

ChE 475, Explosives Surety, 3 cr, 3 cl hrs

Prerequisite: Upper-class standing or consent of instructor

Offered spring semester

An introduction to explosives and other energetic materials. The basic chemical compositions, properties and environmental effects of commercial, military, and improvised (terrorist) explosives and some pyrotechnics will be compared. The basic physics of shock waves and detonation. Explosive effects, blast detection, tagging and environmental issues. Case studies or recent bombings will be used to describe a variety of terrorist approaches. Safety in handling of explosive materials and classifications for transportation and storage. (Same as EXPL 414.)

ChE 476 Drug Delivery Techniques, 3 cr, 3 cl hrs

Prerequisite: Senior standing or consent of instructor

Focus is on current developments in drug delivery techniques, with only a brief discussion of common clinical techniques. The first portion of the class focuses on various delivery mechanisms and the tools needed to validate successful targeted drug delivery (both in vitro, in vivo and diagnostic tools). The second part of the course focuses on current developments in drug delivery based on published research articles. Students will read, digest, and critically analyze scientific work from leading research laboratories. Students will also gain valuable communication tools, as each student will present an article of interest to the class. Finally, the third part of the course focuses on important materials characterization methods such as biological sample prep, SEM, TEM, DSC, Flow Cytometry, Fluorescence Microscopy, ELISA Assays. Shares lecture with MATE 576 but is graded separately and additional work is required at the graduate level.

ChE 485, Senior Seminar, 1 cr, 3 lab hrs

Prerequisite: Senior standing or consent of instructor

Offered fall semester

Student and outside speaker presentations of topics of current interest. Peer and video review of each student's work. Career planning.

ChE 491, Independent Study, hrs and crs to be arranged

Prerequisite: Consent of instructor

Individual study of chemical engineering problems of special interest.

Faculty Research Interests

Choudhury—Computational Modeling of Materials for the Energy and Environment; Specific Research Areas Include Surface Engineering, Catalysis, Gas Sensors, Proton Transport Membranes, Sorbent Materials and CO₂ Reduction

Leclerc—Catalysis, Reactor Design, Alternative Fuels

Tartis - Biomedical Engineering, Targeted Drug Delivery

Civil Engineering

Professor Richardson (Chair of the Department)

Associate Professor Wilson

Assistant Professors Cook, Dong

Adjunct Faculty Ghosh, Hendrickx, McCord, McMullin, Kuhn

Degree Offered: B.S. in Civil Engineering

Department Mission Statement

The primary objective of this program is to produce well-balanced civil engineers capable of entering the civil engineering profession or continuing their studies at the graduate level. Graduates will be well-prepared to solve current civil engineering problems, and they will have the ability to adapt to problems of the future.

The achievements of civil engineers are well-known to the general public, because civil engineers build the world's infrastructure. In doing so, they can shape the history of nations. Projects that civil engineers work on include: airports, bridges, buildings, dams and waterways, drainage and sewer systems, city roads, and highways.

The undergraduate program offers a balanced approach to civil engineering education. Students take a common core of civil engineering courses, and they can specialize in the areas of geotechnical, water resources, or structural engineering. The program is also designed to give students a solid foundation in engineering and science. Students take courses in chemistry, physics, and math, in addition to a core set of engineering courses common to most engineering disciplines. The civil engineering courses teach students the fundamentals of engineering design, as well as potential applications. Students are taught how to use computer software to expedite the design process, and they are also taught how to balance engineering designs with economic constraints. During their senior year, undergraduate students work with a professor on a design project.

Program Educational Objectives

1. To develop graduates that function successfully in the fundamental areas of civil engineering, and within a specialty, such as structural, geotechnical or water resources engineering.
2. To prepare graduates for advanced education in civil engineering and related fields, and for professional licensure.

Undergraduate Program

Bachelor of Science in Civil Engineering

Minimum credit hours required—132

In addition to the General Education Core Curriculum (page 7), the following courses are required:

- CE 101 (1), 201 (3), 301 (3), 302 (3), 401 (3), 402 (3), CE 406 (3), CE 407 (3), 413 (3), 423(3), 481 (3)
- ES 316 (3)
- ES 110 (2), 111 (3), 201 (3), 216 (3), 302 (3)
- MATH 231 (4), 283 (3), 335 (3)
- ME 220 (3), 420(3)
- Basic Science Elective— 3 credits from the following: BIOL 111, EARTH 101, EARTH 120, EARTH 130, EARTH 140, EARTH 150. Students are not required to take the accompanying lab unless it is required by the Biology/Earth Science department.
- Technical Electives (12): Minimum of 12 credit hours from the list of approved civil engineering electives. Students may take approved elective courses from more than one specialty area to satisfy the B.S. degree without prior approval from their advisor or the Department Chair. Courses are grouped by specialty to assist students who may want to specialize in a particular area.

