database entry, manipulation, and query;
- Perform basic to advanced geospatial analysis functions such as overlay, buffer, proximity analysis, and network analysis;
- Produce hardcopy spatial graphics on a variety of output devices;
- Input spatial data via tablet and on-screen digitizing and scanning;
- Collect primary data via GPS;
- Demonstrate competence in working with standard geospatial data (i.e., geo databases, digital elevation models, digital line graphs, orthophotography, and satellite imagery);
- Formulate and complete a comprehensive, directed project related to a geospatial problem.

Admission Requirements

- A baccalaureate degree from an accredited institution
- A cumulative GPA of at least 2.75

Program Requirements

Program requirements for the Geospatial Technology Certificate program are 18 hours, including the following courses:

Core Courses (4 hours):

ERSC 5421 Introduction to GIS

Elective Courses (8 hours):

Students must take 8 hours at the 5000-level or above. Courses must be related to geospatial technology or directly support geospatial projects. The director of the program must approve elective courses for credit toward the GT certificate. Examples of elective courses include:

ERSC 5422 Applied GIS
ERSC 5426 Introduction to Remote Sensing
ERSC 5321 Geomorphology
ERSC 5322 Environmental Geology
ERSC 5371 Engineering Geology
URST/POLS 5355 Urban Planning and Land Use
ENHS 5430 Environmental Epidemiology

Capstone Courses (2 hours)

IGSC 7195/7295/7395* Internship in Integrated Science and Mathematics
IGSC 7391* Cooperative Education in Integrated Science and Mathematics
IGSC 7192/7292/7392* Independent Study

* Capstone course credits above 2 hours count toward elective credit hours.

Courses in Earth Science

ERSC 5100, 5200, 5300 Independent Problems

Prerequisite: consent of the instructor. This course offers the student an independent laboratory or field study of a problem in the earth sciences in consultation with an instructor. Credit varies per problem topic.

ERSC 5199, 5299, 5399, 5499 Special Topics

Prerequisite: consent of the instructor. This course offers study in advanced and specialized topics in the geological sciences especially those of current interest. Refer to the semester's schedule for the special topics offered. Credit will vary depending upon the course topic.

ERSC 5322 Environmental Geology

Prerequisite: consent of instructor. Humanity as a geologic agent; geologic hazards in the environment; geology, land-use studies; urban geology; case histories; requires two term projects and a case history presentation. Three hours lecture per week.

ERSC 5323 Geology of Arkansas

Regional geomorphology, structure, stratigraphy, paleontology of Arkansas; includes field trips to Ozark Dome, Ouachita Fold Belt, Arkansas Valley, Mississippi Embayment, Gulf Coastal Plain; requires field trip reports, term project. Three lectures per week, weekend field trips.

ERSC 5371 Engineering Geology

The study of the interaction of rock, soil, and geologic processes with the engineering activities of man by applying geological data, techniques and principles. The integration of geological, geotechnical and geophysical investigative methods will be emphasized. Lecture topics will include soil and rock mechanics and rock deformation, the assessment of the spatial-temporal variability of sub surface material, slop stability analysis and slope failure mitigation, earthquake engineering, hydrologic systems management, and the application of GIS and geology. Two hours lecture, two hours laboratory per week. Three credit hours.

ERSC 5373 Hydrogeology

Prerequisites: MATH 1302 or 1311; ERSC 3310; Co-requisite CHEM 1402 Ground water occurrence, flow, porosity, permeability, aquifer analysis, geology of ground water, water well logging, well development, case histories, field methods, hydrogeologic planning. Three hours lecture per week. Offered in spring on even years.

ERSC 5391 Cooperative Education in Earth Science

Prerequisites: Graduate standing and consent and approval of assignment by advisor. Supervised professional experience related to students discipline with governmental agencies, industry and consulting firms. This course requires a minimum of 200 semester work hours. Three credit hours.

ERSC 5419 Geomorphology

Prerequisites: ERSC 1302/1102, 3320, or consent of instructor. The study of form and process at the Earth's surface. The interactions between erosional and depositional processes at the Earth's surface with tectonic processes operating within the Earth are examined with respect to landform evolution. Laboratory includes the analysis of maps, digital imagery, and field applications of GPS/GIS technology. Two hours lecture, four hours laboratory or field study per week. Four credit hours.

ERSC 5421 Introduction to Geographic Information Systems

Prerequisites: consent of instructor. This course introduces Geographic Information Systems (GIS) and the use of spatial data for problem-solving in science. The lecture portion of the course focuses on the data models used to represent spatial features and on the processes involved in creating, acquiring, analyzing, and displaying georeferenced information. The laboratory portion of this course employs a project-based methodology including applications from geology, biology, environmental science, and political science to foster basic GIS software proficiency. Two lecture hours per week, four laboratory hours. Four credit hours.

ERSC 5422 Applied GIS (Geographic Information Systems)

Prerequisites: BIOL/ERSC 4421/5421 or consent of instructor. This course builds on the fundamental concepts of Geographic Information Systems (GIS) from Introduction to GIS. It focuses on advanced applications in GIS with an emphasis on problem-solving, advanced analysis techniques, and satabase management. Two lecture hours per week, four laboratory hours. Four credit hours.

