

# DEPARTMENT OF ENVIRONMENTAL AND INTERDISCIPLINARY SCIENCES

The **Environmental Toxicology** degree program is offered through the Graduate School and housed in the Department of Environmental and Interdisciplinary Sciences within the College of Science, Engineering and Technology. The program is interdisciplinary with support provided by faculty mainly from the College of Science, Engineering and Technology and the College of Pharmacy and Health Sciences.

The department offers two degree programs which lead to a Master of Science in Environmental Toxicology or a Doctor of Philosophy in Environmental Toxicology. In offering these degrees, the program is designed to:

1. Prepare students for professional careers in industry, government, and higher education
  2. Produce independent, hypothesis-driven researchers
  3. Prepare scientists who have knowledge of the basic mechanisms by which pollutants act in the natural environment.
  4. Produce qualified graduates capable of conducting environmentally relevant research in the biological, chemical, or physical Sciences
  5. Prepare professionals who are capable of making an impact on the environment by completing environmental risk assessments and developing appropriate environmental planning and management models that will be used in formulating environmental policy.
  6. Train environmental toxicologists who are trained to anticipate, assess, and recommend action on a wide spectrum of environmental problems.
  7. Increase the number of underrepresented minority researchers in the field of environmental toxicology.
- Environmental Toxicology (Non-Thesis Option), Master of Science (<https://catalog.tsu.edu/graduate/schools-colleges/science-engineering-technology/environmental-interdisciplinary-sciences/environmental-toxicology-non-thesis-option-ms/>)
  - Environmental Toxicology (Thesis Option), Master of Science (<https://catalog.tsu.edu/graduate/schools-colleges/science-engineering-technology/environmental-interdisciplinary-sciences/environmental-toxicology-thesis-option-ms/>)
  - Environmental Toxicology, Doctor of Philosophy (<https://catalog.tsu.edu/graduate/schools-colleges/science-engineering-technology/environmental-interdisciplinary-sciences/environmental-toxicology-phd/>)

## ES 701 Principles of Toxicology (3 Credits)

**Lecture:** 3

This course presents the fundamental and basic concepts of toxicology, including dose-response relationships, pathogenesis of toxic exposures, metabolism of toxicants, toxic kinetics, activation and detoxification mechanisms, biologic and chemical factors that influence toxicity, mechanisms of carcinogenesis and mutagenesis target organ toxicology, the principles of testing for toxic effects, epidemiology and concepts of risk assessment.

**College/School:** Col of Science, Engr & Tech

**Department:** Dept Environmental Toxio

## ES 702 Environmental Toxicology I (3 Credits)

**Lecture:** 3, **Lab:** 0

This course presents topics illustrating toxic chemicals, their occurrence, structure, and the reactions underlying detection, toxicity, fate, and ecological importance.

**College/School:** Col of Science, Engr & Tech

**Department:** Dept Environmental Toxio

## ES 703 Environmental Science (3 Credits)

**Lecture:** 3

This course will provide students with the scientific principles, concepts, and methodologies required to understand and identify environmental problems both natural and human-made, to evaluate the relative risks associated with these problems, and to examine alternative solutions for resolving and/or preventing them.

**College/School:** Col of Science, Engr & Tech

**Department:** Dept Environmental Toxio

## ES 704 Aquatic Resources & Pollution (3 Credits)

**Lecture:** 3

This course presents a survey of global aquatic systems and resources and the impacts of mankind on these resources. Topics include impacts of chemicals on aquatic ecosystems and man's utilization of marine resources. Scientific method applied to the processes. Biota and history of the aquatic systems and major scientific breakthroughs will be explored.

**College/School:** Col of Science, Engr & Tech

**Department:** Dept Environmental Toxio

## ES 705 Environmental Policy & MGMT (3 Credits)

**Lecture:** 3

This course presents an examination of selected topics in the formulation and implementation of environmental policy with a principal emphasis on conceptual and methodological issues. Examination of recent research and practice in the evaluation of environmentally related policies, programs, and plans will be reviewed.

**College/School:** Col of Science, Engr & Tech

**Department:** Dept Environmental Toxio

## ES 707 Ground Water Contamination (3 Credits)

**Lecture:** 3, **Lab:** 0

The emphasis of this course will be on acquiring extensive working knowledge of the concepts, principles and professional practices underlying groundwater pollution, hydrology and remediation.

