

ENVIRONMENTAL ENGINEERING SCIENCES

CWR 5125 Groundwater Flow I 3 Credits

Grading Scheme: Letter Grade

Porous media flow. Darcy's law. Conservation of mass. Laplace equation. Flownets. Well hydraulics.

Prerequisite: Undergraduate coursework including Differential Equations, Dynamics, Hydrodynamics (Fluid Mechanics), and Hydraulics.

CWR 6116 Advanced Surface Hydrology 3 Credits

Grading Scheme: Letter Grade

Physical and quantitative concepts and principles of hydrologic processes and their engineering applications. Reynolds Transport Theorem, the Continuity and Momentum Equations applied to phenomena and processes. Hydrologic analyses, including unit hydrograph theory, lumped flow routing, and distributed flow routing. Engineering concepts of hydrologic design, design storms and hydrologic chemistry.

Prerequisite: ENV3040C or equivalent numerical methods, STA 3032 or equivalent statistics, CWR3201 or equivalent hydrodynamics

CWR 6252 Environmental Biochemistry of Trace Metals 3 Credits

Grading Scheme: Letter Grade

Environmental impact and fate of trace metals and metalloids as they cycle through geological and biological environmental compartments. Emphasizes anthropogenic activities of metals with growing environmental concerns, including arsenic, mercury, chromium, and lead.

Prerequisite: consent of instructor.

CWR 6537 Contaminant Subsurface Hydrology 3 Credits

Grading Scheme: Letter Grade

Physical-chemical-biological concepts and modeling of retention and transport of water and solutes in unsaturated and saturated media. Applications of environmental aspects of soil and groundwater contamination.

Prerequisite: None.

EES 5245 Water Quality Analysis 3 Credits

Grading Scheme: Letter Grade

Applying the principles of analytical chemistry to determine the chemical composition of natural waters and wastewaters. Emphasizes methods used routinely to determine water and wastewater quality and to interpret data.

Prerequisite: Undergraduate courses in general chemistry and water chemistry.

EES 5305C Ecological and General Systems 3 Credits

Grading Scheme: Letter Grade

Systems ecology, including examples, languages, theoretical formulations, and models for designing, synthesizing, and predicting systems of man and nature.

Prerequisite: Undergraduate coursework including Differential Equations, Chemistry, and Biology.

EES 5306 Energy Analysis 3 Credits

Grading Scheme: Letter Grade

Energetics of systems of environment and economics; energy analysis of environmental systems, agroecosystems, regional and national economies; energy evaluation of public policy.

EES 5415 Environmental Health 3 Credits

Grading Scheme: Letter Grade

Effects of environment pollution on health. Methods of evaluating, treating, and preventing pollutants of health significance.

EES 6007 Advanced Energy and Environment 3 Credits

Grading Scheme: Letter Grade

Energy basis for a system of humanity and nature, including principles of systems ecology, ecological economics, and public policy.

EES 6051 Advanced Environmental Planning and Design 3 Credits

Grading Scheme: Letter Grade

Sustainable communities and regions. Quantitative methods for evaluating environmental impacts and carrying capacity. Theories of spatial and temporal organization of systems of humanity and nature.

EES 6107C Advanced Ecological Engineering 3 Credits

Grading Scheme: Letter Grade

A unified course in fundamental principles of ecology and engineering methods that enables students to use their engineering training to quantitatively evaluate and design interface ecosystems and the restoration of drastically altered lands. Course content is organized using a systems framework.

EES 6208 Principles of Water Chemistry I 3 Credits

Grading Scheme: Letter Grade

Applying chemical principles to aqueous reactions. Emphasizes thermodynamics, kinetics, and aqueous equilibria including acid-base, solubility, complexation, precipitation, and redox.

Prerequisite: Undergraduate coursework in both chemistry and calculus.

EES 6225 Atmospheric Chemistry 3 Credits

Grading Scheme: Letter Grade

Nature, sources, and sinks of fixed and variable constituents of atmosphere. Chemical changes occurring. Influences and properties of atmospheric components of natural and anthropogenic origin.

Prerequisite: Undergraduate coursework including foundations of air pollution.

EES 6307 Advanced Ecological Engineering 3 Credits

Grading Scheme: Letter Grade

An advanced course in the fundamental principles of ecology and engineering methods that enables students to use their engineering training to design and quantitatively evaluate interface ecosystems and restoration of drastically altered lands to create symbiotic relationships between humans and the environment.

EES 6308C Wetland Ecology 3 Credits

Grading Scheme: Letter Grade

Defining and classifying major wetland ecosystems, formation of wetlands, wetland functions and values; wetlands ecological engineering and management; and integrating wetlands into developing landscape. Emphasizes several field trips to natural and altered wetlands.

Prerequisite: Undergraduate coursework including Biology and Chemistry.