ERSC 5426 Introduction to Remote Sensing

Prerequisite: ERSC 4421/5421 or BIOL 4421/5421 or consent of instructor. This course introduces the fundamentals of manipulating and interpreting the electromagnetic spectrum. The lecture portion of this class covers concepts of remote sensing, including how data is collected, processed, analyzed, and interpreted. The lab portion of the class is focuses on building proficiency in several image processing software programs and the use of spatial data for problem solving in science. Two lecture hours per week, four laboratory hours. Four credit hours.

ERSC 7399 Selected Topics

Prerequisites: four undergraduate geology hours, professional experience in some area of earth science, consent of instructor. Topics include modern geology, meteorology, oceanography; assists professionals to remain current in these rapidly expanding fields; laboratory emphasis on creative problem solving, field trips. Two hours lecture, three hours laboratory per week. Offered in summer.

Health, Human Performance and Sport Management

Friboourgh Hall, Room 505
(501) 569-3523

The Master of Science in Health, Human Performance and Sport Management degree focuses on three graduate-study emphasis areas: (1) health education, (2) exercise science, and (3) sport management. This degree is designed to provide professional educational opportunities to interested students, health service professionals, teachers, researchers, corporate wellness/fitness coordinators, and sport/athletic management personnel throughout Arkansas and the nation. These professionals will be employed in a variety of venues, including education settings, health care institutions, private health clinics, rehabilitation centers, businesses, fitness and wellness programs, and sport/athletic facilities. Students will have the opportunity to improve their intellectual and professional skills through advanced classroom instruction, participation in behavioral research, and community service learning activities.

Admission Requirements

The following materials should be submitted to the UALR Graduate School when applying to the program:

- Undergraduate transcript. Applicants are expected to have a baccalaureate degree from an accredited university. A 3.0 grade point average is generally expected.
- Graduate Record Examination (GRE) Scores. Applicants are required to take the GRE General Test resulting in a minimum score at or above the 50th percentile.
- Reference letters. Applicants should obtain three letters of reference from college professors or individuals familiar with their academic work. Applicants should ask each writer of a reference letter to place the letter in an envelope, seal it, and sign across the seal. Applicants should collect the sealed reference letters and forward them to the UALR Graduate School.
- Letter of intent. Each applicant must submit a letter of intent describing the field or specialty within Health, Human Performance and Sport Management for which training is sought and describing how the proposed training relates to the student's career goals. Letters are not to exceed 500 words.

Applicants for admission to the MS in Health, Human Performance and Sport Management program are evaluated on a competitive basis by the faculty, and acceptance is conferred to the most qualified applicants. Fulfilling admission requirements is necessary to be considered for admission but in no way guarantees acceptance into the program. Students may be admitted in one of the admission status categories outlined in the *Graduate Catalog*.

Application for admission should be received by the UALR Graduate School by March 15 for students anticipating Fall matriculation and October 15 for Spring matriculation in order to get full consideration for admittance. Applications received after these dates will be considered as long as program openings remain available. Students who do not meet the above requirements for admission may apply to the Department of Health, Human Performance and Sport Management for a faculty review of their qualifications

Transfer Credit

Subject to faculty approval, a combined maximum of 12 semester credit hours of transfer credit and/or credit taken as a special student may be applied to the degree. Successful completion of course work taken as a special student does not guarantee acceptance into the program.

Program Requirements

Master of Science in Health, Human Performance and Sport Management students must complete nine hours of core requirements as well as twenty-seven hours in a chosen area of emphasis (Health Education, Exercise Science, or Sports Management), as follows:

Core Requirements (9 hours)

All students seeking a Master of Science in Health, Human Performance and Sport Management must complete the following three core courses:

HHPS 7301 Research Methods in Health Sciences

HHPS 7302 Basic Statistics in Health Sciences

HHPS 7303 Evaluation of Health Programs

Health Education Emphasis (27 hours)

In addition to the nine core hours, students seeking an emphasis in Health Education must complete 21 hours from the following courses as well as a Thesis or Project (6 hours), including the following:

HHPS 7310 Theoretical Foundations of HLED

HHPS 7311 Concepts & Methods HLED

HHPS 5430 Epidemiology

Electives (8 hours)

HHPS 7699 Thesis Preparation (6 hours) plus HHPS 7313 Advanced Stats for HHPS (3 hours), or HHPS 7698 Project Preparation (6 hours) plus HHPS 7314 HLED Curriculum Development (3 hours)

Exercise Science Emphasis (27 hours)

In addition to the 9 core hours, students seeking an emphasis in Exercise Science must complete 21 hours from the following courses as well as a Thesis or Project (6 hours):

HHPS 7320 Curriculum Development in PE
HHPS 7321 Advanced Motor Learning
HHPS 7322 Admin of PE & Sport
HHPS 7323 Biomechanics
HHPS 7324 Advanced Exercise Physiology

Electives (6 hours)

HHPS 7699 Thesis Preparation (6 hours)
or HHPS 7698 Project Preparation (6 hours)

Sports Management Emphasis(27 hours)

In addition to the 9 core hours, students seeking an emphasis in Sports Management must complete 21 hours from the following courses as well as a Thesis or Project (6 hours):

HHPS 7330 Management & Leadership in Sport Organizations
HHPS 7331 Sport Law
HHPS 7332 Planning & Management of Facilities
HHPS 7333 Issues & Ethics in Sport Management
HHPS 7334 Sport Marketing
HHPS 7335 Event Development & Management
HHPS 7336 Fiscal Management of Sport Organizations

Electives (3 hours)

HHPS 7699 Thesis Preparation (6 hours)
or HHPS 7698 Project Preparation (6 hours)

Graduation Requirements

- Students must successfully complete 36 hours of approved courses, a comprehensive exam, and a thesis or project.