**College/School:** Col of Science, Engr & Tech

**Department:** Dept Environmental Toxio

**ES 711 Air Pollution (3 Credits)****Lecture:** 3

This course is designed to study the influence of man-caused pollution on the atmosphere and its effect on human health and economy. Techniques for the measurement of atmosphere pollutant concentrations and determination of local and regional air quality will also be covered. Detailed presentation of air pollution sources and methods for their control will be covered. The role of local, state and federal government in air pollution control will be reviewed.

**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 718 Special Topics Environ Tox (3 Credits)****Lecture:** 3

Special topics will be assigned and discussed in relation to new findings and trends in environmental toxicological study and research. (Prerequisite: Consent of the professor)

**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 720 GIS for Environmental Sciences (3 Credits)****Lecture:** 2, **Lab:** 1

Geographical Information Systems for environmental sciences is an introductory course to the concepts and use of geospatial (GIS and GPS) technology. It involves introducing the hardware and software component of the GIS and review of GIS applications for the field of environmental study. 2 credit hours lecture and 1 credit hour lab.

**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 724 Research Problems (1-6 Credits)****Lecture:** 1-6, **Lab:** 0

This course provides supervised student research on approved problems suitable for the preparation of a thesis.

**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 730 Introduction to Remote Sensing Image Processing (3 Credits)****Lecture:** 2, **Lab:** 1

Introduction to remote sensing and image processing is designed to introduce and explore the basic applications of remotely sensed data in the evaluation of environmental problems. The course includes the theories and principles of remote sensing, types of sensors, identification and mapping the materials. 3 credit hours, 2 lecture and 1 lab.

**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 901 Environmental Toxicology (3 Credits)****Lecture:** 3, **Lab:** 0

ENVIRONMENTAL TOXICOLOGY (3) Topics illustrating toxic chemicals, their occurrence, structure, and the reactions underlying detection, toxicity, fate, and ecological importance.

**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 902 Environmental Toxicology II (3 Credits)****Lecture:** 3

This course presents biochemical and physiological mechanisms underlying toxicity and detoxification. (Prerequisite: ES 702)

**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 903 General Ecology (3 Credits)****Lecture:** 3

GENERAL ECOLOGY (3) Ecological principles of biological systems, emphasizing populations and ecosystems. Principles of growth, regulation, distribution, structure, energetics, and mineral cycles related to the evolution of biological systems and applications to selected human ecological problems. Field trips required.

**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 904 The Oceans (3 Credits)****Lecture:** 3

THE OCEANS (3) Introductory survey of the marine environment. Oceanic physical-phenomena, chemical constituents geological history, and the sea's biota: Man's utilization of marine resources. Scientific method applied to the processes. Biota and history of the oceans and major scientific breakthroughs explored.

**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 905 Environmental Policy & Mgmt. (3 Credits)****Lecture:** 3, **Lab:** 0

ENVIRONMENTAL POLICY & MANAGEMENT (3) An examination of selected topics in the formulation and implementation of environmental policy, with a principal emphasis on conceptual and methodological issues. Examination of recent research and practice in the evaluation of environmentally related policies, programs, and plans.

**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 906 Environmental Geology (3 Credits)****Lecture:** 3

This course presents a study of the influence of geologic processes and hazards on human activities. Emphasis will be placed upon topics of interest to students in environmental science and toxicology.

**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 907 Limnology (3 Credits)****Lecture:** 3**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 908 Sample Analysis (3 Credits)****Lecture:** 3

This course presents the principles of the microanalysis of toxicants. The course addresses theoretical microanalysis of toxicants, separation, detection, and quantitative determination of toxicants using chemical and instrumental methods. (Prerequisite: CHEM 332 Analytical Chemistry and consent of instructor)

**Prerequisite(s):** (CHEM 332)**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 909 Sample Analysis Laboratory (3 Credits)****Lecture:** 0, **Lab:** 9

This course presents laboratory techniques for microanalysis of toxicants. The course addresses separation, detection, and quantitative determination of toxicants using chemical and instrumental methods. (Prerequisite: ES 908 [may be taken concurrently] or by consent of instructor)

**Prerequisite(s):** (ES 908)**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio

**ES 910 Reproductive Toxicology (3 Credits)****Lecture:** 3

This course introduces students into the field of reproductive toxicology. Specific topics include exposure to chemicals during pregnancy, the teratology of chemical exposure, folic acid and the classical and the environmental estrogen saga. Special attention is given to the interpretation of animal reproductive toxicity studies which form the basis for human risk assessment of chemicals.

