DESCRIPTION OF COURSES

REQUIRED COURSES

ENV 700: Environmental Systems (*3 hours*). A groundwork of environmental science, environmental awareness and ecological literacy for the incoming Ph.D. students is presented. The environment and its living and non living components, and the interactions of these component areas studied. The course is set in a thermodynamic perspective and is based on a nested hierarchy of systems. Key concepts and principles that govern how we think the environment works are presented while learning how to apply these concepts to possible solutions of various environmental degradation, pollution and resource problems.

ENV 701: Environmental Chemistry
(*3 hours*). Prerequisites: One year of general Chemistry and one year of organic chemistry. Studies of the basic concepts of environmental chemistry; the nature of chemical compounds; organic and inorganic; chemical reactions; their effects, and fate of chemical species, in aquatic systems. This include: Studies of equilibrium phenomena of acids, bases, salts, complex compounds, and oxidation/reduction reactions. Studies of water pollution, environmental chemistry of water and its properties.

ENVL 701: Environmental Chemistry
(*1 hour*). Experiments done for the purpose of water quality control and assessment, such as the determination of alkalinity, acidity, water hardness, biochemical oxygen demand (BOD), and other important parameters. The laboratory is coordinated to go with the lecture material.

ENV 702: Environmental Health
(*3 hours*). Thiscourse focuses on the impact of environmentalproblems on human health. Health issues related to water pollution/contamination by physical, chemical and biological agents; wastewater discharges; radiations; air pollution; municipal, and industrial wastes; food contamination; pesticides; occupational hazards; and vector-borne diseases are discussed.

ENV 711: Applied Environmental Biostatistics
(*3 hours*) Prerequisite: Biostatistics (Bio 511) or equivalent. This course is designed as an applied, advanced biostatistics course for students in the Environmental Science Ph.D. Program. Students will learn how to apply important concepts and principles of environmental biostatistics in the conduct of their research, from the initial designing of experiments to proper data collection and analysis, inferences, interpretation of results in applied terms, reporting and presentation of the results. The statistical computer software (SAS) will be used to analyze and interpret results.

ENV 751: Water Quality Management
(*3 hours*). This course provides students with basic concepts and principles in Water Quality Management. The effects of organic, inorganic, biological and thermal pollutants/contaminants in various systems of the hydrologic cycle including streams, reservoirs, and estuaries; eutrophication; water quality criteria and standards; monitoring concepts; methods in water quality management; regulatory considerations; and non point source pollution control, are discussed.

ENV 755: Air Quality Management
(*3 hours*). This course provides students with basic concepts and principles of air quality management. Contaminant classification, pollutant sources, criteria pollutants, health effects, exposure and risk assessment are discussed. Pollutant measurements and air quality assessment techniques are considered with regard to atmospheric effects on dispersion and transport. Identification of, and control strategies for, stationary and mobile sources, and environmental regulations are studied, and indoor air quality considered.

ENV 800: Environmental Toxicology
(*3 hours*). Prerequisites: ENV 701, ENV 702. This course is designed to provide an overview of the basic principles and concepts of toxicology including: exposure characterization, dose-response relationship, kinetics and distribution of toxicants in a biological system; to understand the fate, behavior and toxicities of xenobiotic chemicals, and the

mechanisms by which they affect cells and organs; and to identify the sources and discuss the effects of various groups of environmental toxicants including heavy metals, pesticides and other industrial byproducts.

ENVL 800: Environmental Toxicology (*1 hour*). This course is designed to familiarize the students with important laboratory and field procedures and methods used in toxicological testing of environmental toxicants; and to discuss the strengths and weaknesses of major methodologies including acute, subacute, subchronic and chronic bioassays.

ENV 801: Risk Assessment and Management (*3 hours*). Prerequisites: ENV 800, MATH 700. This course is designed to provide students with qualitative and quantitative skills necessary to evaluate the probability of injury, disease and death in humans and other life forms, from exposure to various environmental contaminants. Hazard identification, exposure assessment, dose-response evaluation and risk characterization are emphasized. Regulatory and technical aspects of risk assessment in the promulgation of public and environmental safety standards are discussed.

ENV 900: Seminar
(*0.5 hr x 4 semesters =2*) (Lecture). This course focuses on contemporary issues in environmental health science. The student is expected to review, discuss, and present orally a report on a topic related to contemporary environmental issues. Topic areas for selection include (but not limited to): environmental biology, environmental chemistry, environmental microbiology, environmental toxicology, atmospheric science, water quality management, solid and hazardous waste management, computer modeling and remote sensing. Students are required to attend all scheduled seminars.

ENV 999: Dissertation Research
(*20 hours*). Original research in one of several subdisciplines in Environmental Science. Credit per academic session allowable is 1-6 hours. Student must produce, present and defend a document of publication quality.

ELECTIVE COURSES

CSC 700: Computer Modeling (*3 hours*). The purpose of this course is to provide the student with the fundamental knowledge of simulation models, writing programs to generate random numbers from various probability distributions using differential methods, and testing the statistical properties of random number generators. The student will also be trained to write simple programs to simulate real life situation models using GPSS language.

CSC 800: Image Interpretation (*3 hours*). This course presents a broad overview of various image processing concepts and techniques. Topics include the history of remote sensing, image digitations, data formats, hardware and software functions, commercial and public available digital processing systems, image preprocessing (radiometric and geometric correction), image enhancement, image classification, change detection, interfaces of remote sensing and geographical information system (GIS), and the future of digital image processing.