Courses in Health, Human Performance and Sport Management

HHPS 5340 Adapted Physical Education K-12

This course presents the philosophy and methods pertaining to the adaptation of physical education for handicapped and exceptional students. A basic knowledge of handicapped conditions and the complications thereof for participating in physical education along with classroom, laboratory and practical experience will be provided to increase the awareness of the handicapped and to facilitate the application of knowledge to real life situations. Three hours of lecture per week.

HHPS 5350 Methods and Techniques of Teaching Physical Education 6-12

Prerequisites: HHPS 3320, HHPS 3210, and HHPS 3310, or department approval. This course provides a detailed review of the analysis and application of the major responsibilities and competencies required for teaching physical education 6-12. Emphasis is on learning the State Standards for Physical Education, Wellness, & Leisure (SSPEWL) K-12 licensure requirements and preparation for the ETS PRAXIS Series exams. This is the designated capstone course for the BS in Health Human Performance and Sport Management: emphasis in Health and Exercise Science, Minor in Secondary Education. Dual-listed in the *UALR Undergraduate Catalog* as HSCI 4350. Three hours lecture per week. Three credits hours.

HHPS 5371 Health Education Concepts and Applications

Concepts, philosophy, applications in public, private, professional, commercial organizations that exist to improve, maintain health. Three hours lecture per week. Offered in fall on even years.

HHPS 5373 Controversial Issues in Health Education

Health issues as influenced by laws, public opinion, scientific knowledge; current controversial issues in health education. (Also offered each summer in conjunction with Mid-South Summer School on Drug and Alcohol Abuse, usually last full week in June.) Three hours lecture per week. Offered on demand.

HHPS 5378 Organization and Administration of Health Education Programs

Prerequisites: HHPS 2303 and HHPS 4380 or department approval. This course is designed to provide a foundation in the organization and management of community-based health education programs. The purpose of this course is to provide an introduction to the fundamental concepts of management, administration and leadership; as well as, demonstrate their application in a variety of health education, health promotion and wellness programs. Dual listed in the UALR Undergraduate Catalog as HHPS 4378. This course is not open to students with credit for HHPS 4378. Three hours lecture per week. Three credits hours.

HHPS 5399 HHPS Special Topics

Prerequisite: HHPS 2330. Selected topics in specialized areas of health education, human performance, and sport management. Course topics will be announced in advance. Three credit hour lecture course.

HHPS 5430 Epidemiology: Environmental & Health

The principles of health and environmental epidemiology are introduced with specific emphasis on its application to various health and environmental settings. Statistical methods used for analyzing health and environmental epidemiological data are introduced. Computer applications will be presented in lecture and laboratory sessions. The role of health and environmental epidemiology in anti-terrorism programs will be presented. Lectures will be supplemented with laboratory computer exercises, site visits, and field studies.

HHPS 7301 Research Methods in Health Sciences

This course provides an overview examination of research methods applicable to the study of individual and group behavior. The course will interface behavioral theory, research design and methods, and data analysis/interpretation. The course will serve as an introduction and practical guide to conducting and critically evaluating health sciences and health behavior research.

HHPS 7302 Basic Statistics in Heath Sciences

A study of fundamental statistical concepts and techniques including descriptive and inferential parametric/non-parametric tests.

HHPS 7303 Evaluation of Health Programs

This course is an introductory course in evaluation designed for practitioners. The course content includes rationales for evaluation; political, organizational, theoretical, and educational aspects of evaluation; and methods to implement a sound evaluation.

HHPS 7310 Theoretical Foundations of Health Education

This course explores the role of theory in shaping research and practice in health promotion and education, as well as historical and ongoing interaction between health education and the applied social sciences.

HHPS 7311 Concepts and Methods of Health Education

Fundamental principles and practices of public health promotion including history, ethics, cultural competence, professional responsibilities, overview of theory and models, and selection and implementation of instructional methods.

HHPS 7313 Advanced Statistics for Health Science

This course will introduce students to applied multivariable, multivariate, and data modeling analyses approaches used in health sciences research. Successful completion of HHPS 7302 (or equivalent) and permission of instructor required for enrollment.

HHPS 7314 Health Education Curriculum Development

The major focus of this course is on curriculum development and program planning in health promotion and education on a micro level. Practical aspects of curriculum development and program planning are emphasized. Learning theory and learning styles are discussed as they relate to health education curricula and program planning.

HHPS 7320 Curriculum Development in Physical Education

This course focuses on the content and process of PK-12 Physical Education curriculum development for the public schools.

HHPS 7321 Advanced Motor Learning

This course focuses on the advanced study of principles/ theories of human motor learning, behavior and performance.

HHPS 7322 Administration of Physical Education and Sport

This course covers basic managerial theories and practices required to administer physical education and health programs in elementary, secondary schools and athletic settings.