**College/School:** Col of Science, Engr & Tech

**Department:** Dept Environmental Toxio

**ES 911 Gas Chrom & Mass Spec of Toxic (3 Credits)****Lecture:** 3

GAS CHROMATOGRAPHY & MASS SPECTROMETRY OF TOXIC CHEMICALS (3) Application of GC and MS techniques to investigate toxic chemicals. Mass spectral fragmentation and their application to structural identification and structural elucidation. Practical application of GC/MS in current research. (Prerequisite: CHEM 453 or equivalent)

**Prerequisite(s):** (CHEM 453)

**College/School:** Col of Science, Engr & Tech

**Department:** Dept Environmental Toxio

**ES 912 Neurotoxicology (3 Credits)****Lecture:** 3

This course presents mechanism of action of a number of different neurotoxins, including marine toxins, insecticides and heavy metals. The course gives examples of ways toxins may act on the nervous system and techniques for the study of neurotoxicology.

**College/School:** Col of Science, Engr & Tech

**Department:** Dept Environmental Toxio

**ES 913 Adv Simulation Modeling (3 Credits)****Lecture:** 3

This course presents advanced techniques in simulation modeling, optimization and simulation, dynamic parameter estimation, linear model error propagation, and sensitivity testing; model evaluation in ecological and social systems.

**College/School:** Col of Science, Engr & Tech

**Department:** Department of Chemistry

**ES 914 Modeling Laboratory (3 Credits)****Lab:** 3

Students must complete a series of exercises on advanced topics in modeling and a term project based on their graduate research.

**College/School:** Col of Science, Engr & Tech

**Department:** Department of Chemistry

**ES 915 Adv Physical Chemistry (3 Credits)****Lecture:** 3, **Lab:** 0

This course presents principles and applications of statistical mechanics; ensemble theory; statistical thermodynamics of gases, solids, liquids, electrolyte solutions, polymers and chemical equilibriums. (Prerequisite: Chemistry 432 or equivalent)

**Prerequisite(s):** (CHEM 432)

**College/School:** Col of Science, Engr & Tech

**Department:** Dept Environmental Toxio

**ES 916 Chemistry of Natural Products (3 Credits)****Lecture:** 3

This course presents advanced treatment of chemistry of naturally occurring compounds isolated from a variety of sources. Topics will include isolation, structure determination, chemical transformations, total synthesis, biological activity, and biosynthesis. (Prerequisite: CHEM 232 or equivalent)

**Prerequisite(s):** (CHEM 232)

**College/School:** Col of Science, Engr & Tech

**Department:** Dept Environmental Toxio

**ES 917 Bioorganic Chemistry (3 Credits)****Lecture:** 3

BIOORGANIC CHEMISTRY (3) Structure and function of biomolecules; molecular recognition; enzyme reaction mechanisms; design of substrates for I enzymes; enzyme engineering; design of artificial enzymes and application of enzymes in organic synthesis. (Prerequisites: CHEM 232, CHEM 445 or equivalents)

**Prerequisite(s):** (CHEM 232)

**College/School:** Col of Science, Engr & Tech

**Department:** Dept Environmental Toxio

**ES 918 Special Topics (3 Credits)****Lecture:** 3

SPECIAL TOPICS IN ENVIRONMENTAL TOXICOLOGY (3) Special topics will be assigned and discussed in relation to new findings and trends in environmental toxicological study and research. (Prerequisite: Consent of the professor)

**College/School:** Col of Science, Engr & Tech

**Department:** Department of Chemistry

**ES 919 Special Topics (3 Credits)****Lecture:** 3

Special topics will be assigned and discussed in relation to new findings and trends in environmental toxicological study and research. (Prerequisite: Consent of the professor)

**College/School:** Col of Science, Engr & Tech

**Department:** Dept Environmental Toxio

**ES 920 Special Topics (3 Credits)****Lecture:** 3

Special topics will be assigned and discussed in relation to new findings and trends in environmental toxicological study and research. (Prerequisite: Consent of the professor)

**College/School:** Col of Science, Engr & Tech

**Department:** Dept Environmental Toxio

**ES 921 Sem in Envir Toxicology (2 Credits)****Lecture:** 2

This course discusses pertinent diverse issues related to the field of environmental toxicology based on reports, lectures and field experiences. Attendance and/or viewing with written reports on seminar presentations is required. (Prerequisite: Consent of the professor)

**College/School:** Col of Science, Engr & Tech

**Department:** Dept Environmental Toxio

**ES 922 Sem in Envir Toxicology (2 Credits)****Lecture:** 2

This course discusses pertinent diverse issues related to the field of environmental toxicology based on reports, lectures and field experiences. Attendance and/or viewing with written reports on seminar presentations is required. (Prerequisite: Consent of the professor)

**College/School:** Col of Science, Engr & Tech

**Department:** Dept Environmental Toxio

**ES 923 Sem in Envir Toxicology (2 Credits)****Lecture:** 2

This course discusses pertinent diverse issues related to the field of environmental toxicology based on reports, lectures and field experiences. Attendance and/or viewing with written reports on seminar presentations is required. (Prerequisite: Consent of the professor)

**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 924 Research Problems (3,6 Credits)****Lecture:** 6

RESEARCH PROBLEMS - MASTER'S DEGREE STUDENTS (6) Supervised student research on approved problems suitable for the preparation of a thesis.

