

# ENVIRONMENTAL ENGINEERING

ENE

## Department of Civil and Environmental Engineering College of Engineering

### 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 133 or MTH 153H or LB 119)

Analysis of environmental problems and engineering solutions based on physical, chemical, and biological processes. Mass balance modeling of contaminant fate, transport and removal in environmental media.

### 371 Sustainable Civil and Environmental Engineering Systems

Fall, Spring. 3(3-0) Interdepartmental with Civil Engineering. Administered by Civil Engineering. P: (MTH 234 or concurrently) or (LB 220 or concurrently) or (MTH 254H or concurrently) R: Open to juniors or seniors in the Applied Engineering Sciences Major or in the Energy Minor or in the Civil Engineering Major or in the Environmental Engineering Major. SA: CE 272

Principles and tools of sustainable design and engineering economics in Civil and Environmental Engineering.

### 421 Engineering Hydrology

Fall. 3(3-0) Interdepartmental with Civil Engineering. Administered by Environmental Engineering. P: (CE 321) and (GLG 201 or GLG 301) and (CE 372 or STT 351) 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 Plant, Soil and Microbial Sciences.

Hydrologic design of storm water 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.

### 472 Life Cycle Assessment of Energy Technologies

Spring. 3(2-2) Interdepartmental with Civil Engineering. Administered by Environmental Engineering. P: CE 371 or approval of department R: Open to students in the College of Engineering.

Use of life-cycle assessment (LCA) for energy technologies to evaluate trade-offs between various energy options and guide energy choices.

### 473 Smart and Sustainable Building Design and Operations

Spring of odd years. 3(3-0) Interdepartmental with Civil Engineering. Administered by Civil Engineering. P: CE 371 or approval of department

Elements of the design and operation of smart and sustainable buildings. Current and future energy-related challenges of existing buildings.

### 480 Environmental Measurements Laboratory

Fall. 2(1-3) Interdepartmental with Civil Engineering. Administered by Environmental Engineering. P: (CEM 161 or CEM 185H or LB 171L) and ENE 280 and (CEM 142 or CEM 152 or CEM 182H or LB 172) and ((ENE 481 or concurrently) or (ENE 483 or concurrently)) and Completion of Tier I Writing Requirement R: Open to juniors or seniors or graduate students in the College of Engineering.

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

### 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)} and (ENE 280 or BE 230 or GLG 201 or GLG 301 or approval of department) and ((CHE 201 or concurrently) or (CEM 251 or concurrently)) R: Open to sophomores or juniors or seniors or graduate students in the Department of Biosystems and Agricultural Engineering or in the Department of Chemical Engineering and Materials Science or in the Department of Civil and Environmental Engineering or in the Department of Earth and Environmental Sciences.

Chemistry of environmental systems and air, water, and soil pollutants as applied to environmental engineering.

### 483 Water and Wastewater Engineering

Fall. 4(3-2) Interdepartmental with Civil Engineering. Administered by Environmental Engineering. P: (ENE 280 or BE 230) and (CE 321 or CHE 311) R: Open to juniors or seniors or graduate students in the College of Engineering.

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. Field trips required.

### 484 Water Resource Recovery Engineering

Spring. 3(3-0) Interdepartmental with Biosystems Engineering. Administered by Biosystems Engineering. P: BE 360 or (ENE 487 or concurrently) or approval of department R: Open to juniors or seniors or graduate students in the College of Agriculture and Natural Resources or in the College of Engineering.

Municipal, industrial, and rural wastewater characteristics. Selection of best site- and management-specific treatment strategy, including the influence of governmental policy and societal needs.

### 485 Landfill Design

Spring. 3(3-0) Interdepartmental with Civil Engineering. Administered by Civil Engineering. P: ENE 280 and CE 321 RB: 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) and (CE 321 or CHE 311) and (CE 372 or CHE 316) and ((ME 201 or concurrently) or (BE 351 or concurrently) or (CHE 321 or concurrently)) R: Open to juniors or seniors or graduate students in the College of Engineering.

Basic physical and chemical principles governing indoor and atmospheric air pollutant fate, transport and control technologies.

### 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.

## ENE—Environmental Engineering

- 803 Water Quality and Public Health**  
Spring of odd years. 3(3-0)  
Principles, applications, and latest research in the area of water quality and public health. Various chemical and microbiological water contaminants and their health effects. Concepts of public health and epidemiology, principles of toxicology, exposure characterization and risk assessment approaches, water management alternatives, and global issues of concern.
- 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.
- 805 Contaminated Site Remediation**  
Spring of odd years. 3(3-0) RB: Undergraduate classes in environmental engineering.  
Key topics within contaminated site remediation. Regulations relevant to remediation. Site characterization and assessment. Removal technologies, mechanisms involved, variations in approaches, advantages and limitations. Case studies for each method. Overview of air treatment technologies. Remediation approaches for problematic groundwater contaminants.
- 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.
- 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.
- 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.
- 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 master's 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 36 credits in all enrollments for this course.  
Doctoral dissertation research.