HHPS 7323 Biomechanics

This course is designed to provide an advanced study of biomechanical concepts and their application to human movement and sport skills.

HHPS 7324 Advanced Exercise Physiology

This course applies physiological principles to exercise circumstance and includes critical analysis of the effect of exercise on human physiologic function with in-depth examination of current literature.

HHPS 7325 Sports and Exercise Nutrition

Prerequisite: Consent of the instructor. The Sports and Exercise Nutrition course is a study of the scientific basis of nutrition and diet on physical performance and health. Topics include energy metabolism, substrate utilization, and measurement of energy expenditure, thermoregulation, fluid balance, rehydration, weight control, eating disorders, ergogenic aids, meal planning and evaluation.

HHPS 7330 Management and Leadership in Sport Organizations

This course emphasizes the management and leadership components of sport organizations. Specifically, the course will focus on the means of improving performance and satisfaction within sport organizations. Several areas will be discussed such as developing goals, decision making, strategic planning, leadership styles, and human resource management with the objective of developing a management and leadership philosophy.

HHPS 7331 Sport Law

This course is a study of legal issues affecting the delivery of sport services; focuses on liability in sport activities.

HHPS 7332 Planning and Management of Facilities

This course is designed to develop student understanding of the competencies necessary to manage and operate sport, recreation, physical education, and public assembly facilities. Additionally, the conceptual and technical aspects related to the planning and design of recreation and athletic facilities will be addressed.

HHPS 7333 Issues and Ethics in Sports Management

Students will study ethical theories, moral reasoning, and ethical decision-making, and their value for sport managers. The application of ethical decision-making approaches relative to the major issues currently facing sport managers, and their impact on the operation of sport programs will also be addressed.

HHPS 7334: Sport Marketing

Students will develop an understanding and skill in the marketing process as relates to promotion & public relations activities in physical education, athletics and commercial sport operations. Primary focus will be on the application of marketing principles to specific sport scenarios.

HHPS 7335 Event Development and Management

This course is designed to provide students with the skills necessary to develop, propose and conduct sport-related contests and special events including game management and facility.

HHPS 7336 Fiscal Management in Sport Organizations

This course is intended to provide students a general overview of many of the traditional and innovative revenue acquisition methods available for sport managers. Initial class time is devoted to helping students understand the fundamentals of finance, accounting, and the application of key financial techniques utilized in the administration and operation of a business, including: ration analysis, cash flow management, budgeting, and general investment strategies. Subsequently, a large portion of the semester will cover a wide range of topics geared towards educating students to basic financial concepts and other financial issues related to the sports industry.

HHPS 7698 Project

All students must pass comprehensive examinations before enrolling in this course. Prerequisites for Health Education: HHPS 7301, 7302, 7303, 7310, 7311, 5430, 7314. Prerequisites for Exercise Science: HHPS 7301, 7302, 7303, 7320, 7321, 7322, 7323, 7324. Prerequisites for Sports Management: HHPS 7301, 7302, 7303, 7330, 7331, 7332, 7333, 7334, 7335. Project preparation is a mid-level research experience for master's degree students who have elected the special project option. With the guidance of a research committee, the student will plan, conduct, and prepare a written and oral report on a specific master 's-level project containing some original research.

HHPS 7699 Thesis

All students must pass comprehensive examinations before enrolling in this course. Prerequisites for Health Education: HHPS 7301, 7302, 7303, 7310, 7311, 5430, 7313. Prerequisites for Exercise Science: HHPS 7301, 7302, 7303, 7320, 7321, 7322, 7323, 7324. Prerequisites for Sports Management: HHPS 7301, 7302, 7303, 7330, 7331, 7332, 7333, 7334, 7335. Thesis preparation is designed to provide students with graduate-level research experience. Under the direction of the student's major advisor and graduate committee, the student will carry out original research to support her/his thesis.

College of Science
ETAS 125. (501) 569-3247

Integrated Science and Mathematics

The Master of Science in Integrated Science and Mathematics (MSISM) degree is designed to serve populations of graduate students whose interests and needs for professional development transcend traditional disciplinary boundaries. The program gives the student the opportunity to combine graduate courses from many departments within the College of Science, allowing them to design a program to suit their needs. Courses address the challenges and methods of study in such areas as STEM education environmental science, forensic sciences, integrated natural and life sciences, and mathematics disciplines. Students pursuing this degree will be able to construct a variety of rigorous, innovative, and non-traditional interdisciplinary programs.

Students in this program come from a variety of undergraduate fields, including biology, chemistry, environmental health sciences, earth sciences-geology, physics, health sciences, and mathematics. Professionals currently employed in environmental sciences, medical research support, and forensic science and others who are interested in integrating the sciences would particularly benefit from this degree.

Admission Requirements

- Official copies of all transcripts.
- GPA of at least 2.75 overall, or 3.0 in the last 60 hours.
- Three letters of reference.
- A 1-2 page Statement of Career and Education Objectives.
- A 1-2 page Curriculum Vita or Resume.
- A minimum score of 147 on the verbal and 147 on the quantitative sections of the GRE general section. GRE tests must have been taken within the last five years. Applicants with a 3.5 or greater GPA on their last 60 hours are not required to take the GRE.
- International students must present TOEFL scores. Minimum scores for acceptance are 525 on the paper-based test or 195 on the computer-based version.

