# M.S. in Environmental Engineering

*Candidates must satisfy a total of 30 credit hours (CH) with a minimum G.P.A. of 3.000 on a 4.000 scale.*

*All students must complete 15 credit hours (CH) of the core curriculum.*

### CEE 7312 Risk Assessment and Health Effects
Introduction to toxicology as it relates to environmental and health effects of hazardous materials; toxicology methodology; risk management factors including legal aspects; human health and ecological risk assessment and risk communication; emergency response; computer databases.

### CEE 7313 Environmental Chemistry and Biology
Chemical and biochemical processes; controlling fate and transport of hazardous materials with emphasis on chemical equilibria; chemical thermodynamics; acid-base equilibria; precipitation and dissolution; oxidation reduction processes; environmental transformations of organic materials; introductory taxonomy; microbial growth and kinetics; energy transfer; microbial ecosystems.

### CEE 7322 Biological Waste Treatment
Biological treatment topics include an overview of microbiology and microbial metabolism; kinetics of biological growth; aerobic suspended growth processes including the various modifications of the activated sludge process, aerated lagoons, and sequencing batch reactors; aerobic attached growth processes including trickling filter, biofilter towers, and rotating biological contactors; anaerobic processes including sludge digestion and liquid waste treatment with the anaerobic contact process and anaerobic filters; biosolids handling and disposal; composting; land treatment; in situ biotreatment and biotreatment of contaminated soils.

### CEE 7331 Air Pollution Management and Engineering
This course covers the science, engineering, public health, and economic aspects of air quality. Students will develop in-depth Understanding and broad knowledge of the sources and properties of air pollutants, air quality management, fate and transport of pollutants in the environment, regulations of air quality, and the operation and design of air pollution control systems. In addition, the class will review the current status of science, policy and regulations on several selected topics such as urban smog, regional haze, greenhouse gas and global climate change, stratospheric ozone depletion, and mercury emissions and control.

### CEE 7354 Environmental Engineering Principles and Processes
Waste minimization and pollution prevention techniques and objectives are introduced. A comprehensive study is made of biological, chemical, and physical principles and treatment strategies for controlling pollutant emissions. Equal emphasis is placed on underlying theory and practical engineering application of both common and innovative water and wastewater treatment processes. Design equations, procedures, and process models are rigorously derived for chemical/biological reactors and physical unit operations. Emphasis is placed on engineering analysis and application of process modeling techniques for design unit processes to achieve specific treatment objectives.

*All students must complete 9 credit hours (CH) of Group I specialization electives chosen from environmental engineering courses and related engineering disciplines, including:*

### CEE 7317 Environmental Organic Chemistry
Examines the fundamental processes that govern transformation of organic chemicals in natural and engineering systems. The course is divided into three parts: organic chemistry overview, physical transformations of organic compounds, and organic chemical reactions in the environment. The organic chemistry overview provides knowledge regarding basic properties of organic compounds such as nomenclature and structures. Physical transformation of organic compounds provides an understanding in processes (such as sorption and volatilization) that control the distribution of organic chemicals between different phases (such as air, water, and soil). Environmentally mediated reactions (such as hydrolysis and photolysis) that control the breakdown of organic chemicals are the focus of chemical reactions.

### CEE 7318 Bioremediation of Inorganic Contaminants
Focuses on bioremediation techniques and applications for removing inorganic contaminants (nitrogen, sulfur and phosphorus compounds, iron, heavy metals, metalloids and radionuclides) through the metabolic activities of microorganisms. Explores fundamental chemical and biological processes as well as engineering aspects. Prerequisites: Prior course experience with biochemistry or instructor approval.

## CEE 7319 Soil Chemistry and Mineralogy

Examines soil solution chemistry and reactivity. Covers distribution and significance of common soil minerals, weathering, and general solid phase reactivity. Lab covers mineral structures, techniques of mineral identification, and solution-solid phase partitioning. *Prerequisite:* CEE 2421 or permission of instructor.

## CEE 7320 Biodegradation of Hazardous Organic Pollutants

Students learn and integrate the basic principles of biochemistry required for understanding the biodegradation of hazardous and toxic organic compounds. Students become familiar with current biological remediation techniques and molecular microbiology and solve problems often encountered in application of bioremediation. Prerequisite Prior course experience with biochemistry.

## CEE 7324 Geographical Information Systems and Mapping

Introduces modern GIS software and tools, including map design, geodatabases, geospatial and attribute data, geocoding, and simple spatial analysis. Students use research-based projects to explore GIS as a tool for innovative spatial thinking and as a catalyst for sustainable strategies.

## CEE 7332 Groundwater Hydrology and Contamination

Groundwater hydrology; aquifer and well hydraulics; flow equations and models; implications for landfill design; sources and nature of groundwater contaminants; monitoring and analysis; contaminant fate and transport; transport model for hazardous substances; groundwater pollution control measures; containment and treatment; groundwater quality management.

## CEE 7334 Fate and Transport of Contaminants

Development and application of fate and transport models for hazardous substances with focus on water-sediment, water-soil, and water-air interfaces; material balance principle; mass transport and transformation processes; modeling of lakes and reservoirs; stream modeling; general flow case; groundwater models; multiphase and integrated modeling approaches; case studies.

## CEE 7335 Aerosol Mechanics

Fundamental and advanced principles of airborne particles, including their physical properties, aerodynamic behavior, and their collection, measurement, and analysis. This course emphasizes the origins and properties of atmospheric aerosols and the design of air pollution control equipment.

