# CIVIL ENGINEERING (CER)

**CER 210. Infrastructure Engineering. 3 Credits.**
This course identifies, analyzes and assesses built infrastructure, which is the foundation for modern society. The complex and interconnected lifecycles are investigated and demands on critical components are calculated. Students explore the nontechnical factors necessary for the functioning of infrastructure including supplies, trained personnel, public policy, ethics and cross-sector dependencies. The course provides a basis for understanding the complexity and cost of maintaining, rebuilding and developing infrastructure. Topics include general infrastructure concepts, water and wastewater, transportation, energy and buildings and cities. Several in-class scenarios are provided to synthesize the connectivity between the major items of infrastructure.
**Offered:** Every year, Fall

**CER 220. Civil Engineering Site Design. 3 Credits.**
This course provides students with the necessary background to select and develop sites for civil engineering projects as well as review the work of others. Proper site selection and engineering have a significant impact on the economics of a project and long-term utility of the constructed facility. Specifically, the course covers the skills of determining site layout and access, zoning requirements, establishing site contour and drainage, installation of utilities, elementary surveying, creation of drawings using a computer-aided drafting package, and the development of environmental impact statements.
**Prerequisites:** Take MA 152 or MA 153 and MA 154; or Sophomore standing in the major.
**Corequisites:** Take CER 220L.
**Offered:** Every year, Spring

**CER 220L. Civil Engineering Site Design Lab. 0 Credits.**
Lab to accompany CER 220.
**Prerequisites:** Take MA 153 and MA 154 or MA 142; or Sophomore standing in the major.
**Corequisites:** Take CER 220.
**Offered:** Every year, Spring

**CER 300. Special Topics in Engineering. 3 Credits.**
**Offered:** As needed

**CER 310. Structural Analysis. 3 Credits.**
This course addresses the analysis and design of basic structural forms such as beams, trusses and frames, which are found in bridges and buildings. Classical deflection techniques such as direct integration and virtual work; and indeterminate analysis techniques such as the force method and displacement methods (slope deflection, direct stiffness and moment distribution) are used to determine forces and deflections in elastic structures. Structural analysis computer programs are introduced and directly applied in the solution of graded analysis and design problems. Approximate analysis techniques are used to check the general accuracy of computer-based results.
**Prerequisites:** Take MER 220.
**Offered:** Every year, Spring

**CER 315. Surface Water Hydrology. 3 Credits.**
This course covers hydrologic processes relevant to surface water hydrology, including precipitation, evapotranspiration, infiltration, surface runoff and streamflow. Global issues, including climate change and sustainable development, are discussed.
**Prerequisites:** Take MER 310.
**Offered:** As needed

**CER 325. Concrete Materials. 1 Credit.**
This course introduces the design and control of concrete mixtures. Topics include Portland cement, cement hydration, aggregates, supplementary cementitious materials, fresh and hardened concrete, and concrete durability
**Prerequisites:** Take MER 220 or MER 220L.
**Corequisites:** Take CER 325L.
**Offered:** Every year, Fall

**CER 325L. Concrete Materials Lab. 0 Credits.**
This laboratory uses concrete mix design and strength testing labs to proportion the constituents of quality concrete and to provide a background in materials testing techniques, quality control and sound construction practices.
**Corequisites:** Take CER 325.

**CER 330. Fundamentals of Environmental Engineering. 3 Credits.**
This course introduces students to the field of environmental engineering with an emphasis on basic principles, design, problem solving, analytical skills and sustainable solutions to environmental engineering problems. Topics include water chemistry, mass balance, water treatment, water quality and pollution control.
**Prerequisites:** Take CHE 110, MA 153 and MA 154 or MA 142.
**Corequisites:** Take CER 330L.
**Offered:** Every year, Fall

**CER 330L. Fundamentals of Environmental Engineering Lab. 0 Credits.**
Lab to accompany CER 330.
**Prerequisites:** Take CHE 110.
**Corequisites:** Take CER 330.
**Offered:** Every year, Fall

**CER 340. Introduction to Geotechnical Engineering and Foundation Design. 3 Credits.**
Soil mechanics is the study of soil properties, which govern the use of soil as a construction or foundation material. The course is devoted to describing soils, analyzing soil stresses, determining consolidation settlement, designing earth embankments, determining earth pressures and designing foundations based on applicable engineering principles and recognition of the fundamental concepts of soil behavior.
**Prerequisites:** Take MER 210.
**Offered:** Every year, Fall

**CER 340L. Introduction to Geotechnical Engineering and Foundation Design Lab. 1 Credit.**
In this laboratory course, students examine soil properties and extract necessary parameters for design. This course focuses on the common testing methods of soils in geotechnical engineering practice following ASTM standards for classification of soils and basic design of foundations.
**Prerequisites:** Take MER 210.
**Corequisites:** Take CER 340.
**Offered:** Every year, Fall

