

CIVIL AND ENVIRONMENTAL ENGINEERING (CIV_ENV)

CIV_ENV 101-0 Introduction to Civil and Environmental Engineering (0 Unit) In this seminar course we discuss the grand challenges facing society in the coming decades, and how Civil and Environmental Engineers are meeting these challenges. Seminars will focus on key CE and EE topics, the CE & EE curricula at NU, and the career paths of recent CE & EE graduates.

CIV_ENV 195-0 Introductory Course in Civil and Environmental Engineering (0-1 Unit) Introductory-level special topics courses in civil and environmental engineering. 195 is similar to CIV_ENV 395-0 but intended for first and second-year students.

CIV_ENV 201-0 Engineering Possibilities: Decision Science in the Age of Smart Technologies (1 Unit) Define challenges facing cities, and learn how to critically evaluate different solutions, ranging from traditional to innovative. Foster critical thinking about problem definitions along with the definition of metrics that represent desirable (and undesirable) outcomes in urban systems.

CIV_ENV 202-0 Biological and Ecological Principles (1 Unit) Fundamentals of biology - including cell biology, genetics, and biochemistry - and ecology - including biological interactions, microbial ecology - and biogeochemical cycling as they apply to natural and engineered systems. Bioinformatics tools necessary for analyzing biological and ecological data. Prerequisites: MATH 220-2; CHEM 131-0, CHEM 151-0, or CHEM 171-0.

CIV_ENV 203-0 Earth in the Anthropocene (1 Unit) Fundamentals of Earth system science and their connections to the need for humans to develop food, water, energy and infrastructure systems that has led to transformation of the Earth's surface and of its atmosphere. Prerequisite: MATH 220-2; CHEM 131-0, CHEM 151-0, or CHEM 171-0 is highly recommended. *Natural Sciences Distro Area*

CIV_ENV 205-0 Economics and Finance for Engineers (1 Unit) Principles of corporate finance; financial decisions of firms; value; risk and return; investment and capital budgeting decisions under certainty and uncertainty; performance evaluation. May not be taken for credit with or after KELLG_FE 310-0. Prerequisite: MATH 220-1; basic understanding of probability and economics recommended.

CIV_ENV 216-0 Mechanics of Materials I (1 Unit) Analytical and experimental study of stresses and deformations and their application to the design of machine and structural elements subjected to static, dynamic, and repeated loads. Prerequisite: GEN_ENG 205-2 or GEN_ENG 206-2.

CIV_ENV 220-0 Structural Art (1 Unit) Learn how to interpret and understand the built environment through an examination of the history of structural engineering as a creative art, with particular emphasis on technical, visual, and social analysis and critique of bridges, buildings, and designers.

CIV_ENV 221-0 Theory of Structures I (1 Unit) Deflections of structures, energy concepts, idealization of structures, truss analysis, column stability, and influence lines. Introduction to indeterminate truss and frame analyses, slope-deflection analysis, and moment distribution. Portal method. Prerequisite: CIV_ENV 216-0.

CIV_ENV 250-0 Earth Surface Engineering (1 Unit) Fundamental properties and behavior of soils as engineering materials. Origin of soils

through the properties of soil components to the strength, permeability, and deformation of soil masses. Prerequisite: MECH_ENG 241-0.

CIV_ENV 260-0 Environmental Systems and Processes (1 Unit) Basic engineering principles required for the design, operation, analysis, and modeling of both natural and engineered systems and their application to major issues facing human and environmental health of ecosystems. Corequisite: MATH 220-2; CHEM 131-0, CHEM 151-0, or CHEM 171-0 highly recommended.

CIV_ENV 280-1 Architectural Engineering & Design Seminar I (0 Unit) First course in the AED seminar series. Students will learn from practicing architects and engineers, and will also conduct independent studies culminating in their own seminars to the class.

CIV_ENV 280-2 Architectural Engineering & Design Seminar II (0 Unit) Second course in the AED seminar series. Students will learn from practicing architects and engineers, and will also conduct independent studies culminating in their own seminars to the class.

CIV_ENV 280-3 Architectural Engineering & Design Seminar III (0 Unit) Third course in the AED seminar series. Students will learn from practicing architects and engineers, and will also conduct independent studies culminating in their own seminars to the class.

CIV_ENV 295-0 Introductory topics in Civil and Environmental Engineering (1 Unit) Intermediate-level study of topics suggested by students or faculty members and approved by the department.

CIV_ENV 301-1 Professional Development Seminar I (0.34 Unit) Case study in engineering ethics, with discussion of topics in professional development and lifelong learning. Prerequisite: junior engineering standing.

