

# CIVIL & ENVIRONMENTAL ENGINEERING

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## Courses

### CEE 101. Introduction to Civil Engineering. 0-1 Hours

Introduction to the civil engineering faculty, facilities, and curriculum; to the career opportunities offered by the civil engineering profession; and to the areas of specialization within civil engineering.

### CEE 198. Research & Innovation Laboratory. 1-6 Hours

Students participate in (1) selection and design, (2) investigation and data collection, (3) analysis and (4) presentation of a research project. Research can include, but is not limited to, developing an experiment, collecting and analyzing data, surveying and evaluating literature, developing new tools and techniques including software, and surveying, brainstorming and evaluating engineering solutions and engineering designs. Proposals from teams of students will be considered.

### CEE 200. Professional Development Seminar. 0 Hours

Presentations on contemporary and professional engineering subjects by students, faculty, and engineers in active practice. The seminar addresses topics in key areas that complement traditional courses and prepare distinctive graduates, ready for life and work. Registration required for all sophomore students.

### CEE 213. Surveying. 3 Hours

An introduction to surveying and geomatics, with emphasis to theory of measurements and computation errors, leveling and traverse computations. topographic surveys, computations of earthwork, slope staking and stake out of highway curves. First term, each year. Prerequisite(s): MTH 168.

### CEE 214. Highway Geometrics. 2 Hours

Study of circular and spiral curves, vertical curves, grade lines, earthwork and mass diagram, slope and grade stakes, and contour grading. Second term, each year. Prerequisite(s): CEE 213.

### CEE 215L. Surveying Field Practice. 3 Hours

Field work and computation in topography, highway surveying, triangulation, level net, evaluation of errors, and preparation of plans. Five eight-hour days a week for three weeks. Summer, each year. Prerequisite(s): CEE 214.

### CEE 221L. Civil Computation Laboratory. 2 Hours

Introduction to numerical methods and logical problem solving techniques commonly used in the civil engineering profession. Introduction to computer aided drawing and design and the use of popular CADD packages in the civil engineering profession.

### CEE 298. Research & Innovation Laboratory. 1-6 Hours

Students participate in (1) selection and design, (2) investigation and data collection, (3) analysis and (4) presentation of a research project. Research can include, but is not limited to, developing an experiment, collecting and analyzing data, surveying and evaluating literature, developing new tools and techniques including software, and surveying, brainstorming and evaluating engineering solutions and engineering designs. Proposals from teams of students will be considered.

### CEE 300. Professional Development Seminar. 0 Hours

Practice in the presentation and discussion of papers; lectures by staff and prominent engineers. Attendance required of all civil engineering juniors.

### CEE 311. Civil Engineering Materials. 2 Hours

Physical and mechanical properties of construction materials; Portland cement concrete, bituminous materials, wood, ferrous and non-ferrous metals, masonry units; proportioning of concrete mixtures including admixtures. Prerequisite(s): EGM 303. Corequisite(s): CEE 311L.

### CEE 311L. Civil Engineering Materials Laboratory. 2 Hours

Laboratory experiments in the physical and mechanical properties of construction materials; Portland cement concrete, bituminous materials, wood, ferrous and non-ferrous metals, and masonry units; proportioning of concrete mixtures including admixtures. Prerequisite(s): EGM 303.

### CEE 312. Geotechnical Engineering. 3 Hours

Principles of soil structures, classification, capillarity, permeability, flow nets, shear strength, consolidation, stress analysis, slope stability, lateral pressure, bearing capacity, and piles. Second term, each year. Prerequisite(s): EGM 303. Corequisite(s): GEO 218.

### CEE 312L. Geotechnical Engineering Laboratory. 1 Hour

Laboratory tests to evaluate and identify soil properties for engineering purposes. Design problems are also included. Second term, each year. Corequisite(s): CEE 312.

### CEE 313. Hydraulics. 3 Hours

Basic principles of fluid mechanics in closed conduits and open channels. Principles include fluid statics, conservation of mass, conservation of momentum, conservation of energy, and fluid dynamics. Presentation of fluid mechanics principles through the solution of practical problems and a comprehensive semester project. Prerequisite(s): EGM 202. Corequisite(s): CEE 313L.

### CEE 313L. Hydraulics Laboratory. 1 Hour

Laboratory experiments and problems associated with CEE 313. Corequisite(s): CEE 313.

### CEE 316. Analysis of Structures I. 3 Hours

Elastic analysis of structures; deflection, moment-area theorems; conjugate-beam; virtual work influence lines; analysis of indeterminate structures using force methods; theories of failure, stiffness matrices, and use of software to analyze structures. Prerequisite(s): EGM 303.

