**ESE Core and Required Course**

The ESE Core consists of ESE 6301, 6303, and 6402, 6404, 6405, 6306 and 6307. All of the core courses are required. Optionally the student may obtain pass a written or oral exam over the subject material covered in the class. Enrollment in ESE 6107 is required during each semester of residence up to 6 semesters.

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**Environmental Science and Engineering Ph.D. Course Description**

**ESE Core and Required Courses**

**ESE 6301 - Environmental Law and Policy (3-0).** Focus is on the formulation, implementation, enforcement and evaluation of environmental policies. A review of the legal and administrative environmental systems of both the United States and Mexico will be included. Questions of environmental equity will be addressed.

Prerequisite: Admission to the ESE program or permission of the ESE Program Director.


Prerequisite: Admission to the ESE program or permission of the ESE Program Director.
ESE 6402 - Environmental Chemistry (3-3). Review of classification and properties of chemical materials of environmental interest. Study of chemical principles pertaining to acidity, basicity, redox properties, solubility, partitioning and transport in the environment. Chemical reactions in aqueous, soil/sediment and atmospheric phases. Environmental analytical techniques. The laboratory emphasizes analytical protocols utilized in environmental laboratories.

Prerequisites: One year of introductory work in chemistry. Admission to the ESE program or permission of the ESE Program Director.

ESE 6404 - Environmental Biology (3-3). An examination of the theoretical and experimental aspects of the relationship between biological and physical environments at the individual, population, community, and ecosystem levels. This includes microbial ecology and biogeochemical cycling of nutrients.

Prerequisites: One year of introductory work in biology. Admission to the ESE program or permission of the ESE Program Director.

ESE 6405 - Environmental Geoscience (3-3). Application of earth science principles to environmental issues. Topics will include fundamentals of physical geology and their applications to geohazards, engineering geology, surface and ground water, erosion, and environmental geochemistry. Atmospheric and climate topics will include global change issues. Labs will feature hands-on experience with earth materials, maps, analytical techniques, and environmental problem solving. Team-taught by ESE geological sciences faculty.

Prerequisites: One semester of introductory work in physical geology. Admission to the ESE program or permission of the ESE Program Director.

ESE 6306 - Principles of Experimental and Engineering Design (3-0). Students with different backgrounds examine experimental and engineering design principles with special application to the solution of environmental problems. Student teams will be formed to define an interdisciplinary environmental problem of regional interest.

Prerequisite: Admission to the ESE program or permission of the ESE Program Director.

ESE 6307 - Interdisciplinary Environmental Problem Solving (3-0). Students with different backgrounds will work in teams to examine interdisciplinary environmental issues specific to the Far West Texas Border region and prepare team reports with recommendations, which consider scientific, political, economic and social aspects.

Prerequisites: Admission to the ESE program, and ESE 6306 or permission of the ESE Program Director.

Graduate Seminar

ESE 6107 - Graduate Seminar (1-0). Presentation and discussion of topics in environmental science and engineering by graduate students, faculty and visitors.

Prerequisite: Admission to the ESE program or permission of the ESE Program Director.

Research and Dissertation
**ESE 6396 - Doctoral Research (3-0).** Directed research on topics in environmental science and engineering related to the dissertation or conducted as a component of the student's overall graduate program.

Prerequisite: Admission to the ESE program or permission of the ESE Program Director

**ESE 6398 - Dissertation (3-0).** Taken when preparation of the dissertation is begun. One enrollment is required.

Prerequisites: Admission to the ESE program and passage of the comprehensive examination.

**ESE 6399 - Dissertation (3-0).** Taken continuously during preparation of the dissertation.

Prerequisites: Admission to the ESE Program and ESE 6398.

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**ESE ELECTIVES**

Note: Elective classes are as approved by the committee, the list below is a sample of course offerings.

**BIOL 5307 - Biology of the Pleistocene (3-0).** Study of the organisms of the Pleistocene. As it relates to the ESE program, this course will put the climatic change that we observe today into perspective through comparison with climatic change in the Pleistocene and thus assist students in understanding if the changes seen today are human-caused.

**BIOL 5328 - Numerical Analysis in Biology (2-3).** Study and application of specialized numerical methods in biological sciences.

Prerequisite: Undergraduate core mathematics (MATH 4329) in Biology or equivalent.

**BIOL 5343 - Mechanisms of Cellular Toxicity (3-0).** Theory and application of toxicology. Focus will be on the absorption, distribution, excretion, and metabolism of xenobiotic and toxic materials and the molecular approaches to the study of toxicology.

**BIOL 5346 - Ecosystem Toxicology (3-0).** Practical analysis of degraded natural communities of plants and animals, including biotic inventories, detection of bioaccumulated toxins and the use of indicator species.

**BIOL 6312 - Biodiversity (3-0).** Genotypic and phenotypic diversity at the population, species, and community levels. Role of bioconservation in maintaining intact communities and preserving genetic heterogeneity.

**CE 5302 - Groundwater Hydrology (3-0).** A general course in groundwater hydrology, emphasizing fundamental principles and their applications to practical problems. Topics included are hydrologic cycles, geologic environments and controls, unsaturated and saturated zones, Darcy’s law, continuity and energy principles, Navier-Stokes equations, flow equations, steady and unsteady hydraulics, aquifer tests, analytical and numerical models and computer codes.

Prerequisite: Permission of instructor.

**CE 5312 - Environmental Processes (3-0).** Critical study of fundamental theories and modeling approaches for physical, chemical and biological processes that affect the fate of chemicals in the
environment. Mass flow and diffusion, kinetics and equilibrium, solubility and precipitation, volatilization, oxidation-reduction, types of sorption, complexation, radiodecay and biotransformation. Applications focus on waste disposal, soil and groundwater reclamation, and advanced water and wastewater treatment operations.