MATH 700: Statistics and Experimental Design. (*3 hours*) Prerequisite: MATH 272 or 2 semesters of Introductory Statistics. Probability; random variables; expectation of a function of random variables; sampling distribution; estimation; hypothesis testing; designed experiments; completely randomized design; randomized complete block design; Latin square design; factorial experiments; statistical software application to statistical analysis, are discussed.

MET 801: Environmental Meteorology (*3 hours*). Principles of atmospheric science as applied to gaussian modeling of pollutants. Includes source review and receptor identification and modeling, National Ambient Air Quality Standards and human health and welfare impacts, plume behavior, and access of EPA models, running of EPASCREEN, and web site information. Special topics covered include: scavenging; acid precipitation; weather modification,

green house enhancement; stratospheric ozone; scrubbers; and indoor air quality.

ENV 715: Principles of Bioremediation (*3 hours*). This course uses modern knowledges in life sciences, as well as new developments in biotechnology to address important issues related to environmental clean-up of hazardous wastes. The nature of environmental pollution is reviewed, and basic concepts in molecular biology, biochemistry, microbiology and plant physiology are applied to demonstrate the significance of bioremediation and phytoremediation in pollution control. Therefore, an emphasis is put on the use of biological methods and processes for the remediation of contaminated soils and water resources.

ENVL 715: Principles of Bioremediation
(*1 hour*). Laboratory and field experiments conducted to familiarize students with relevant bioremediation techniques and methodologies. Identification and classification of microorganisms, use of bacteria in toxicity assessment, biodegradation of organic contaminants, and phytoremediation of toxic metals are discussed.

ENV 717: Introduction to Remote Sensing for Environmental Science (*3 hours*). This course introduces the theory and techniques of remote sensing and their application to environmental analysis. Topics include the concepts of remote sensing; characteristics of spectro-magnetic waves; types of remotely sensed data; sensor types; the theory of photogrammetric techniques; digital image analysis for acquisition of geographical information. Several lab activities involve: learning of basics of ERDAS Imagine; data acquisition through internet search for satellite images; importing datasets, band characteristics and visual presentation.

ENV 718: Application of Remote Sensing in Environmental Science (*3 hours*). Prerequisite: ENV 717. This course covers the quantitative and applied aspects and analysis of remotely sensed digital data. It is designed to provide an understanding of digital image processing, analysis,

and interpretation techniques. Topics include digital data visualization; geometric, radiometric, and atmospheric correction; image enhancement and manipulation; information extraction; digital change detection; integration of GIS and remotely sensed data, and spatial modeling. Laboratory exercises are in-depth applications of the exercise topics that have been covered in ENV 717, as well as thematic information extraction and change detection.

ENV 721: Solid Waste Management (*3 hours*). This course emphasizes on waste control methodologies for both municipal and industrial wastes including hazardous and nonhazardous waste under the Resource Conservation and Recovery Act (RCRA). The students are familiarized with environmental legislation regulating these wastes at state and federal levels. A thorough review is done on waste handling, transport, treatment technologies including chemical, physical, biological and thermal treatments, and disposal options such as land disposal of wastes. Waste minimization techniques such as source reduction and recycling are also discussed.

ENV 780: Environmental Epidemiology
(*3 hours*) This course is designed to provide students with the basic knowledge and skills required to develop and apply epidemiologic principles and concepts to the study of adverse effects of various environmental factors on both human and ecological health. Emphasis is put on the study of the health effects of physical, chemical and biologic factors in the external environment, broadly conceived from the epidemiologic point of view. As such, it enables students to interpret epidemiological data and understand the approaches used in the epidemiologic investigations of acute and chronic diseases. The course also covers the basic methods and issues involved in epidemiologic investigation of disease conditions in human populations.

ENV 802: Environmental Physiology (*3 hours*). This course provides students the basic concepts of homeostasis and adaptation to the environment. Discussions are designed to provide an understanding of the physiological responses to

various types of pollutants in the different environmental systems including aerospace, hyperbaric, marine and terrestrial environments. Emphasis is placed on homeostatic responses at cellular, organ and organ system levels to various environmental stresses.

ENVL 802: Environmental Physiology (*1 hour*). Laboratory exercises are performed to introduce students to instrumental techniques necessary in the understanding of homeostatic regulatory mechanisms that permit adaptation of organisms to varied and peculiar habitats.

ENV 803: Wetland Ecology. (*3 hours*). This course is designed to provide scientific knowledge for a better understanding of interactions between biological, physical and chemical components of wetlands. The structure and function of various types of wetlands; their biodiversity, biogeochemistry, and the impact of pollution on their ecological characteristics are discussed. Discussions are also done on how constructed wetlands can be used as water quality enhancers.

ENVL 803: Wetland Ecology. (*1 hour*). Emphasis is placed on field works designed to evaluate the physical, chemical and biological characteristics of wetlands.

ENV 830: Environmental Microbiology. (*3 hours*). The general objective of this course is to study the roles of microorganisms in natural ecosystems. Attention is given to the examination of nutrient cycles, methods of analysis of microbial biomass and activities, and the functional roles of microorganisms. In addition, this course offers in-depth examination of the role of microbial processes related to environmental deterioration, its control and remediation, and ultimately its prevention.

ENVL 830: Environmental Microbiology. (*1 hour*). Laboratory designed to acquaint students with modern techniques for measuring microbial biomass and microbial degradative activities of natural and xenobiotic chemicals in natural environments. Specific projects of microbial analysis will be assigned to students.