## EMIS 7370 Probability and Statistics for Scientists and Engineers

Introduces fundamentals of probability, probability distributions, and statistical techniques used by engineers and physical scientist. Topics include basic concepts ad rules of probability, random variables, probability distributions, expectation and variance, sampling and sampling distributions, statistical analysis techniques, statistical inference estimation and tests of hypothesis, correlation and regression, and analysis of variance. *Prerequisite*: Knowledge of calculus.

## ME 7336 Intermediate Fluid Dynamics

Review of fundamental concepts of undergraduate fluid mechanics and introduction to advanced fluid dynamics, industrial irrigational flow, tensor notation, and the Navier-Stokes equations. *Prerequisite*: ME 2342 or permission of instructor.

*All students must complete 6 credit hours (CH) of Group II breadth electives chosen from civil engineering, environmental science, environmental systems management, hazardous and waste materials management, and engineering management courses, including:*

## CEE 7(0,1,2,3,6)96 Thesis

Variable credit, but no more than six term hours in a single term and no more than four in each summer term. Registration in several sections may be needed to obtain the desired number of thesis hours. For example, four term hours of thesis would require enrollment in CEE 7196 and 7396.

## CEE 7303 Leadership Innovation Hub

Leading change in disruptive times using systems-level innovation and data-driven analysis. Experiential and project-based learning about social and environmental justice with community partners. Addressing challenges with curiosity and compassion. Prerequisites: DISC 1312 and DISC 1313, or equivalent, and instructor approval.

## CEE 7314 Environmental Regulations and Compliance

Practical knowledge of federal and state environmental permitting processes and procedures is provided. Regulatory requirements are reviewed with emphasis on the 40 CFR regulation for water, air, and solid hazardous waste. Air, water, stormwater and waste permits are reviewed, as well as permits-by rule. Also explored are the consequences of noncompliance with regulations by presenting enforcement options available to government agencies.

## CEE 7323 Project Management

Role of project officer; systems and techniques for planning, scheduling, monitoring, reporting, and completing environmental projects; total quality management; project team management, development of winning proposals; contract management and logistics; case study application of project management to all environmental media and programs; community relations, risk communication, crisis management, consensus building, media and public policy.

## CEE 7350 Introduction to Environmental Management Systems

An in-depth introduction to environmental management systems (EMSs). Includes systems such as EMAS, Responsible Care, OHSAS 18000, ISO 14000, and the Texas EMS program. Takes a step by step look at the ISO 14001 standard from the policy statement to the management to review, and allow students to fully understand the plan-do-check-act approach of the system. Also introduces students to management systems auditing the requirements of a system auditor, and the certification process.

## CEE 7351 Introduction to Environmental Toxicology

Toxicology as presented as it relates to environmental and health effects of hazardous materials. Toxicological methodologies, pharmacokinetics, mechanisms of action to toxicants, origin response to toxic substances, and relevant aspects of the occupational and regulatory environment will be examined. Specific topics include toxicology of metals, radiation, industrial solvents and vapors, pesticides, teratogens, mutagens, and carcinogens. Risk communication and risk assessment are examined as they relate to toxic substance exposure. radiological emergency preparedness, and decommissioning. *Prerequisite*s: CEE 5313.

## CEE 7353 Environmental Epidemiology

Introduction to the science of epidemiology. Design and conduct of studies examining health effects of environmental exposures. Strengths and limitations of research strategies and interpretation of study results. Areas of interest include air and water pollution, lead and biological marker outcomes.

## CEE 7362 Engineering Analysis with Numerical Methods

Applications of numerical and approximate methods in solving a variety of engineering problems. Examples include equilibrium, buckling, vibration, fluid mechanics, thermal science, and other engineering applications. Prerequisite: Permission of instructor.

## EMIS 8360 Operation Research Models

A survey of models and methods of operations research. Deterministic and stochastic models in a variety of areas will be covered. Credit is not allowed for both EMIS 3360 and EMIS 8360. *Prerequisite*s: A knowledge of linear algebra and an introduction to probability and statistics.

## EMIS 8361 Engineering Economics and Decision Analysis

Introduction to economic analysis methodology. Topics include engineering economy and cost concepts, interest formulas and equivalence, economic analysis of alternatives, technical rate-of-return analysis, and economic analysis under risk and uncertainty. Credit not allowed for both EMIS 2360 and EMIS 8361. *Prerequisite*: Knowledge of introductory probability and statistics.

## EMIS 8362 Engineering Accounting

An introduction to and overview of financial and managerial accounting for engineering management. Topics include basic accounting concepts and terminology; preparation and interpretation of financial statements; and uses of accounting information for planning, budgeting, decision-making, control, and quality improvement. The focus is on concepts and application in industry today.

## EMIS 8363 Engineering Finance

Develops an understanding of corporate financial decisions for engineers. Topics include cost of capital, capital budgeting, capital structure theory and policy, working capital management, financial analysis and planning, and multinational finance. *Prerequisite*s: EMIS 8361 or a knowledge of time value of money.

## EMIS 8364 Engineering Management

How to manage technology and technical functions from a pragmatic point of view. How to keep from becoming technically obsolete as an individual contributor and how to keep the corporation technically astute. This course will look at the management of technology from three distinct viewpoints: 1) the management of technology from both an individual and a corporate perspective, 2) the management of technical functions and projects, and 3) the management of technical professionals within the organization. *Prerequisite*: Graduate standing in engineering.

## EMIS 8378 Optimization Models for Decision Support

Study of the design and implementation of decision support systems based on optimization models. Course objectives: development of modeling skills, practice in the application of operations research techniques, experience with state-of-the-art software, and the study of decision support systems design and management. Topics include linear, integer, network, nonlinear, multi-objective, and stochastic optimization models for manufacturing, logistics, telecommunications, service operations, and public sector applications.