

# ENVIRONMENTAL ENGINEERING

## Department of Civil and Environmental Engineering College of Engineering

### 272 Civil and Environmental Engineering Analysis

Fall, Spring. 3(3-0) Interdepartmental with Civil Engineering. Administered by Civil Engineering. P: ((MTH 132 or concurrently) or (MTH 152H or concurrently) or (LB 118 or concurrently)) and (CE 271 or concurrently)

Basic operations in AutoCAD. Selected applications of probability and statistics to topics in civil and environmental engineering. Applications of engineering economics including interest, net present worth, benefit-cost analysis, comparison of economic alternatives, and life-cycle costing.

### 280 Principles of Environmental Engineering and Science

Fall, Spring. 3(3-0) Interdepartmental with Civil Engineering. Administered by Environmental Engineering. P: (CEM 141 or CEM 151 or LB 171) and ((MTH 132 or concurrently) or (MTH 152H or concurrently) or (LB 118 or concurrently))

Physical, chemical and biological processes related to environmental science and engineering. Environmental systems analysis with application to air, water and soil. Analysis of environmental problems and development of engineering solutions.

### 421 Engineering Hydrology

Fall. 3(2-2) Interdepartmental with Civil Engineering. Administered by Environmental Engineering. P: CE 321 and (GLG 201 or GLG 301) R: Open to juniors or seniors or graduate students in the College of Engineering or in the College of Natural Science or in the Department of Crop and Soil Sciences.

Hydrologic design of stormwater systems. Equilibrium hydrograph analysis, unit hydrographs, infiltration, hydrograph synthesis, and reservoir routing. Groundwater: Darcy's law, flow nets, well hydraulics, design of capture wells.

### 422 Applied Hydraulics

Spring. 3(2-2) Interdepartmental with Civil Engineering. Administered by Environmental Engineering. P: CE 321 or ME 332 R: Open to juniors or seniors or graduate students in the College of Engineering.

Fundamentals of open-channel flow. Rapidly and gradually varied nonuniform flow analysis. Confined flows past submerged bodies, in pipe networks, and in turbo machinery. Design applications.

**423 Applied Hydrologic Analysis and Design**  
Spring. 3(2-2) Interdepartmental with Civil Engineering. Administered by Civil Engineering. P: CE 321 and CE 421 and (CE 422 or concurrently) R: Open to students in the Department of Civil and Environmental Engineering and open to students in the Department of Geological Sciences and open to students in the Department of Biosystems and Agricultural Engineering.

Project-based work using HEC-RAS and geographic information systems (GIS) to analyze the impacts of land use changes in urban and rural watersheds; design of systems to mitigate specific impacts. Project-based work on water distribution networks, analysis using EPANET to study the use of water storage towers, pressure regulation devices, and cyclic demands.

### 480 Environmental Measurements Laboratory

Fall. 1(0-3) Interdepartmental with Civil Engineering. Administered by Environmental Engineering. P: CEM 161 or CEM 185H or LB 171L

Basic chemical and microbiological methods used in the analysis of environmental media. Laboratory safety, quality assurance, quality control, and statistics used in laboratory analysis. Related technical communication, laboratory report writing.

### 481 Environmental Chemistry: Equilibrium Concepts

Fall. 3(3-0) Interdepartmental with Civil Engineering. Administered by Environmental Engineering. P: (CEM 141 and CEM 142) or (CEM 151 and CEM 152) or (CEM 181H and CEM 182H) or (LB 171 and LB 172)

Chemistry of natural environmental systems and pollutants. Equilibrium concepts and calculations for acid-base, solubility, complexation, redox and phase partitioning reactions and processes. Applications to ecosystem analysis, pollutant fate and transport, and environmental protection.

### 483 Water and Wastewater Engineering

Fall. 3(3-0) Interdepartmental with Civil Engineering. Administered by Environmental Engineering. P: (ENE 280 or BE 230) and (CE 321 or CHE 311)

Engineering and scientific basis and design of physical, chemical and biological methods for the treatment of drinking water and wastewater. Operation process selection and design.

### 485 Landfill Design

Spring. 3(3-0) Interdepartmental with Civil Engineering. Administered by Civil Engineering. P: ENE 280 and CE 312

Geotechnical and environmental design of solid waste landfills.

### 487 Microbiology for Environmental Science and Engineering

Spring. 3(3-0) Interdepartmental with Civil Engineering. Administered by Environmental Engineering. P: ENE 280

Fundamentals of microbiology. Application of these concepts to environmental processes such as wastewater treatment, human health and bioremediation.

**489 Air Pollution: Science and Engineering**  
Spring. 3(3-0) Interdepartmental with Civil Engineering. Administered by Environmental Engineering. P: (CEM 141 or CEM 151 or LB 171) and (MTH 133 or MTH 153H or LB 119) and (ENE 280 or BE 230)

Basic physical and chemical principles governing indoor and atmospheric air pollution. Elements of air pollution meteorology, climate change, atmospheric transformations and transport. Air pollution sources and methods for their control. The role of local, state and federal government in air pollution control.

### 490 Independent Study

Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open to juniors or seniors in the Department of Civil and Environmental Engineering. Approval of department.

Environmental engineering problem of specific interest to the student and a faculty member. May be analysis or design.