EES 6309 Wetland Design and Restoration 3 Credits

Grading Scheme: Letter Grade

Applied and theoretical aspects of wetlands use for water quality management; natural and constructed treatment wetlands; engineering and ecology of wetland systems; design for sustainability and ancillary benefits. Theoretical and applied aspects of the restoration and management of wetland ecosystems.

Prerequisite: EES 6308C; SWS 5242 or WIS 6934

EES 6318 Principles of Industrial Ecology 3 Credits**Grading Scheme:** Letter Grade

Linkage of industry activity with environmental and social sciences. Corporate environmental management and environmental ethics. Resources, laws, and economics. Environmental accounting. Industrial products and processes, and life cycle assessments. Case studies of corporate environmental policies.

EES 6425 Environmental Nanotechnology 3 Credits**Grading Scheme:** Letter Grade

Life cycle, environmental applications and health implications of engineered nanomaterials.

Prerequisite: Undergraduate coursework in biology, general chemistry and organic chemistry.

EES 6932 Modeling the Fate of Air Pollutants 3 Credits**Grading Scheme:** Letter Grade

Provides the concept/skill that integrate atmospheric kinetic and thermodynamic data obtained from photochemical reactors into gas/aerosol models using a kinetic solver. This course provides flexibility in modeling topics that allow students to study emerging issues in atmospheric chemistry and to individualize topics based on their backgrounds/research.

Prerequisite: Undergraduate coursework including general chemistry and foundations of air pollution.

EGN 5949 Practicum/Internship/Cooperative Work Experience 1-6 Credits, Max 6 Credits**Grading Scheme:** S/U

Practical cooperative engineering work under approved industrial and faculty supervision.

Prerequisite: graduate student.

EGN 6640 Entrepreneurship for Engineers 3 Credits**Grading Scheme:** Letter Grade

Introduction to entrepreneurship, idea generating and feasibility analysis, and business planning. Lectures, case studies, student-led discussions, team business plans, and investor presentations.

EGN 6913 Engineering Graduate Research 0-3 Credits, Max 12 Credits**Grading Scheme:** S/U

Course will provide the student with supervised research in a laboratory setting.

ENV 5075 Environmental Policy 3 Credits**Grading Scheme:** Letter Grade

Policy analysis, making, and implementation. Analytical methods for evaluating alternative policies. Legal, social, political, and economic patterns and processes that shape the climate in which environmental policy is made.

ENV 5105 Foundations of Air Pollution 3 Credits**Grading Scheme:** Letter Grade

Principal types, sources, dispersion, effects, and physical, economic and legal aspects of control of atmospheric pollutants.

ENV 5306 Municipal Refuse Disposal 3 Credits**Grading Scheme:** Letter Grade

Quantities and characteristics of municipal refuse and hazardous materials. Collection methods, transfer stations, equipment and costs. Refuse disposal practices, regional planning and equipment.

ENV 5518 Field Methods in Environmental Hydrology 3 Credits**Grading Scheme:** Letter Grade

Field methods for characterizing sites for environmental and hydrologic evaluation. Focuses on subsurface systems and ground water interactions.

Prerequisite: Coursework including introductory concepts of fluid flow.

ENV 5619 Principles of Sustainable Engineering Design 3 Credits**Grading Scheme:** Letter Grade

Principles of Sustainable Engineering Design is a 3-credit hour course for civil and environmental engineering seniors and graduate students. Students will learn the meaning of sustainability and sustainable development and how those concepts apply to the planning, design and operation of civil infrastructure.

ENV 6043 Life Cycle Assessment 3 Credits**Grading Scheme:** Letter Grade

Life Cycle Assessment

ENV 6052 Immiscible Fluids in Porous Media 3 Credits**Grading Scheme:** Letter Grade

Mechanics of immiscible fluids in porous media. Static fluid distributions, and steady and unsteady multiphase flow. Remediation of sites contaminated with nonaqueous phase liquids.

ENV 6126 Air Pollution Control Design 3 Credits**Grading Scheme:** Letter Grade

Design, analysis, operational limitations, cost and performance evaluation of control processes and equipment. Field visits to and inspection of industrial installations.

Prerequisite: Undergraduate coursework including Differential Equations, Physics and Chemistry.

ENV 6130 Aerosol Mechanics 3 Credits**Grading Scheme:** Letter Grade

Generating, collecting, and measuring aerosols. Theory of fluid dynamic, optical, electrical, inertial, and thermal behavior of gas-borne particles.

Prerequisite: Undergraduate coursework including Differential Equations, Physics and Fluid Mechanics.

ENV 6301 Advanced Solid Waste Containment Design 3 Credits**Grading Scheme:** Letter Grade

Current practice in designing solid and hazardous waste landfills, waste piles, monofills, and surface impoundments. Regulations, siting, sizing, liners, leachate and gas management, operations, closure, and post-closure.

ENV 6416 Advanced Stormwater Control Systems 3 Credits**Grading Scheme:** Letter Grade

Chemical, physical, biological and hydrologic aspects of rainfall-runoff; and control through unit operations and processes (UOP); interactions between hydrologic processes; water chemistry, sediment transport, infrastructure materials and UOPs; constituent physical properties, chemistry and loads related to design of UOPs for control, treatment and/or reuse.

