ENVIRONMENTAL ENGINEERING

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Environmental engineering encompasses the scientific assessment and development of engineering solutions to environmental problems affecting land, water, and air (the biosphere). The field embraces broad environmental concerns, including the safety of drinking water, groundwater protection and remediation, wastewater treatment, indoor and outdoor air pollution, solid and hazardous waste disposal, cleanup of contaminated sites, the prevention of pollution through product and process design, and strategies for sustainable water and energy use and production.

Environmental engineers must balance competing technical, social, and legal issues concerning the use of environmental resources. Because of the complexity of these challenges, environmental engineers need a broad understanding not only of engineering disciplines but also of chemistry, biology, geology, and economics. Accordingly, the program allows students in the major to select an emphasis on environmental engineering technology, sustainability, global health, economics, or energy and climate change. The program prepares students for leadership positions in industry and government agencies or for further studies in engineering, science, business, law, and medicine.

Two degree programs are offered: the B.S. in Environmental Engineering, and the B.A. in Engineering Sciences (Environmental). The B.S. degree program in Environmental Engineering is designed for students who desire a strong background in environmental engineering leading to a career in the field. The B.A. degree program in Engineering Sciences (Environmental) is intended for students whose careers will involve, but not be dominated by, the skills of environmental engineering. The B.A. program is appropriate for those contemplating a career in which scientific and technological problems can play an important role, as is often the case in law, business, medicine, or public service.

PREREQUISITES

B.A. degree program in Engineering Sciences (Environmental)  The B.A. degree program requires MATH 112 and 115; a two-term lecture sequence in chemistry; and PHYS 170, 171.

B.S. degree program in Environmental Engineering  The B.S. degree program has the following prerequisites in mathematics and basic sciences: MATH 112, 115; MATH 120 or ENAS 151; ENAS 194; a two-term lecture sequence in chemistry, with corresponding labs; PHYS 180, 181; and BIOL 101 and 102 or BIOL 103 and 104.

REQUIREMENTS OF THE MAJOR

B.A. degree program  The B.A. degree program requires nine term courses beyond the prerequisites, including the senior requirement. Students take ENVE 120, 360, and either ENVE 373 or 377. Five electives must be chosen in consultation with the director of undergraduate studies (DUS).

B.S. degree program  The B.S. degree program requires at least twelve term courses beyond the prerequisites, including the senior requirement. Students take CENG 300 or MENG 211, ENVE 120, 360, 373, 377, and either ENVE 315 or 448, EVST 344, and MENG 361 or F&ES 714. At least three electives must be chosen in consultation with the DUS, preferably within one of the following tracks: environmental engineering technology, sustainability, global health, economics, or energy and climate change.

Credit/D/Fail  No course taken Credit/D/Fail may count toward the major, including prerequisites.

SENIOR REQUIREMENT

B.A. degree program  Students in the B.A. program must pass ENVE 416 or ENVE 490 in their senior year.

B.S. degree program  Students in the B.S. program must pass ENVE 416 or ENVE 490 in their senior year.

REQUIREMENTS OF THE MAJOR

ENGINEERING SCIENCES (ENVIRONMENTAL), B.A.

Prerequisites  MATH 112, 115; two-term lecture sequence in chemistry; PHYS 170, 171

Number of courses  9 term courses beyond prereqs (incl senior req)

Specific courses required  ENVE 120, 360; ENVE 373 or 377

Distribution of courses  5 electives approved by DUS

Senior requirement  ENVE 416 or ENVE 490

ENVIRONMENTAL ENGINEERING, B.S.