CIV_ENV 301-2 Professional Development Seminar II (0 Unit) Preparation for the Fundamentals of Engineering (FE) exam. Prerequisite: senior engineering standing.

CIV_ENV 302-0 Engineering Law (1 Unit) The American legal system from an engineer's perspective. Socratic-method analysis of statutory and case law. Contract, patent, corporation, antitrust, property, and environmental law. Torts, product liability, and arbitration. Prerequisite: junior engineering standing.

CIV_ENV 303-0 Environmental Law and Policy (1 Unit) An introduction to important aspects of environmental law and policy. Covers a wide range of environmental topics, with a focus on major federal environmental statutes. Prerequisite: junior or senior standing.

CIV_ENV 304-0 Civil and Environmental Engineering Systems Analysis (1 Unit) Quantitative techniques to develop descriptive and prescriptive models that support efficient planning and management of civil and environmental engineering systems. Prerequisite: MATH 220-2 or equivalent.

CIV_ENV 306-0 Uncertainty Analysis (1 Unit) Probability, statistics, and decision theory. Discrete and continuous random variables, marginal and conditional distributions, moments, statistical model selection and significance tests, hypothesis testing, and elementary Bayesian decision theory. Application to problems in soil mechanics, water resources, transportation, and structures.

CIV_ENV 308-0 Environmental Justice (1 Unit) This course will examine evidence that there is not equal environmental protection in this country and analyze why this inequality exists. Course participants will review evidence of environmental injustice, with

attention to perspectives of grassroots organizations, the U.S. EPA, and businesses. The course will explore why civil and human rights have become important aspects of environmental protection activities worldwide.

CIV_ENV 309-0 Climate and Energy - Law and Policy (1 Unit)

This course is a survey of the major laws that regulate the acquisition of energy resources, the conversion of energy resources into usable energy, the energy transmission and transportation infrastructure and the climate change implications of these activities.

CIV_ENV 314-0 Organic Geochemistry (1 Unit)

The sources and fates of organic matter in the natural environment; global cycling of organic carbon; applications to the study of modern and ancient environments. Taught with EARTH 314-0; may not receive credit for both courses.

Prerequisites: 1 course in earth and planetary sciences or environmental sciences; 1 course in chemistry.

CIV_ENV 317-0 Biogeochemistry (1 Unit)

Cycling of biogenic elements (C, N, S, Fe, Mn) in surficial environments. Emphasis on microbial processes and isotopic signatures.

Prerequisites: 1 quarter of chemistry; 1 quarter of geoscience, environmental sciences, or biological sciences.

CIV_ENV 320-0 Structural Analysis--Dynamics (1 Unit)

Single and multiple degree-of-freedom systems subjected to periodic, seismic, and general loadings. Time-history analysis of linear and nonlinear systems. Design methods for earthquakes.

Prerequisite: CIV_ENV 221-0.

CIV_ENV 321-0 Concrete Properties (1 Unit)

Concrete as a composite material; relationship between constitutive laws and microstructure; failure theories; fracture; fatigue; strain rate effects; destructive and nondestructive testing; creep and shrinkage; chemistry of cement hydration; admixtures; aggregates; proportioning; new materials.

CIV_ENV 323-0 Structural Steel Design (1 Unit)

Rational basis of structural design. Design approach for structural-steel components of a building system.

Prerequisites: CIV_ENV 216-0; CIV_ENV 221-0 or equivalent.

CIV_ENV 325-0 Reinforced Concrete (1 Unit)

Fundamentals of reinforced concrete theory and design. Analysis and design of beams, slabs, and columns. Concurrent familiarization with current building codes, specifications, and practices.

Prerequisite: CIV_ENV 221-0.

CIV_ENV 326-0 Engineering Forensics (1 Unit) Introduction to failure analysis and forensic engineering to describe how these investigative procedures contribute to regulations, engineering design, safety principles, and the economic aspects of structure engineering.

Prerequisite: CIV_ENV 221-0.

CIV_ENV 327-0 Finite Element Methods in Mechanics (1 Unit)

Development of finite elements from variational principles and application to static stress analysis. Introduction to techniques for transient and generalized field problems. Computer implementation of finite element techniques. Taught with MECH_ENG 327-0; may not receive credit for both courses.

CIV_ENV 328-0 Computational Forensics and Failure Analysis (1 Unit)

The course will cover the use of the scientific method for accident investigation, hypothesis development, and the use of the finite element method to analyze the root cause of a failure. Practical application problems for both civil and mechanical structures will be analyzed using commercial finite element codes (Abaqus, Hypermesh, LS-Dyna)

Prerequisite: CIV_ENV 327-0 or MECH_ENG 327-0.