**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 925 Research & Dissertation (1-12 Credits)****Lecture:** 1-12

This course provides supervised research and dissertation preparation.

**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 926 Internship (3-6 Credits)****Lecture:** 6

This course provides supervised research and dissertation preparation.

**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 927 Biomedical Statistics (3 Credits)****Lecture:** 3

This course will review the practices of research design and data collection and the use of statistics for data interpretation with emphasis on proper presentation of data in the scientific format.

**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 928 Toxicology I (3 Credits)****Lecture:** 3**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 929 Toxicology III (3 Credits)****Lecture:** 3

This course examines the advanced concepts of toxicology. Distribution, absorption, metabolic conversion, and elimination of toxic agents are discussed. Mechanisms of injury to various body systems following exposure to toxic chemicals are explored at the systemic, organ, and cellular levels. Topics also include classes of toxicants, methods for detecting and evaluating their effects, and the scientific basis for risk estimation in humans.

**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 930 Biochemistry (3 Credits)****Lecture:** 3

Topics covered include chemical principles of biologic systems; chemical and physical properties of nucleotides, amino acids, proteins and water; protein structure and stability; introduction to steady-state kinetics; enzyme mechanism; controlling enzyme activity; metabolic circuitry; glucose transport and metabolism; pyruvate metabolism; the TCA cycle; electron flow and Ox- Phos; glycogen metabolism; gluconeogenesis and the pentose shunt; fatty acid catabolism and synthesis; disposal of nitrogen: the urea cycle; amino acid catabolism and synthesis; integrating metabolism: fed and fasted states and exercise; structure of nucleic acids; physical properties of nucleic acids, DNA replication and repair; transcription and its control; RNA processing and Translation.

**College/School:** Col of Science, Engr & Tech**Department:** Department of Chemistry**ES 931 Ethics (3 Credits)****Lecture:** 3

This course will enhance students' understanding of core ethical issues in research. Focus will be made on IRBs (Institutional Review Boards), IACUC (Institutional Animal Care and Use Committees), roles of ethical theories, principles, and human rights. Topics in scientific research will include elements of good science and conflicts of interest.

**College/School:** Col of Science, Engr & Tech**Department:** Department of Chemistry**ES 932 Contemporary Topics in Toxicol (3 Credits)****Lecture:** 3**College/School:** Col of Science, Engr & Tech**Department:** Dept Environmental Toxio**ES 933 Mutagenesis Carcinogenesis (3 Credits)****Lecture:** 3

This course analyzes the modes by which organisms handle damage to DNA by physical and chemical agents, the mechanisms of converting damage to mutations, and the theoretical basis for carcinogenesis screening methods utilizing mutagenesis. Topics include systems for mutagenesis testing, mutational spectra, and inducible responses to DNA damage

**College/School:** Col of Science, Engr & Tech**Department:** Department of Chemistry**ES 934 Molecular Basis of Gene Action (3 Credits)****Lecture:** 3

This course examines advanced topics related to prokaryotic and eukaryotic gene expression and regulation. Conventional and non-conventional cloning tools will also be discussed as they relate to gene expression. The course will also cover topics in genomics and transcriptomics.

**College/School:** Col of Science, Engr & Tech**Department:** Department of Chemistry**ES 935 Stat Aspects of Risk Assessmen (3 Credits)****Lecture:** 3

This course is designed to introduce the potential environmental toxicology specialist to the comprehensive coverage of environmental impact and risk assessment disciplines as tools to environmental planning and management, policy decision making and regulatory standard setting of exposure limits to toxic substances.

**College/School:** Col of Science, Engr & Tech**Department:** Department of Chemistry

**ES 936 Occ & Environ Epidemiology (3 Credits)**

**Lecture: 3**

This course will introduce students to environmental and occupational epidemiologic study designs, basic and novel methods of exposure assessment, and methodologies to improve study validity within this focus area.

**College/School:** Col of Science, Engr & Tech

**Department:** Department of Chemistry