Prerequisites  MATH 112, 115; MATH 120 or ENAS 151; ENAS 194; two-term lecture sequence in chemistry, with labs; PHYS 180, 181; BIOL 101 and 102 or BIOL 103 and 104

Number of courses  12 term courses beyond prereqs (incl senior req)

Specific courses required  CENG 300 or MENG 211; ENVE 120, 360, 373, 377; ENVE 315 or 448; EVST 344; MENG 361 or F&ES 714

Distribution of courses  3 electives as specified
Courses

* ENVE 120b / CENG 120b / ENAS 120b, Introduction to Environmental Engineering  
  John Fortner
Introduction to engineering principles related to the environment, with emphasis on causes of problems and technologies for abatement. Topics include air and water pollution, global climate change, hazardous chemical and emerging environmental technologies. Prerequisites: high school calculus and chemistry or CHEM 161, 165 or CHEM 163, 167 (may be taken concurrently) or permission of instructor. QR, SC

ENVE 315b / CENG 315b, Transport Phenomena  
Amir Haji Akbari Balou
Unified treatment of momentum, energy, and chemical species transport including conservation laws, flux relations, and boundary conditions. Topics include convective and diffusive transport, transport with homogeneous and heterogeneous chemical reactions and/or phase change, and interfacial transport phenomena. Emphasis on problem analysis and mathematical modeling, including problem formulation, scaling arguments, analytical methods, approximation techniques, and numerical solutions. Prerequisite: ENAS 194 or permission of instructor. QR, SC RP

ENVE 360b / ENAS 360b, Green Engineering and Sustainable Design  
Julie Zimmerman
Study of green engineering, focusing on key approaches to advancing sustainability through engineering design. Topics include current design, manufacturing, and disposal processes; toxicity and benign alternatives; policy implications; pollution prevention and source reduction; separations and disassembly; material and energy efficiencies and flows; systems analysis; biomimicry; and life cycle design, management, and analysis. Prerequisites: CHEM 161, 165 or CHEM 163, 167 (or CHEM 112, 113, or 114, 115), or permission of instructor.

ENVE 373, Air Pollution Control

* ENVE 377a / CENG 377a, Water Quality Control  
Jaehong Kim
Study of the preparation of water for domestic and other uses and treatment of wastewater for recycling or discharge to the environment. Topics include processes for removal of organics and inorganics, regulation of dissolved oxygen, and techniques such as ion exchange, electrodialysis, reverse osmosis, activated carbon adsorption, and biological methods. Prerequisite: ENVE 120 or permission of instructor. SC RP

ENVE 416b / CENG 416b, Chemical Engineering Process Design  
Yehia Khalil
Study of the techniques for and the design of chemical processes and plants, applying the principles of chemical engineering and economics. Emphasis on flowsheet development and equipment selection, cost estimation and economic analysis, design strategy and optimization, safety and hazards analysis, and environmental and ethical considerations. Enrollment limited to seniors majoring in Chemical Engineering or Environmental Engineering. QR, SC RP

ENVE 438a, Environmental Chemistry  
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The quantitative treatment of chemical processes, primarily those involving inorganic chemicals, in aquatic systems such as lakes, oceans, rivers, estuaries, groundwaters, and wastewaters. Review of chemical thermodynamics, followed by discussions of acid-base, precipitation-dissolution, coordination, and reduction-oxidation reactions. Emphasis on equilibrium calculations as a tool for understanding variables that govern chemical composition of aquatic systems and the fate of inorganic pollutants. Prerequisite: ENVE 120 and working knowledge of algebra. QR, SC

ENVE 441a, Biological Processes in Environmental Engineering  
Jordan Peccia
Fundamental aspects of microbiology and biochemistry, including stoichiometry, kinetics, and energetics of biochemical reactions, microbial growth, and microbial ecology, as they pertain to biological processes for the transformation of environmental contaminants; principles for analysis and design of aerobic and anaerobic processes, including suspended- and attached-growth systems, for treatment of conventional and hazardous pollutants in municipal and industrial wastewaters and in groundwater. Prerequisites: CHEM 161, 165, or 163, 167 (or CHEM 112, 113, or 114, 115, or 118); MCDB 290 or equivalent; or with permission of instructor. SC

[ ENVE 448, Environmental Transport Processes ]

[ ENVE 473, Air Quality and Energy ]

* ENVE 490a or b, Senior Project  
John Fortner
Individual research and design projects supervised by a faculty member in Environmental Engineering, or in a related field with permission of the director of undergraduate studies.