Prerequisite: Undergraduate coursework in water chemistry and water & wastewater treatment.

ENV 6435 Advanced Water Treatment Process Design 3 Credits**Grading Scheme:** Letter Grade

Design of selected water treatment processes including disinfection, air stripping, adsorption, ion exchange and membrane processes.

Prerequisite: Undergraduate course work in water and/or wastewater treatment process design, calculus, and chemistry.

ENV 6437 Advanced Wastewater System Design 3 Credits**Grading Scheme:** Letter Grade

Layout and design of sanitary sewage systems, pumping stations, force mains, wastewater treatment plants, and methods of effluent disposal. Emphasizes preparing design drawings and estimating costs.

Prerequisite: Undergraduate coursework including water and wastewater treatment;**Corequisite:** Undergraduate coursework including hydraulic system design.**ENV 6438 Advanced Potable Water Systems Design 3 Credits****Grading Scheme:** Letter Grade

Design of water treatment operations, including coagulation, flocculation, mixing, sedimentation, filtration, softening, corrosion control, and sludge management. Design costs.

Prerequisite: Undergraduate course work in water and/or wastewater treatment process design, hydraulics, and chemistry.**ENV 6439 Activated Carbon: Environmental Design and Application 3 Credits****Grading Scheme:** Letter Grade

Theory and application of manufacturing activated carbon, its use in water treatment/remediation (i.e., design of activated carbon systems), and thermal reactivation.

ENV 6441 Water Resources Planning and Management 3 Credits**Grading Scheme:** Letter Grade

Principles and practice of water resource planning and management. Protocols used at local, state, federal, regional, and international levels. Plan formulation, evaluation, and implementation. Stakeholder involvement in planning processes. Analytical tools. Case studies.

ENV 6455 Microbiology of Environmental Engineering Systems 3 Credits**Grading Scheme:** Letter Grade

Divided into three sections that will introduce the morphological and metabolic characteristics of microbial groups and discuss the role of microorganisms in natural (water, soil, and air) and environmental engineered systems.

ENV 6508 Wetland Hydrology 3 Credits**Grading Scheme:** Letter Grade

Water flow and chemical transport in wetlands. Surface water and ground water interaction in wetlands. Constructed wetlands for water treatment.

Prerequisite: Undergraduate coursework in Hydrology, Hydrodynamics, or Fluid Mechanics.**ENV 6511 Biological Wastewater Treatment 3 Credits****Grading Scheme:** Letter Grade

Theory and current research associated with biological treatment processes.

ENV 6556 Advanced Waste Treatment Operations 3 Credits**Grading Scheme:** Letter Grade

Biological, physical, and chemical processes used in the advanced treatment of domestic and industrial wastewater. Reuse application and guidelines.

Prerequisite: course or professional experience in unit operations and processes of water and wastewater treatment.**ENV 6617 Principles of Green Engineering Design and Sustainability 3 Credits****Grading Scheme:** Letter Grade

Principles of sustainability and methods to incorporate them into engineering design practices. Demonstration of tools such as sustainability metrics, life cycle assessment, sustainability auditing and carbon footprinting.

ENV 6905 Individual Work 1-4 Credits, Max 8 Credits**Grading Scheme:** Letter Grade

Faculty-supervised individual research or study of material not covered in formal courses.

ENV 6910 Supervised Research 1-5 Credits, Max 5 Credits**Grading Scheme:** S/U

Supervised Research

ENV 6916 Nonthesis Project 1-3 Credits, Max 3 Credits**Grading Scheme:** Letter Grade

Nonthesis Project

ENV 6932 Special Problems in Environmental Engineering 1-4 Credits, Max 8 Credits**Grading Scheme:** Letter Grade

Special Problems in Environmental Engineering

ENV 6935 Graduate Environmental Engineering Seminar 1 Credit, Max 6 Credits**Grading Scheme:** S/U

Graduate Environmental Engineering Seminar

ENV 6940 Supervised Teaching 1-5 Credits, Max 5 Credits**Grading Scheme:** S/U

Practicum course to provide students with supervised teaching experience on developing effective instructional methods and materials in engineering education.

Corequisite: EGS 6056.**ENV 6971 Research for Master's Thesis 1-15 Credits****Grading Scheme:** S/U

Research for Master's Thesis

ENV 7979 Advanced Research 1-12 Credits**Grading Scheme:** S/U

Research for doctoral students before admission to candidacy. Designed for students with a master's degree in the field of study or for students who have been accepted for a doctoral program. Not appropriate for students who have been admitted to candidacy.

ENV 7980 Research for Doctoral Dissertation 1-15 Credits**Grading Scheme:** S/U

Research for Doctoral Dissertation

LAW 6472 Natural Resources Law 3-4 Credits**Grading Scheme:** Letter Grade

Natural Resources Law