CIV_ENV 330-0 Engineering Project Management (1 Unit)

Techniques for coordinating decisions and actions of various parties in the design and construction of civil and environmental engineering projects. Delivery systems; preconstruction services; project planning; cost control and value engineering; bidding.

Prerequisite: instructor consent.

CIV_ENV 332-10 Building Construction Estimating (1 Unit)

Estimation of cost at different stages of design; conceptual estimating and quantity takeoff of various elements, such as materials, labor, and equipment.

Prerequisites: CIV_ENV 330-0; consent of instructor.

CIV_ENV 336-10 Project Scheduling (1 Unit)

Project planning, scheduling, and control using CPM arrow and precedence networks; resource allocation and resource leveling; earned value analysis; linear scheduling; PERT, CPM in dispute resolution and litigation, computer scheduling.

Prerequisite: CIV_ENV 330-0.

CIV_ENV 346-0 Ecohydrology (1 Unit)

Interactions between water and ecosystems in freshwater, terrestrial, and urban environments. Feedbacks between ecological and hydrological processes. Engineering of ecosystems such as constructed wetlands, green roofs, and other green infrastructure for resilient and sustainable water management.

Prerequisites: Students must have taken CIV_ENV 260, one course in fluid mechanics, or have graduate standing.

CIV_ENV 352-0 Foundation Engineering (1 Unit)

Application of soil mechanics to analysis and design of foundations and embankments. Settlement of structures, bearing capacities of shallow and deep foundations, earth pressures on retaining structures, and slope stability.

Prerequisite: CIV_ENV 250-0.

CIV_ENV 353-0 Energy Geostuctures & Geosystems (1 Unit)

This course focuses on energy geostuctures and geosystems: novel earth-contact technologies that provide renewable energy supply and structural support to any built environment. The course comprises theoretical and practical sessions. The theoretical sessions expand on the analysis and design of such technologies from energy, geotechnical and structural perspectives. The practical sessions simulate an actual design project of energy geostuctures.

CIV_ENV 361-1 Environmental Microbiology (1 Unit)

Basic principles and practical applications of microbiology to environmental issues, such as microbial contamination, degradation of organic contaminants, production of alternative fuels, and global climate change.

CIV_ENV 361-2 Public & Environmental Health (1 Unit)

Current problems in public and environmental health, such as the worldwide burden of major infectious diseases, emergence of new pathogens, and environmental reservoirs of infectious organisms.

Prerequisite: CIV_ENV 361-1 or consent of instructor.

CIV_ENV 364-0 Sustainable Water Systems (1 Unit)

An overview of the engineered water cycle focusing the fundamental principles as well as the design and assessment methods for physical, chemical and biological treatment unit processes for drinking water treatment, used water treatment and reuse, and emerging issues such as the energy-food-water nexus.

Prerequisites: CIV_ENV 260-0, MECH_ENG 241-0.

CIV_ENV 365-0 Environmental Laboratory (1 Unit)

Chemical and microbiological aspects of environmental engineering and science are explored through an integrated laboratory course.

Prerequisite: CIV_ENV 367-0.

CIV_ENV 366-0 Dynamics in Chemical Transport and Reaction (1 Unit)

Application of environmental engineering fundamentals to evaluate, model, and develop engineering solutions for different environmental contamination scenarios. Prerequisite: CIV_ENV 260 or instructor consent.

CIV_ENV 367-0 Chemical Processes in Aquatic Systems (1 Unit)

Chemical principles for understanding and predicting the chemical composition and evolution of natural waters using an equilibrium approach. Applications to environmental issues such as metal speciation and toxicity, ocean acidification, carbon storage.

Prerequisite: BMD_ENG 250-0 or CHEM_ENG 211-0.

CIV_ENV 368-0 Sustainability: The City (1 Unit)

Exploration of the issues that motivate the design and engineering of sustainable resource use and development.

CIV_ENV 370-0 Emerging Organic Contaminants (1 Unit)

Fundamental molecular processes that govern the fate and transformation of emerging organic contaminants in natural and engineered environmental systems.

Prerequisite: CHEM 210-1 or consent of instructor.

CIV_ENV 371-0 Introduction to Transportation Planning and Analysis (1 Unit)

Analysis and design of solutions to transportation problems; introduction to selected operations research and statistical analysis techniques; use of case studies in urban transportation, intercity passenger transport, and freight movements.

Prerequisite: junior standing or consent of instructor.

CIV_ENV 374-0 Data Science for Urban Systems (1 Unit)

Introduces students to modern data science methodologies tailored for solving complex urban challenges, such as transportation systems, sustainable infrastructure, environmental monitoring, and smart cities.

CIV_ENV 376-0 Transportation System Operations (1 Unit)

Traffic-flow theory; vehicle and human factors, capacity analysis, intersection performance and control; management and control of arterial streets and networks; neighborhood traffic restraint, urban transit operations. Operations concepts and theories applied to actual problems through laboratory practice.