### 492 Selected Topics in Environmental Engineering

Fall, Spring. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department.

Selected topics related to environmental engineering, fluid mechanics and hydrology.

### 800 Environmental Engineering Seminar

Fall, Spring. 1(1-0) R: Open only to Environmental Engineering majors.

Current research in environmental engineering.

### 801 Dynamics of Environmental Systems

Spring. 3(3-0)

Principles of mass balance, reaction kinetics, mass transfer, reactor theory in environmental engineering.

### 802 Physicochemical Processes in Environmental Engineering

Fall. 3(3-0) RB: ENE 801

Physical and chemical principles of air and water pollution control and environmental contaminants in water, air and soils.

### 804 Biological Processes in Environmental Engineering

Fall. 3(3-0) RB: ENE 801 or concurrently

Engineering of microbial processes used in wastewater treatment, in-situ bioreclamation, and solid waste stabilization.

### 806 Environmental Engineering Process Laboratory

Spring. 3(2-4) P: ENE 480 and ENE 802 and ENE 804 R: Open to graduate students in the Environmental Engineering major.

Development of skills related to planning, design, and execution of processes related to environmental engineering, enhance decision making skills, teamwork, analysis of data, report writing, and oral presentation.

### 811 Membrane Processes

Spring of odd years. 3(3-0) RB: (CE 321 or concurrently) and Calculus through differential equations, Physical chemistry

Fundamental principles and applications of membrane processes in environmental engineering, emphasizing solid-liquid separations and pressure-driven membrane systems.

## Environmental Engineering—ENE

- 821 Groundwater Hydraulics**  
Fall. 3(3-0) Interdepartmental with Civil Engineering. Administered by Environmental Engineering.  
Physical properties of porous media. Equations of flow in saturated media. Flow nets, well flow and parameter measurement. Transport processes and the advective-dispersion equation for conservative contaminants.
- 822 Groundwater Modeling**  
Spring of even years. 3(3-0) Interdepartmental with Civil Engineering. Administered by Environmental Engineering.  
Analysis and modeling of groundwater flow, surface water and groundwater interaction, and reactive contaminant transport. Applied numerical methods for solving groundwater flow and contaminant transport equations. Case studies.
- 823 Stochastic Groundwater Modeling**  
Spring of odd years. 3(3-0) Interdepartmental with Civil Engineering. Administered by Environmental Engineering. P: ENE 821 RB: Groundwater Hydrology, groundwater modeling  
Analysis and modeling of flow and solute transport in heterogeneous aquifers. Geostatistics and variogram modeling. Upscaling and effective models. Uncertainty modeling. Perturbation methods and Monte Carlo simulation.
- 827 Integrated Risk Assessment of Environmental Hazards**  
Spring of odd years. 3(3-0) Interdepartmental with Animal Science. Administered by Animal Science. R: Open only to graduate students in the College of Agriculture and Natural Resources or College of Engineering or College of Human Medicine or College of Natural Science or College of Osteopathic Medicine or College of Veterinary Medicine.  
Alternative approaches to assessing environmental and health risk. Analyzing, interpreting, and using scientific data from ecology, agriculture, environmental chemodynamics, biology, geological sciences, and toxicology in the risk assessment process.
- 829 Mixing and Transport in Surface Waters**  
Fall of odd years. 3(3-0) Interdepartmental with Civil Engineering. Administered by Environmental Engineering. P: ENE 801  
Waves, tides and shallow-water processes. Numerical solutions and applications of shallow-water equations to lakes, rivers and estuaries. Principles and processes of sediment transport, and dispersion of materials in surface waters. Wind-driven circulation in Lake Michigan.
- 861 Introduction to Risk and Reliability in Civil and Environmental Engineering**  
Fall. 1(1-0) Interdepartmental with Civil Engineering. Administered by Civil Engineering. Not open to students with credit in CE 810.  
Characterization of variability using probabilistic and statistical methods.
- 880 Independent Study in Environmental Engineering**  
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to Environmental Engineering majors.  
Solution of environmental engineering problems not related to student's thesis.
- 890 Selected Topics in Environmental Engineering**  
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open to students in the Environmental Engineering major.  
Selected topics in new or developing areas of environmental engineering.
- 892 Master's Research Project**  
Fall, Spring, Summer. 1 to 5 credits. A student may earn a maximum of 5 credits in all enrollments for this course. R: Open only to masters students in the Environmental Engineering major. Approval of department.  
Master's degree Plan B individual student research project. Original research, research replication, or survey and reporting on a research topic.
- 899 Master's Thesis Research**  
Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 24 credits in all enrollments for this course.  
Master's thesis research.
- 900 Research Strategies and Methods in Environmental Engineering and Science**  
Spring. 1(1-0) Interdepartmental with Geological Sciences. Administered by Environmental Engineering. R: Open to graduate students in the Department of Civil and Environmental Engineering and open to graduate students in the Department of Geological Sciences. Not open to students with credit in CE 900.  
Criteria for quality research, scientific method, scientific arguments, statistical testing, critical thinking skills, reviewing journal articles, literature synthesis, writing proposals and papers, giving presentations, responsible conduct of research.
- 999 Doctoral Dissertation Research**  
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 72 credits in all enrollments for this course.  
Doctoral dissertation research.