Prerequisite: Permission of instructor.

**CE 5321 - Industrial Hygiene and Toxicology (3-0).** Techniques of industrial toxicology, mechanisms by which toxic gases, vapors, and dusts produce disease in experimental animals and in humans.

Prerequisite: Permission of instructor.

**CE 5326 - Air Pollution Control (3-0).** Effect of air pollution, classification of wastes, meteorological factors, sampling and analysis, abatement, statistical analysis.

Prerequisite: Permission of instructor.

**CE 5342 - Groundwater Contamination and Reclamation (3-0).** This course is a study of groundwater pollution sources and typical cases in hazardous and radioactive waste management. It emphasizes the fundamentals of flow and transport of chemicals in porous media and the modeling phase distribution of chemicals in subsurface environments. Use of state-of-the-art computer codes (mainframe computers and microcomputers). Applications to either planning, case evaluation, remedial action or clean-up technologies.

Prerequisite: Permission of instructor.

**CHEM 5318 - Advanced Analytical Chemistry (3-0).** This course is a study of chemical equilibrium and its applications to separation and analysis.

**CHEM 5319 - Contemporary Topics in Analytical Chemistry: Environmental Chemistry (3-0).** Examination of the sources of environmental contamination and the classes of chemicals associated with them. Information on chemical analytical techniques used to monitor the environment.

**GEOP 5357 - Well Logging (2-2).** The application of well logs to hydrogeologic, petroleum, and mineral studies to characterize sedimentation history and quantitatively evaluate rock and fluid properties.

Prerequisite: Graduate Standing.

**GEOL 5315 - Selected Topics in the Geological Sciences (3-0).** Study of advanced topics in such fields as environmental geoscience, economic geology, risk assessment, microprobe, GIS, geochemistry, and others. May be repeated when the topics vary.

Prerequisite: Instructor approval.

**GEOL 5345 - Environmental Geochemistry (3-0).** Processes of a geological nature, which are important in environmental studies, will be the topic of this course. The geological context is usually important in determining the effect of foreign intrusions into the natural environment. This course will involve problem solving, class participation, exams, field trips, and a semester project report.
Prerequisite: Graduate standing or instructor approval.

**GEOL 5375 - Quantitative Techniques in the Geological Sciences (2-3).** This course is an introduction to techniques for quantitative analysis of geologic data, with an emphasis on the extraction of maximum information from large data matrices and a focus on specific applications to petroleum and mineral exploration.

**GEOL 5376 - Low Temperature Geochemistry (2-2).** This course is a study of the chemical reactions at the earth=s surface and their interpretation by thermodynamic and kinetic principles. Precipitation and dissolution, the solid-solution interface, oxidation and reduction, the distribution and circulation of elements and compounds.

Prerequisite: CHEM 1306.

**GEOL 5382 - Chemical Hydrogeology (3-0).** This course is a study of the chemistry of ground and surface water. Subjects covered by the course are the chemistry of natural waters, chemistry of weathering, chemical interactions between geological materials and water, groundwater contamination and the movement of contaminants in groundwater.

Prerequisite: Graduate standing

**GEOL 5383 - Physical Hydrogeology (2-3).** The first part of the class will highlight subsurface geology and groundwater flow, recharge and discharge of groundwater and the interaction between surface water bodies and groundwater. The second part of the course will focus on well hydraulics with aquifer tests to determine hydraulic parameters such as transmissivity, hydraulic conductivity, and storage in various types of aquifers.

**GEOL 5384 - Nuclear Waste Disposal (3-0).** This course is an in-depth study of problems and issues associated with the past, current, and projected principles and methods of nuclear waste disposal. The multidisciplinary legal, political, and technical aspects of siting, operation, and decommissioning of reactors and the subsequent removal of source waste generated at these facilities are considered. The course examines waste removal classification, containerization, quality assurance, and transport. Waste repository selection, performance assessment, operation and entombment, in various geological media, are stressed.

Prerequisites: Graduate standing; students outside the colleges of Engineering and Science will require permission of the instructor.

**MICR 3328 - Microorganisms in Ecosystems (3-0).** This course focuses on the relationship between microorganisms (viruses, bacteria, fungi, algae, and protozoa) and their environment (air, water and soil microbiology decomposition, and pollution). Concurrent with MICR 2141.

Prerequisites: BIOL 1305-1107 and (or concurrent with) CHEM 1306-1106

**Environmental Health**

In addition to electives offered as part of UTEP=s ESE Program, students may also take graduate-level course work offered by the University of Texas Health Science Center at Houston School of Public Health= s MPH program in El Paso. These relevant electives include:

**PHEP 2110 - Overview of Environmental Health (4 credits).** This course is designed as a first course for students undertaking a graduate program in Environmental Sciences and as an overview course for students in other graduate programs wishing to gain an understanding of
elements of environmental health. The course covers external factors in the environment that impact on human health, biological mechanisms that maintain homeostasis and defend humans against environmental insults, adverse health effects induced by environmental agents, and efforts to minimize the occurrence of these adverse health effects. Concepts derived from the environmental sciences, physiology and biochemistry, ecology, toxicology, epidemiology, and environmental management are utilized in this overview.

**PHEP 2498 - Special Topics in Environmental Sciences: Risk Assessment and Risk Communication (3 credits).** Study of risk assessment and communication methods through case studies. Risk assessment methods are taught using mathematical models and GIS software on PCs. Methods for characterizing important risk management issues in communities are presented with a focus on the concerns for environmental equity. Each semester, the class will apply these methods to a local environmental health issue.