**CER 350. Hydrology/Hydraulic Design. 3 Credits.**
This course studies both hydrology, which is the study of occurrence, movement and distribution of rainfall, and hydraulic design, which is the application of fluid mechanics, physical science and engineering disciplines in the design of structures and development of water resources. Hydrologic principles are applied to model and analyze the distribution and movement of rainfall in a watershed. Hydraulic principles are applied to analyze and design flow-through systems of reservoirs, channels and culverts. The course makes extensive use of computer simulation models used in engineering practice.
**Prerequisites:** Take MER 310.
**Offered:** Every year, Spring

**CER 350L. Hydrology/Hydraulic Design Lab. 1 Credit.**
This lab supports and reinforces concepts from the Hydrology/Hydraulic Design course. Hands-on laboratory and field activities are performed for the measurement of pipe flow and headloss, evaluation of pipe networks, pump characterization, rainfall measurement, open channel weirs and orifices and streamflow measurement. Various industry-standard software packages for water distribution systems, open channel hydraulics and stormwater management are introduced.
**Prerequisites:** Take MER 310.
**Corequisites:** Take CER 350.
**Offered:** Every year, Spring

**CER 360. Construction Management. 3 Credits.**
This course focuses on the implementation of various projects in which a civil engineer may be engaged, including planning and feasibility studies, design and construction. Students study topics relating to the management of construction, including scope of work, rough order-of-magnitude estimating, scheduling, planning, progress reporting, resource constraining and quality control. The roles of the contractor, owner, public entities and designer are explained.
**Prerequisites:** Take ENR 210.
**Offered:** As needed

**CER 370. Materials Engineering for Civil Engineers. 3 Credits.**
This course introduces the fundamental properties of civil engineering materials, including mechanical, chemical, physical, surface, fracture and rheological properties. The materials discussed are cements, metals, asphalt, wood and composites. Special effort is directed at learning new sustainable construction materials and practices, including alternative binders for concrete and methods for increasing the service life of civil engineering infrastructure.
**Prerequisites:** Take CHE 110.
**Corequisites:** Take MER 220.
**Offered:** As needed

**CER 405. Ecological Engineering. 3 Credits.**
Ecological engineering is the design of sustainable ecosystems that integrate human society with its natural environment for the benefit of both. This course explores the basic concepts of ecological engineering for design applications including green infrastructure, wetland creation and restoration, restoration/rehabilitation of forests, grasslands, lakes, reservoirs and rivers and the development of engineered sustainable ecosystems.
**Prerequisites:** Take MER 310 or permission of instructor.
**Offered:** As needed

**CER 410. Design of Steel Structures. 3 Credits.**
The course synthesizes the fundamentals of statics, mechanics of materials and structural analysis and applies them to the design of structural members, with emphasis on satisfying real-world needs. Topics include an introduction to the design of structural systems, steel tension and compression members, beams and beam-columns and connections. All design is performed in accordance with codes and specifications used in current engineering practice. A comprehensive design problem requires development of a design methodology, consideration of alternative solutions and design of an optimal steel structure to meet stated functional requirements.
**Prerequisites:** Take CER 310 or permission of instructor.
**Offered:** As needed

**CER 415. Advanced Structural Analysis. 3 Credits.**
This course builds on the material covered in CER 310 to develop a better understanding of structural behavior. Matrix analysis methods, including an introduction to finite elements, are developed as the basis for modern, computer-based structural analysis. These and other advanced analytical techniques are used to analyze and design trusses, beams and frames. Coursework involves extensive use of the computer as an analytical tool. Students use state-of-the-art structural engineering analysis and design software.
**Prerequisites:** Take CER 310.
**Offered:** As needed

**CER 420. Design of Concrete Structures. 3 Credits.**
This course introduces the behavior and failure mechanisms of structural concrete. Current codes and industry standards are used to guide the practical design of beams, slabs and columns.
**Prerequisites:** Take CER 310.
**Offered:** Every year, Fall

**CER 435. Geotechnical Aspects of Transportation Infrastructure. 3 Credits.**
Students are exposed to the geotechnical aspects of transportation systems, with a strong focus on pavement design (both rigid and flexible). Basic transportation topics necessary for the geotechnical design of roads are covered.
**Prerequisites:** Take CER 340.
**Offered:** As needed

**CER 445. Advanced Geotechnical Engineering and Foundation Design. 3 Credits.**
This course focuses on the analysis and design of shallow and deep foundations. Other topics include field testing, structural design of footings, and the geotechnical aspects of retaining wall design and excavations.
**Prerequisites:** Take CER 340.
**Offered:** Every year, Spring