Prerequisite: basic understanding of calculus and statistics; knowledge of MATLAB desirable but not required.

CIV_ENV 377-0 Choice Modelling in Engineering (1 Unit)

"This course focuses on the theory and practice of survey design, data and analysis. In this course students will learn the theories and scientific debates around the design, administration and analysis of various types of behavioral data-collection methods."

CIV_ENV 382-1 Capstone Design I (0.5 Unit) Culminating team-based design experience in civil and environmental engineering, with an overview of the function, design, and operations of modern infrastructure systems. Part 1 of 2-course sequence. Prerequisite: senior standing in civil or environmental engineering or consent of instructor.

CIV_ENV 382-2 Capstone Design II (0.5 Unit) Culminating team-based design experience in civil and environmental engineering, with an overview of the function, design, and operations of modern infrastructure systems. Part 2 of 2-course sequence. Prerequisite: CIV_ENV 382-1.

CIV_ENV 385-1 Architectural Engineering and Design 1: Fundamentals (1 Unit)

Architectural engineering and design studios: architectural history, case studies in design, construction and management of buildings, and drawing and model building. Fundamental studio: basic architectural and structural design of a simple building project.

Prerequisite: junior standing in engineering or consent of instructor.

CIV_ENV 385-2 Architectural Engineering & Design 2: Intermediate (1 Unit)

Architectural engineering and design studios: architectural history, case studies in design, construction and management of buildings, and drawing and model building. Intermediate studio: architectural and structural design of a building project with multiple requirements.

Prerequisites: CIV_ENV 385-1 and junior standing in engineering; or consent of instructor.

CIV_ENV 385-3 Architectural Engineering & Design 3: Advanced Studio (1 Unit)

Architectural engineering and design studios: architectural history, case studies in design, construction and management of buildings, and drawing and model building. Advanced studio: architectural and structural design of a large, complex building project.

Prerequisites: CIV_ENV 385-2 and junior standing in engineering; or consent of instructor.

CIV_ENV 386-0 High Performance Architectural Design (1 Unit)

Elements of high performance building design and to explore the various matrices used to analyze the relationship between the structure and function of various design alternatives.

CIV_ENV 387-0 Design of Sustainable Urban Developments (1 Unit)

Design high performing neighborhoods, districts and communities that incorporate principles of density, diversity and flexibility around the "operating system of nature". Prerequisites: CIV_ENV 386-0, senior standing, consent of instructor; recommend CIV_ENV 385-1, CIV_ENV 385-2, and CIV_ENV 385-3.

CIV_ENV 388-1 Building Science I: Fundamentals for Sustainable Buildings (1 Unit) The course is the first of a two-part series focusing on Building Science. This course aims to provide the fundamental knowledge of the physics related to buildings, focusing on heat and mass transfer, moisture, and the energy consumed in buildings to guarantee the comfort of their occupants.

CIV_ENV 388-2 Building Science II: Application for Sustainable Buildings (1 Unit)

This course enriches and applies the concepts learned in CIV_ENV 388-1. The course comprises both theoretical and practical sessions. Theoretical sessions introduce the environmental factors affecting occupants' comfort inside buildings. Practical sessions focus on the design of a virtual project, with calculations related to energy consumption and visual and thermal parameters with the help of computer software.

CIV_ENV 391-SA Engineering Nature in South Africa: Impacts on Human and Ecological Health (1 Unit) A field-based course that explores how human development and anthropogenic climate change affect water quality and quantity in urban and rural settings.

CIV_ENV 392-SA Climate Policy in Africa (1 Unit) Analysis of the impacts of climate change on the African continent, the comparison of policy responses at national and regional levels, and the evaluation of Africa's role in global climate negotiations focusing on mitigation and adaptation strategies, climate finance, and case studies.

CIV_ENV 393-SA Resources and Equity in South Africa (1 Unit) The course explores the range of climate impacts to which South Africa is

most vulnerable, explains how interdependent they are, and examines the implications for resource equity and sociopolitical stability.

CIV_ENV 394-SA Climate and Health Projects (1 Unit) A project-based course that addresses the unique context of South Africa geography, ecology, socioeconomic, political structure and the many human and ecological health challenges communities face in this era of rapid climate change. Projects are a culminating capstone experience targeted at developing solutions tailored to the special conditions of South Africa.

CIV_ENV 395-0 Special Topics in Civil and Environmental Engrg (1 Unit)
Topics suggested by students or faculty and approved by the department.

CIV_ENV 399-0 Projects (1 Unit) Special studies under faculty direction.
Credit to be arranged.