Civil engineering approved electives include:

- **Geotechnical** (12): CE 420 (3), CE 422 (3), ME 360 (3), ME 409 (3), ME 422 (3), ME 427 (3), ME 434 (3), EXPL XXX (3)
- **Water Resources** (12): ENVE 201 (3), ENVE 301 (3), ENVE 303(3), ENVE 304 (3), ENVE 406 (3), EARTH 440 (4), EARTH 441 (1), EARTH 442 (1), EARTH 443 (1), ES 347 (3), ES 350 (3)
- **Structural** (12): CE 410 (3), CE 412 (3), CE 414 (3), CE 418 (3), CE 420 (3), MATE 470 (3), MENG 304 (3), MENG 441 (3), ME 409 (3), ME 434 (3) , EXPL XXX (3)

Additional technical electives must be approved by the Department Chair.

Students pursuing a B.S. in Civil Engineering must take all engineering courses for a letter grade.

Civil engineering majors must maintain a minimum GPA of 2.0 in required courses in order to graduate. Civil engineering majors are required to take the Fundamentals in Engineering (FE) exam as a requirement for graduation.

Sample Curriculum for the Bachelor of Science Degree in Civil Engineering

Semester 1

- 1 CE 101 (civil engineering seminar)
- 4 CHEM 121 & 121L (general)
- 3 ENGL 111 (college English)
- 2 ES 110 (drafting)
- 4 MATH 131 (calculus)
- 3 Basic Science*

17 Total credit hours

* Basic Science Elective from one of the following: BIOL 111, EARTH 101, EARTH 120, EARTH 140, EARTH 150

Semester 2

- 3 ENGL 112 (college English)
- 3 ES 111 (computer programming)
- 4 MATH 132 (calculus)
- 5 PHYS 121 & 121L (general)

15 Total credit hours

Semester 3

- 4 CHEM 122 & 122L (general)
- 3 ES 201 (statics)
- 4 MATH 231 (calculus)
- 5 PHYS 122 & 122L (general)

16 Total credit hours

Semester 4

- 3 ES 216 (fluid mechanics)
- 3 ES 302 (mechanics of materials)
- 3 MATH 335 (ordinary differential equations)
- 3 ME 220 (surveying and map preparation)
- 6 Humanities / Social Science

18 Total credit hours

Semester 5

- 3 CE 201 (materials, properties, and testing)
- 3 CE 302 (structures)
- 3 ME 420 (soil mechanics)
- 3 ENGL 341 (technical writing)
- 3 MATH 283 (statistics)
- 3 Social Science

18 Total credit hours

Semester 6

- 3 CE 301 (construction engineering)
- 3 CE 401 (finite element analysis)
- 3 CE 402 (transportation)
- 3 ES 316 (engineering practice and economics)
- 3 CE Elective
- 3 Humanities

18 Total credit hours

Semester 7

- 3 CE 406 (steel)
- 3 CE 407 (concrete)
- 6 CE Electives
- 3 Humanities
- 15 Total credit hours

Semester 8

- 3 CE 413 (foundation design & analysis)
- 3 CE 423 (open channel hydraulics)
- 3 CE 481 (senior design)
- 3 Humanities
- 3 CE Elective
- 15 Total credit hours

Approved Civil Engineering Electives

CE students must take a minimum of 12 elective credit hours. Students may take approved elective courses from more than one specialty area to satisfy the B.S. degree without prior approval from their advisor or the Department Chair. Courses are grouped by specialty to assist students who may want to specialize in a particular area.

Water Resources Engineering

- 3 ENVE 201 (environmental engineering)
- 3 ENVE 301 (applied principles of environmental engineering)
- 3 ENVE 303 (water treatment process design)
- 3 ENVE 304 (wastewater treatment process design)
- 3 ENVE 406 (environmental engineering unit operations)
- 4 EARTH 440 (hydrological theory and field methods)
- 1 EARTH 441 (aquifer mechanics)
- 1 EARTH 442 (vadose zone processes)
- 1 EARTH 443 (atmospheric dynamics and rainfall processes)
- 3 ES 347 (engineering thermodynamics)
- 3 ES 350 (heat and mass transfer)