### CEE 317. Analysis of Structures II. 3 Hours

Elastic analysis of structures; virtual work; Castigliano's theorems; slope deflection and moment distribution; computer analysis of structural systems, influence lines, column analogy, limit analysis. Departmental elective. Prerequisite(s): CEE 316.

### CEE 333. Water Resources Engineering. 3 Hours

Integrated study of the principles of water movement and management. Focus areas include hydrology, water distribution, storm water management, and waste water collection. Second semester, each year. Prerequisite(s): CEE 313.

### CEE 390. Environmental Pollution Control. 3 Hours

Study of environmental pollution problems relating to air, water, and land resources. Causes and effects of pollution technology for solving problems. Legal and political considerations. For juniors and seniors other than civil engineering students. Credit may not be applied toward civil engineering degree. Prerequisite(s): Some knowledge of chemistry.

### CEE 398. Research & Innovation Laboratory. 1-6 Hours

Students participate in (1) selection and design, (2) investigation and data collection, (3) analysis and (4) presentation of a research project. Research can include, but is not limited to, developing an experiment, collecting and analyzing data, surveying and evaluating literature, developing new tools and techniques including software, and surveying, brainstorming and evaluating engineering solutions and engineering designs. Proposals from teams of students will be considered.

**CEE 400. Professional Development Seminar. 0 Hours**

Practice in the presentation and discussion of papers; lectures by staff and prominent engineers. Attendance required of all civil engineering seniors.

**CEE 403. Transportation Engineering. 3 Hours**

Fundamentals of transportation engineering, including design, construction, maintenance, and economics of transportation facilities. Design of pavement structures and drainage systems. Prerequisite(s): Junior or senior status.

**CEE 411. Design of Steel Structures. 3 Hours**

Design and behavior of structural steel connections, columns, beams, and beams subjected to tension, compression, bending, shear, torsion, and composite action. Second semester, each year. Prerequisite(s): CEE 316.

**CEE 412. Design of Concrete Structures. 3 Hours**

Design and behavior of reinforced concrete slabs, beams, columns, walls, and footings subjected to tension, compression, bending, shear, and torsion. First semester, each year. Prerequisite(s): CEE 311, CEE 316.

**CEE 421. Construction Engineering. 3 Hours**

Organization, planning, and control of construction projects, including a study of the use of machinery, methods, materials, estimates, cost controls, and fundamentals of CPM and PERT. Contracts and bonds and legal aspects of contracting. Engineering economics including present and annual worth analysis, evaluation of alternatives.

**CEE 422. Design & Construction Project Management. 3 Hours**

Fundamentals of project management as they relate to the design and construction professional, and the application of project management techniques to the design and construction of major projects. Departmental elective.

**CEE 424. Foundation Engineering. 3 Hours**

Review of soil properties, site exploration and evaluation, bearing capacity, settlements, shallow foundations, retaining structures, and deep foundations. Prerequisite(s): CEE 312.

**CEE 425. Civil Engineering Systems. 3 Hours**

Analysis and evaluation of civil engineering systems using operations research tools including systems modeling, optimization and probability, and statistics. Civil engineering systems will also be examined from an economic perspective. Prerequisite(s): Junior or senior status.

**CEE 434. Water & Wastewater Engineering. 3 Hours**

Problems of water pollution; development and design of public water supply and waste water treatment systems; legal, political, ethical, and moral considerations. First term, each year. Prerequisite(s): CHM 124. Corequisite(s): CEE 313, CEE 434L.

**CEE 434L. Water & Wastewater Engineering Laboratory. 1 Hour**

Laboratory exercises, demonstrations, and design problems associated with water and wastewater engineering. First semester, each year. Prerequisite(s): CHM 123L. Corequisite(s): CEE 434.

**CEE 450. Civil Engineering Design. 3 Hours**

A group design of a complete, large-scale civil engineering system. The capstone design experience draws upon knowledge acquired over a wide spectrum of civil engineering subjects including environmental, geotechnical, structural, transportation and water resources engineering as well as project management. Second semester, each year. Prerequisite(s): CEE 312, CEE 333, CEE 403, CEE 411, CEE 412, CEE 434.

**CEE 463. Hazardous Waste Treatment. 3 Hours**

The fundamental principles of the design and operation of hazardous waste control and hazardous substances remediation processes. Hazardous waste regulations, risk assessment, and management. Department Elective. Prerequisite(s): CHM 124.