Program Requirements

The MSISM degree combines writing, thinking, and analyzing skills with study of specialized knowledge in several science disciplines and mathematics. The program requires 36 semester hours of graduate course work for the Course Work Option and 30 semester hours of graduate course work for the Thesis or Project Option. Students must take a minimum of 18 semester credit hours of graduate-level work which emphasizes the interdisciplinary content in at least two of the following traditional disciplines:

Biology

Chemistry

Environmental Health Science

Geology-Earth Science

Health Science

Physics and Astronomy

Mathematics

Additional course work may come from outside the College of Science. The course work curriculum must be approved by the student's advisor and by the Integrated Science Program Director.

A six-credit-hour project or thesis is required for students in the Thesis or Project Option. For both the Thesis and Project Options, the student will have a three person graduate committee composed of at least one faculty member from each area of emphasis with one faculty member serving as the student's advisor. The advisor, with input from the committee, will recommend which option, Thesis or Project, is right for optimizing the student's educational goals and develop a curriculum for the student.

The topic of thesis study and the scope of the study are designed by the student in consultation with the student's advisor. Theses require a formal thesis proposal that must be approved by the student's committee. Thesis studies are hypothesis driven lines of scientific inquiry that demonstrate a student's ability to:

1. identify a scientific problem,
2. design a plan to examine the problem,
3. carry out the plan,
4. interpret the results of the study, and
5. defend the interpretations in the form of an oral defense.

A formal written thesis document is required. The UALR Dissertation and Thesis Guide, available at ualr.edu/ gradschool/, provides a detailed description for preparing the thesis document. Projects are scholarly activities that do not fit within the scope of a traditional thesis.

Projects require a formal proposal and must be approved by the student's committee. A formal document may not be appropriate for all projects. Documentation of the project is required, as is a formal presentation of the project. The formal presentation of the project must be approved by the student's committee.

For students in the Course Work Option, an additional 12 credit hours of graduate course work is required beyond 24 hours for a total of 36 hours. Students in this option will have a course work committee composed of a faculty advisor from each of the areas of emphasis that the student has selected. This committee will meet with the student each semester to discuss the student's progress, and it will approve all course work.

All undergraduate work will be assessed prior to acceptance 'into the degree program and deficiencies will be defined at that time. All deficiencies must be removed before students progress into the program.

Possible degree combinations with sample curriculum content blocks are:

Biology - Chemistry

18 credit hours in biology and chemistry

3 credit hours of technical writing

3 credit hours of applied science

6 credit hours of thesis or project

Biology - Earth Science

18 credit hours of biology and earth science

3 credit hours of statistics /

3 credit hours of technical writing

6 credit hours of thesis or project

Mathematics - Earth Science

32 credit hours of mathematics and earth sciences

4 credit hours of integrated science and mathematics

Please contact the program director to discuss additional degree combinations.

Courses in Integrated Science and Mathematics

A list of courses in integrated science (IGSC) with descriptions is provided below. Course listings and descriptions for earth science, environmental science, and physics are found in the "Non-program Courses" section in this Catalog. For a list of available courses in biology, chemistry, and applied science, please visit the "Master of Science in Biology," "Master of Science and Master of Arts in Chemistry", and the "Master of Science and Doctor of Philosophy in Applied Science" sections in this Catalog.

IGSC 5401 Integrated Science Methods

Prerequisite: At least 16 hours of science. This course incorporates lecture, laboratory work, and field methods to stress the learning of science as an active, integrated constructive process that involves experimentation, investigation, communication, reasoning and problem solving as they apply to life, earth and physical systems. Three hours of lecture per week and two hours of laboratory per week.

IGSC 7192,7292,7392 Independent Study

Independent study provides an opportunity for students to gain depth in a specialized area to support a particular aspect of their degree program. The specific topic and course of study for the independent study will vary by student. The student will develop the course of study in collaboration with a faculty member in the department and their academic advisor.

IGSC 7195/7295/7395 Internship in Integrated Science and Mathematics

Prerequisites: graduate standing and consent and approval of assignment by advisor. Supervised professional experience related to students discipline with governmental agencies, industry and consulting firms. Forty hours supervised work per credit hour. One, two, or three credit hours.

IGSC 7199, 7299, 7399, 7499 Special Topics

Prerequisites: variable, depending on instructor and course content. Courses will cover topics that draw from two or more scientific disciplines and that can be best taught from an integrated perspective. Credit and laboratory/lecture format vary depending on the topic. One hour of credit per one hour of lecture; one hour of credit per two-three hours of laboratory.

IGSC 7301 Higher Order Thinking in Science

Prerequisite: consent of the instructor. Laboratory-based; stresses the learning of science as active, integrated, constructive processes involving experimentation, investigation, communication, reasoning, and problem solving; show connections and relevant applications in life systems, earth systems, and physical systems; goals include helping teachers extend content learning and create successful learning environments for every student through use of manipulatives, calculators, science equipment, and various learning strategies; provides access to appropriate materials, equipment, and technology. Two hours of lecture and two hours of laboratory per week.