Geotechnical Engineering

- 3 CE 420 (pavement design)
- 3 CE 422 (geotechnical waste containment design)
- 3 ME 360 (exploration and field mapping)
- 3 ME 409 (design of structures)
- 3 ME 422 (rock mechanics)
- 3 ME 427 (site investigation)
- 3 ME 434 (drilling & blasting)
- 3 Some explosives (EXPL) courses – check with Department Chair

Structural Engineering

- 3 CE 410 (reinforced masonry and timber design)
- 3 CE 412 (advanced design of steel structures)
- 3 CE 414 (advanced design of concrete structures)
- 3 CE 418 (structural dynamics)
- 3 CE 420 (pavement design)
- 3 MATE 470 (corrosion phenomena)
- 3 MENG 304 (advanced strength of materials)
- 3 MENG 441 (dynamics and vibrations in structural design)
- 3 ME 409 (design of structures)
- 3 ME 434 (drilling & blasting)
- 3 Some explosives (EXPL) courses – check with Department Chair

Additional technical electives must be approved by the Department Chair.

Minor in Civil Engineering

Minimum credit hours required – 18

The following courses are required:

- 18 total credit hours of CE courses, ME 420, or ME 422

Civil Engineering Courses**CE 101, Civil Engineering Seminar, 1 cr, 1 cl hrs**

Brief overview of civil engineering topics, including structures, water resources, geotechnical and transportation engineering in the form of seminars by faculty, and guest speakers from industry, consulting, and government.

CE 201, Construction Materials, Properties, and Testing, 3 cr, 3 cl hrs

Prerequisite: CHEM 122

Mechanical behavior of engineering materials, including metals, ceramics, polymers, concrete, wood, bitumens, and asphaltic concretes; explanations of macroscopic behavior in terms of phenomena at the microscopic level.

CE 301, Introduction to Construction Engineering, 3 cr, 3 cl hrs

Topics covered include: contracting and bonding, planning and scheduling, estimating, project control, and productivity models.

CE 302, Introduction to Structural Engineering, 3 cr, 3 cl hrs

Prerequisites: ES 201, 302 or consent of instructor

Basic topics in the analysis, behavior, and design of trusses and framed structures under static loads; analysis topics include member forces in trusses, shear and moment diagrams, deflections, simple applications of the force method and slope-deflection; and an introduction to computer applications by means of a general purpose structural analysis program.

CE 401 – Finite Element Analysis for Civil Engineers, 3 cr, 3 cl hrs

Prerequisite: CE 302 or consent of instructor

Introduction to finite element analysis (FEA) for Civil Engineering students. Students will learn the fundamentals of FEA, and they will learn to use software packages to analyze complex structures. Topics include: 1-D systems, trusses, 2-D problems, axis-symmetric solids, beams, frames, and some types of 3-D problems.

CE 402, Introduction to Transportation Engineering, 3 cr, 3 cl hrs

Introduction to the design, planning, operation, management, and maintenance of transportation systems. Principles for planning integrated multi-modal transportation systems (highways, air, rail, etc.). Introduction to the layout of highways, airports, and railroads with traffic flow models, capacity analysis, and safety. Functional design concepts for both the facilities and systems areas of study with life cycle costing procedures and criteria for optimization.

CE 406, Design of Steel Structures, 3 cr, 3 cl hrs

Prerequisite: CE 302 or consent of instructor

Behavior and design of steel members subjected to tension, compression and flexural loads, according to AISC specifications. Topics covered include: elastic and inelastic design, buckling of beams and columns, and structural connections.

CE 407, Design of Concrete Structures, 3 cr, 3 cl hrs

Prerequisite: CE 302 or consent of instructor

Study of the strength, behavior and design of reinforced concrete members, including beams, columns and slabs. Topics covered will include serviceability of beams and slabs, control of deflections and cracking, shear design, and bonding.

CE 410, Reinforced Masonry and Timber Design, 3 cr, 3 cl hrs

Prerequisite: CE 302 or consent of instructor

Reinforced masonry design topics covered include: the properties and performance of masonry materials; design criteria and methods in reinforced masonry; and design examples including reinforced masonry walls, masonry columns and pilasters, and rectangular beams. Timber topics covered include: design of beams, columns, trusses, and diaphragms in wood; design of gluelaminated beams; design of wood connections; use of timber design codes and the International Building Code (IBC).

CE 412, Advanced Design of Steel Structures, 3 cr, 3 cl hrs

Prerequisite: CE 406 or consent of instructor

Behavior and design of structural steel beams, columns, frames, and connections. Topics include: elastic and inelastic design, composite beam design, stability of beams and columns, behavior of steel frame structures, design of bolted and welded connections, metallurgical and mechanical properties of welds, braced frame and moment frame design for lateral loads. Extensive use of the current AISC-LRFD design code.