**CER 450. Water and Waste Water Technology. 3 Credits.**
Students study technical engineering solutions to problems regarding water processing, water distribution, wastewater collection, and wastewater treatment. Advanced technical topics include: water distribution and sewerage system design, unit process design and environmental biotechnology.
**Prerequisites:** Take CER 330.
**Offered:** As needed

**CER 455. Advanced Environmental Engineering. 3 Credits.**
Students extend what they learned in the Fundamentals of Environmental Engineering course. This course provides a more in-depth look at environmental policies and regulations concerning water and air and their implications on design. Case studies and design projects allow students to focus on both technical and nontechnical issues associated with environmental projects. Advanced technical topics include: biological treatment, cell growth kinetics, sludge treatment/disposal, landfills, air pollution control, hazardous waste, contaminant transport, quantitative risk assessment and advanced water treatment.
**Prerequisites:** Take CER 330.
**Corequisites:** Take CER 455L.
**Offered:** Every year, Spring

**CER 455L. Advanced Environmental Engineering Lab. 0 Credits.**
Lab to accompany CER 455.
**Prerequisites:** Take CER 330.
**Corequisites:** Take CER 455.
**Offered:** Every year, Spring

**CER 465. Hazardous Waste and Environmental Site Assessment. 3 Credits.**
This course provides an introduction to hazardous waste management and preliminary site investigations for environmental hazards. Topics include identification of wetlands, title searches, air photo interpretation for environmental hazards, visual site surveys, operation of environment monitors, current EPA regulations regarding site assessment and investigation, and sampling of surface materials. Additional coursework focuses on hazardous waste; in particular, the legal framework, chemistry, quantitative risk assessment and remediation.
**Prerequisites:** Take CER 330.
**Offered:** As needed

**CER 470. Water Quality. 3 Credits.**
This course introduces basic chemical principles and applications to the analysis and understanding of aqueous environmental chemistry in natural waters and wastewaters. Topics include modeling of chemical systems, dissolved oxygen, nutrients, temperature and toxic substances with applications to groundwater, rivers, lakes, estuaries and coastal waters.
**Prerequisites:** Take CER 330.
**Offered:** As needed

**CER 475. Groundwater Hydrology and Contaminant Transport. 3 Credits.**
Students analyze groundwater flow and contaminant transport in the subsurface. Topics include geologic and physical factors affecting the movement of water and contaminants, sources of pollution, mathematical formulation and solution of groundwater flow and transport problems, remediation methods and an introduction to computer simulation models.
**Prerequisites:** Take CER 330, CER 340, CER 350.
**Offered:** As needed

**CER 485. Slope and Earth Structures Stability. 3 Credits.**
Students deepen their understanding of the mechanical behavior of slopes and earthen structures. The focus of this course is on the design, construction and performance of slopes and earthen structures.
**Prerequisites:** Take CER 340.
**Offered:** As needed

**CER 490. Engineering Professional Experience. 0-1 Credits.**
Students gain experience by employing engineering skills in a professional setting under the guidance of practicing engineers. Students must obtain departmental approval and register prior to starting the experience.
**Prerequisites:** Take ENR 395 or permission of the instructor.
**Offered:** Every year, All

**CER 497. Design of Civil Engineering Systems I. 3 Credits.**
The first half of a two-semester sequence, this course is part of the culminating senior design sequence for students in the civil engineering program. This course focuses on the implementation of civil engineering projects, including the senior design project. Students study topics related to the stages and structure of construction, costing and take-off, scheduling, ethics, safety, sustainable construction and project planning. In the context of the senior design project, students investigate the project, develop functional requirements, and prepare a draft project schedule in preparation for the second half of the sequence.
**Prerequisites:** Take ENR 210, and Senior Standing.
**Offered:** Every year, Fall

**CER 498. Design of Civil Engineering Systems II. 3 Credits.**
This course provides an opportunity for students to apply and synthesize their knowledge of civil engineering. Multidisciplinary teamwork is emphasized. Coursework from the various subdisciplines of civil engineering provides the foundation for this course. Students develop requirements, generate alternatives, make practical engineering approximations, analyze feasibility and make decisions leading to a completed design. The design includes principles of sustainability taking into account realistic constraints. These may include economic, environmental, legal and cultural issues. Deliverables include a comprehensive design report including drawings and a client briefing. This course provides an integrative experience that supports the overarching academic program goal.
**Prerequisites:** Take CER 310, CER 330, CER 340, CER 350 or permission of instructor.
**Offered:** Every year, Spring

**CER 499. Independent Study in Civil Engineering. 3 Credits.**
On an individual or small group basis, students pursue advanced study of a research or design topic in civil engineering. The scope of the course is tailored to the needs of the project and desires of the student, in consultation with the faculty adviser. The student is required to define and analyze the problem, study the fundamentals involved, organize an approach, determine a procedure, perform research and/or achieve a solution, submit a written report and give a formal briefing. Requires permission of the instructor.
**Offered:** Every year, Fall and Spring