IGSC 7391 Cooperative Education in Integrated Science

Prerequisites: Graduate standing and consent and approval of assignment by advisor. Supervised professional experience related to students discipline with governmental agencies, industry, and consulting firms. This course requires a minimum of 200 semester work hours. Three credit hours.

IGSC 8100, 8200, 8300 Thesis Research

Under the supervision of the student's major advisor, along with the graduate advisory committee, the student will carry out original research to support his thesis. May be taken for a maximum of six hours.

Dickinson Hall, Room 622
(501) 569-8100

Mathematical Sciences

The Master of Science in Mathematical Sciences program provides advanced preparation for careers in private industry and government or for doctoral study. It is designed to accommodate full-time employees and can be completed in two years by including summer classes. Concentrations are offered in applied mathematics, applied statistics, computational sciences, and interdisciplinary mathematics. Computer labs are available with research-quality mathematical and scientific software. The program is continually adding to and updating its software and a number of courses in the program require computer use. Applied mathematics is critical to most areas of today's highly technological workforce, and the master's program is a passport to this exciting and expanding career field. For more information visit the mathematical sciences program website at ualr.edu/mathematics/.

Admission Requirements

- Baccalaureate degree from an accredited institution with a cumulative grade point average of 2.75 (4.0 scale) or 3.0 in the last 60 hours.
- Courses with a grade of C or greater in matrix algebra, differential equations, an advanced calculus sequence, statistical methods, and a scientific programming language.
- Six appropriate advanced mathematics hours with grades of C or greater (i.e., Analysis, Topology, Numerical Analysis, Mathematical Statistics)
- Official Graduate Record Examination score.
- Letters of Recommendation.
- Writing Sample.

Applicants lacking prerequisite classes must complete specified preparatory courses. Contact the program coordinator for details.

Program Requirements

The mathematical sciences degree requires 33 graduate semester credit hours with a master's research project or 36 graduate credit hours without the project, including 12 core hours; 3 research project hours or 6 alternate hours; 9 hours of mathematical emphasis courses; 9 hours from specialization; and written and oral comprehensive examination. In addition, the Graduate Record Examination general and mathematics sections must be taken during the first semester.

The written comprehensive examination covers material from the four core courses - MATH 7323 Advanced Numerical Analysis I, MATH 7350 Mathematical Statistics I, MATH 7311 Advanced Linear Algebra, and MATH 7322 Advanced Differential Equations. The oral comprehensive examination consists of a presentation from the student's area of specialization and a question and answer session derived from the student's course work..

Core Courses

MATH 7311 Advanced Linear Algebra
MATH 7322 Advanced Differential Equations
MATH 7323 Advanced Numerical Analysis I
MATH 7350 Mathematical Statistics I

Graduate Assistantships

A limited number of graduate assistantships are available. Contact the program coordinator for information.

Graduation Requirements

- Successful completion of an approved program of study.
- Pass both the written and oral comprehensive exams.

Specializations

There are two areas of specialization: applied mathematics and applied statistics.

Applied Mathematics

This specialization requires 33 semester credit hours, the research project, or 36 semester hours without the research project In addition to the 12 hours of core courses listed above, the degree requires 9 hours of mathematical emphasis courses, 9 hours of elective courses, MATH 8300, and written and oral comprehensive examinations.

Emphasis Courses

MATH 7312 Computational Linear Algebra
MATH 7324 Advanced Numerical Analysis II
MATH 7325 Partial Differential Equations

Approved Electives

MATH 5302 Complex Analysis
MATH 5308 Integral Transforms
MATH 7351 Mathematical Statistics II
MATH 7352 Mathematical Statistics III
MATH 7353 Linear and Nonlinear Regression
MATH 7354 Experimental Design
MATH 7355 Sampling Techniques
MATH 7399 Selected Topics
MATH 5305 Financial Math

Applied Statistics

This program is designed to place students into an industry working as a statistician. In addition to the 12 hours of core courses listed above, the degree requires MATH 7351, 7352, and 7353, 9 hours of courses in an area of emphasis, MATH 8300 or 6 hours of approved electives, and written and oral comprehensive examinations.

Approved Electives

MATH 7354 Experimental Design
MATH 7355 Sampling Techniques
MATH 7312 Computational Linear Algebra
MATH 7399 Selected Topics
MATH 5305 Financial Math

Emphasis Areas

MATH 7399 Special Topics
MATH 7354 Experimental Design
MATH 7355 Sampling Techniques

Examples of elective courses include:

STAT 7343 Programming in SAS
MATH 7350 Mathematical Statistics I
MATH 7351 Mathematical Statistics II
MATH 7352 Mathematical Statistics III
MATH 7353 Linear and Nonlinear Regression Models
MATH 7354 Experimental Design

Courses in Mathematics

MATH 5199, 5299, 5399 Selected Topics

Prerequisites: graduate standing, consent of instructor. Content varies; see semester schedule. One hour lecture per week for each hour of credit. Offered on demand.

MATH 5301 Analysis I

Prerequisites: MATH 2307, 3312. Real number system, Euclidean n-space, complex numbers, topology of general metric spaces, continuous functions, point-wise and uniform convergence, series, the derivative. Offered on demand.

MATH 5302 Complex Analysis

Prerequisite: grade of C or greater in MATH 5303. Algebra of complex numbers, analytic functions, integration, power series, Laurent series, elementary conformal mappings. Three hours lecture per week.