CE 413, Foundation Design and Analysis, 3 cr, 3 cl hrs

Prerequisite: ME 420

Principles of soil mechanics and foundation engineering. Immediate and time dependent settlements, service loads, lateral loads, loading, approximate analysis methods, performance requirements, shallow foundations, lateral earth pressure, design of retaining walls, deep foundations, special footings, slope stability, and computer modeling of foundations. (Same as ME 413).

CE 414, Advanced Design of Concrete Structures, 3 cr, 3 cl hrs

Prerequisite: CE 407 or consent of instructor

Topics covered include: strut and tie models, footings, retaining walls, principles of prestressed concrete, materials and techniques used in these systems, advantages and disadvantages of prestressing methods over regular reinforced concrete, and the design of prestressed concrete structures, such as axially loaded members, beams (for flexure and shear), and slabs.

CE 418, Structural Dynamics, 3 cr, 3 cl hrs

Prerequisites: Math 335 and CE 302 or consent of instructor

Fundamentals of structural dynamics. Analysis of single and multi-degree-of-freedom structures subjected to various types of vibrations. Topics covered will include structural responses to free, harmonic and periodic excitations, step and pulse excitations, and earthquake loads.

CE 420, Pavement Materials and Design, 3 cr, 3 cl hrs

Prerequisites: CE 201 or ES 302

Analysis, behavior, performance, and structural design of pavements for highways, bridges and airfields. Topics include: climatic factors, maintenance strategies and life cycle design economics, traffic loadings, recycled pavement materials, evaluation by nondestructive testing (roughness, skid resistance, structural capacity), destructive testing, and rehabilitation of pavement systems.

CE 422, Geotechnical Waste Containment Design, 3 cr, 3 cl hrs

Prerequisites: ME 420; MATH 335

Design procedures consisting of waste disposal methods, various containment systems, and associated remediation techniques. Waste characterization and soil-waste interactions, contaminant transport in low permeability soils, geosynthetics and soil materials use in waste containment, remedial issues of solidification and stabilization and barrier design, and landfill- and surface impoundment-related design, including liners, leachate and gas collection and removal, final covers, static and seismic slope stability, and settlement analysis. Geotechnical problem definition, application of field and laboratory test data, use of computer models for analysis and design.

CE 423, Open Channel Hydraulics, 3 cr, 3 cl hrs

Prerequisites: ES 216

Analysis and characteristics of flow in natural and artificial open channel systems using energy, continuity, and momentum equations as applied to steady-state uniform, gradually varied, and rapidly varied flow profiles with emphasis on design of hydraulic structures. The students will use their knowledge of fluid mechanics, calculus, numerical analysis, and computer science to solve practical open channel flow problems. A variety of hydraulic conveyance and structures are covered, including rigid and flexible boundary channels, culverts, sluice gates, fumes, weirs, spillways, stilling basins, and bridges.

CE 481, Senior Engineering Design , 3 cr, 3 cl hrs

Prerequisite: Senior standing

A semester-long civil engineering design project organized and directed by a faculty member.

CE 491, Special Topics in Civil Engineering, 2-3 cr

Prerequisite: Senior standing or consent of instructor

New and developing areas of knowledge in civil engineering offered to augment the formal course offerings.

CE 518, Structural Dynamics, 3 cr, 3 cl hrs

Prerequisite: MATH 335 and CE 302 or consent of instructor

Fundamentals of structural dynamics. Analysis of single and multi-degree-of-freedom structures subjected to various types of vibrations. Topics covered will include structural responses to free, harmonic and periodic excitations, step and pulse excitations, and earthquake loads. Graduate students complete an additional project and a classroom presentation. Graduate work is graded separately. Lectures shared with CE 418.

Faculty Research Interests

- Cook—Full-scale infrastructure destructive testing, bridge risk assessment (observed failures).
- Dong— Numerical modeling and analysis, application of advanced fiber reinforced polymer (FRP), structural health monitoring with advanced sensing technologies and computational techniques
- Ghosh—Macro behavior of composites, structural health monitoring and restoration
- Hendrickx—Vadose zone hydrology, water and salt balance of natural and irrigated systems, evapotranspiration, remote sensing, soil physics, electromagnetic induction
- Kuhn—Geotechnical engineering
- McCord—Water resources engineering
- McMullin—Structural engineering
- Richardson—Biological wastewater treatment, groundwater contamination, site remediation
- Wilson—Structural vibration control, fuzzy control, earthquake engineering