MATH 5303 Advanced Calculus I

Prerequisites: MATH 2307, 3312. Real number system, sequences, limits, continuity, metric spaces, convexity, derivatives, linear analysis, implicit function theorem.

MATH 5304 Advanced Calculus II

Prerequisite: MATH 4303/5303. Measure theory, geometry of curves and surfaces, differential forms, Stoke's theorem, and Green's theorem.

MATH 5305 Financial Mathematics

Prerequisites: Math 1451 or equivalent. Determining equivalent measures of interest; discounting; accumulating; determining yield rates; estimating the rate of return on a fund; amortization. Three credit hours.

MATH 5308 Integral Transform Theory

Prerequisite: MATH 3322. Linear differential equations; Laplace transform; functions of complex variable, integration by method of residues, Laplace transform inversion integral; Z- transform, Z-transform inversion integral, difference equations; Fourier series, Fourier transform.

MATH 5323 Numerical Analysis

Prerequisites: MATH 2307 or equivalent, 3312 or equivalent; scientific programming language. Error analysis, solutions of equations, interpolation, approximations, numerical differentiation and integration, linear systems.

MATH 7311 Advanced Linear Algebra

Prerequisite: MATH 3312. Vector spaces, subspaces, linear independence and dependence, basis and dimensions; linear transformations, null space, rank, isomorphism, inner product spaces, norms, inner products, orthogonal sets, orthogonal projections, bilinear and quadratic forms; eigen values and eigen vectors, similar matrices, diagonalization, symmetric and Hermitian matrices. Jordan canonical form. Three lecture hours per week.

MATH 7312 Computational Linear Algebra

Prerequisites; MATH 3312 and MATH 4323. LU decomposition; QR factorization; Iterative techniques for solving systems of equations, Gauss-Seidel; Eigen value problem, iterative and direct techniques, The Condition Number; Lanczos Algorithm. Three lecture hours per week.

MATH 7322 Advanced Differential Equations

Prerequisite: MATH 3322. Power series solutions, systems of differential equations, nonlinear ordinary differential equations, phase plane analysis, stability, differential equations and applications.

MATH 7323 Advanced Numerical Analysis I

Prerequisites: MATH 4323, 7311. Numerical solutions of linear operator equations, some nonlinear systems, optimization methods.

MATH 7324 Advanced Numerical Analysis II

Prerequisites: MATH 7323 and 7325. Numerical analysis of ordinary and partial differential equations. Three lecture hours per week.

MATH 7325 Partial Differential Equations

Prerequisites; MATH 3322 or equivalent course. First order equations in two independent variables, the method of characteristics, discontinuous and weak solutions; Linear second order equations, elliptic equations, hyperbolic equations, parabolic equations; Fourier series. Three lecture hours per week.

MATH 7326 Optimization

Prerequisites: MATH 3312 and 3322 or equivalent courses. Linear and nonlinear programming. Three lecture hours.

MATH 7327 Graph Theory

Prerequisites; MATH 3312 or equivalent course. Graphs and subgraphs; trees; connectivity; Euler tours and Hamiltionian cycles; matchings; planar graphs; directed graphs; networks. Three lecture hours per week.

MATH 7330 Theory of Finite Element Methods

Prerequisites: Math 2453 and Math 3322 or equivalent. Finite element method is a numerical technique for finding approximate solutions of partial differential equations. It has strong applications in engineering. This course will provide mathematical foundation for finite element method. Three lecture hours per week. Three credit hours.

MATH 7350 Mathematical Statistics I

Probability measures, combinatorial theory, random variables, continuous and discrete distributions, expectations, moments, jointly distributed random variables, independence, functions of a random variable, limit theorems.

MATH 7351 Mathematical Statistics II

Sampling, sampling distributions, order statistics, point estimators and their properties, interval estimators and their properties, tests of hypotheses, linear models, nonparametric methods.

MATH 7352 Mathematical Statistics III

Prerequisites; MATH 7350. Multivariate distribution theory and quadratic forms; Linear models and least squares; Analysis of categorical data; Non-parametric statistics; Decision theory and Baysian inference. Three lecture hours per week.

MATH 7353 Linear/Non-Linear Regression

Prerequisites; MATH 7350. Differentiation of vectors and matrices; random vectors and matrices; distribution theory; full rank linear regression models; non-linear regression models. Three lecture hours per week.

MATH 7354 Experimental Design

Prerequisites; MATH 7350 (may be taken as a corequisite with the consent of the instructor). Single factor experiments; Randomized blocks and Latin square designs; factorial designs; repeated measures; nested designs; response surfaces. Three lecture hours per week.

MATH 7313 Real Analysis

Prerequisites; A grade of C or greater in MATH 4302/5302. Set theory and axioms, functions of a real variable, Lévesque measure, differentiation and integration, Branch Spaces

MATH 7355 Sampling Techniques

Prerequisites: MATH 7350 (may be taken as a corequisite with the consent of the instructor). Simple random sampling; sampling for proportions; stratified random sampling; ratio estimators; systematic random sampling; cluster sampling; acceptance sampling. Three lecture hours.

MATH 7399 Selected Topics in Applied Mathematics

Prerequisite: consent of instructor. Topics in mathematics, applied mathematics, and numerical analysis may include discrete mathematics; ordinary, partial differential equations; integral transforms; complex variables; optimization techniques, linear algebra; approximation theory; topology; geometry; abstract algebra; number theory. Topics in statistics may include statistical inference, sampling, linear models, biostatistics, stochastic processes, statistical computing. May be repeated for credit when topic changes. Offered on demand.

MATH 8300 Master Research Project

Prerequisite: 18 graduate hours. Research and individual investigation on a topic in applied mathematics.

Nonprogram Courses in the College of Science

Many departments that do not offer graduate degrees provide graduate courses for other degree programs such as those in applied science, computer science, education, integrated science and mathematics, journalism, and Interdisciplinary Studies. Degree-seeking students should check with their advisors and/or the UALR Graduate School to determine which of these courses may be accepted toward graduation requirements, to inquire about prerequisites, or other requirements for these courses.

Courses in Astronomy

5301 Astrophysics

PHYS 2322 required. ASTR 2300 recommended, but not required. A graduate level course in astrophysics, with an emphasis on applying the tools of mechanics, electromagnetism, thermodynamics, and quantum theory to understand the processes inherent in galaxies, cosmology and the structure and evolution of stars, including a focus on extragalatic astronomy. This course is dual listed in the UALR Undergraduate Catalog as ASTR 4301. This course is not open to students with credit for ASTR 4301. Three hours of lecture per week.

Courses in Physics

PHYS 5199, 5299, 5399, 5499 Special Topics

Prerequisite: consent of instructor. Advanced, specialized topics of current interest in physics and astronomy. One, two, three, or four hours of lecture, or equivalent, per week.

PHYS 5310 Statistical Thermodynamics

Prerequisites: PHYS 2322, 3323. Microscopic, unified approach to thermodynamics, statistical mechanics with applications to ideal gases; includes blackbody radiation and conduction electronics, magnetic systems, the Debye model, chemical and phase equilibria. Three hours lecture, one hour optional discussion per week. Offered in spring on even years, or when in demand.

PHYS 5311 Classical Mechanics

Prerequisites: PHYS 2321, MATH 2306 or consent of instructor. Concepts of Newtonian mechanics, dynamics of particles and systems of particles, gravitation, vector analysis, dynamics of rigid bodies, moving coordinate systems, continuous media, small oscillations, and the methods of Lagrange and Hamilton. Three hours lecture, one hour optional discussion. Three credit hours.

PHYS 5321 Electromagnetism I

Prerequisite: PHYS 2322. Coulomb, Gauss laws; Poisson, Laplace equations and solutions in several coordinate systems; electric, magnetic energy; AC, DC circuits; Ampere's, Faraday's laws; vector potential; Maxwell's equations; propagation of electromagnetic waves. Three hours lecture, one hour optional discussion per week. Offered in fall on even years.

PHYS 5331 Modern Physics I

More detailed treatment of topics in Physics 3323; relativity, quantum mechanics, statistical physics, atomic and nuclear physics, elementary particles. Three hours lecture, one hour optional discussion per week. Offered in spring on odd years.

PHYS 5340 Solid State Physics

Structure of crystals, dispersion relations, specific heat, phonons, electric and magnetic properties of insulators and metals, band theory of metals, insulators and semiconductors, superconductivity. Three hours lecture, one hour optional discussion. Three credit hours.

PHYS 5350 Quantum Mechanics I

This course covers the concepts and history of quantum mechanics, experimental basis, the uncertainty principle, the Schrodinger equation with applications to simple systems, the hydrogen atom, perturbation theory, and the symmetry principles. Material from the Consortium for Upper-level Physics Software (CUPS) is assigned to enable students to investigate quantum systems in a sophisticated way. Three hours lecture and one hour optional discussion per week.

PHYS 5360 High Energy and Nuclear Physics

Prerequisite: PHYS 3323. Properties of the nuclei, nuclear structure and stability, quark-gluon structure of hadrons, thermodynamics of large ensembles of hadrons, nuclear reactions, instrumentation, and accelerators. Three hours lecture, one hour optional discussion per week. Three credit hours.

PHYS 5380 Wave Motion/Optics

Prerequisite: PHYS 2322. Wave equation and solutions, wave propagation, coherence, interference, diffraction, polarization, refraction and reflection, dispersion, interactions of light with matter, Huygens' principle, optical instruments, quantum optics. Three hours lecture, one hour optional discussion per week. Offered in spring on even years.

PHYS 7199, 7299, 7399 Selected Topics

Prerequisites: four undergraduate physics hours, professional experience in some physics area, consent of instructor. Topics include modern physics, astronomy; assists professionals to remain current in these fields; laboratory emphasis on physics demonstrations, experiments, simple astronomical observations. One hour lecture or two hours laboratory per week for each semester credit hour.

PHYS 7289, 7389, 7489 Graduate Research

Prerequisite: consent of department chairperson. Scholarly research and individual investigation on a topic in physics or astronomy; student will analyze, plan, and conduct experimental or theoretical work on a research problem. The student will spend four to six hours per week for each hour of credit earned. The exact hourly commitment per week will depend on the nature of the project and will be agreed on in advance by the student and the instructor; a memorandum of understanding must be signed by the student, instructor, and chairperson.