**CEE 493. Honors Thesis. 3 Hours**

Selection, design, investigation, and completion of an independent, original research study resulting in a document prepared for submission as a potential publication and a completed undergraduate thesis. Restricted to students in University Honors Program.

**CEE 494. Honors Thesis. 3 Hours**

Selection, design, investigation, and completion of an independent, original research study resulting in a document prepared for submission as a potential publication and a completed undergraduate thesis. Restricted to students in University Honors Program. Prerequisite(s): CEE 493.

**CEE 498. Research & Innovation Laboratory. 1-6 Hours**

Students participate in (1) selection and design, (2) investigation and data collection, (3) analysis and (4) presentation of a research project. Research can include, but is not limited to, developing an experiment, collecting and analyzing data, surveying and evaluating literature, developing new tools and techniques including software, and surveying, brainstorming and evaluating engineering solutions and engineering designs. Proposals from teams of students will be considered.

**CEE 499. Special Problems in Civil Engineering. 1-6 Hours**

Particular assignments to be arranged and approved by chairperson of the department. Departmental elective.

**CEE 500. Advanced Structural Analysis. 3 Hours**

Frames of variable cross section; arches; flat and folded plates; elastic stability of columns, frames, and plates; cylindrical, spherical, and barrel shells; structural dynamics of beams and frames. Prerequisite(s): CEE 317.

**CEE 501. Structural Analysis by Computer. 3 Hours**

Review of force and displacement methods. Introduction to direct element and substructure methods. Students write and execute computer programs to analyze plane and space trusses, grids, and frames. Prerequisite(s): CEE 317 or equivalent.

**CEE 502. Prestressed Concrete. 3 Hours**

Discussion of the properties of concrete and prestressed steel. Theory and design of prestressed concrete beams, slabs, columns, frames, ties, and circular tanks. Prerequisite(s): CEE 412 or equivalent.

**CEE 503. Introduction to Continuum Mechanics. 3 Hours**

Tensors, calculus of variations, Lagrangian and Eulerian descriptions of motion. General equations of continuum mechanics, constitutive equations of mechanics, thermodynamics of continua. Specialization to cases of solid and fluid mechanics. Prerequisite(s): EGM 303 or equivalent.

**CEE 504. Structural Dynamics. 3 Hours**

Response of undamped and damped single and multi-degree-of-freedom structures subjected to harmonic, periodic, and general dynamic loadings. Special topics include nonlinear structural response, response spectra, shear buildings, and simple systems with distributed properties. Prerequisite(s): CEE 316 or permission of instructor.

**CEE 505. Plastic Design in Steel. 3 Hours**

Analysis and design procedures based on ultimate load capacity applied to steel beams, frames, and their connections. Concept of plastic hinge, necessary conditions for the existence of plastic moment, instability, deformations, repeated and reversed loading, and minimum weight design. Prerequisite(s): CEE 411 or equivalent.

**CEE 507. Masonry Design. 3 Hours**

Properties and performance criteria of bricks, concrete blocks, mortar and grout; codes and construction practices; design of masonry elements. Prerequisite(s): CEE 316.

**CEE 508. Design Timber Structures. 3 Hours**

Study of basic wood properties and design considerations. Design and behavior of wood connectors, fasteners, beams, columns, and beam columns. Introduction to plywood and glued laminated members. Analysis and design of structural diaphragms and shear walls. Prerequisite(s): CEE 316 or permission of instructor.

**CEE 511. Experimental Stress Analysis. 3 Hours**

A study of the experimental analysis of stress as an aid to design for strength and economy with emphasis on electrical strain gages. Also, photoelasticity, brittle coatings, analogies, structural similitude. Two hours lecture and one three-hour laboratory period per week. Prerequisite(s): EGM 303 or equivalent.

**CEE 515. Pavement Engineering. 3 Hours**

Fundamental principles of flexible and rigid highway and airport pavement design, construction, and management. Prerequisite(s): CEE 403 or consent or equivalent.

**CEE 520. Advanced Geotechnical Engineering. 3 Hours**

Advanced study of Geotechnical engineering principles and study. Stress-strain characteristics; constitutive relationships; failure theories; dynamic soil properties; difficult soils; soil improvement; stability of earth slopes. Prerequisite(s): CEE 312 or equivalent.

**CEE 522. Subsurface Investigations. 3 Hours**

Soil & rock classification; Geophysical methods; subsurface explorations; soil sampling; van shear, standard penetration, cone penetration, pressuremeter, dilatometer, and plate load testing; in-situ measurements; field instrumentation. Prerequisite(s): CEE 312 or equivalent.

**CEE 524. Foundation Engineering. 3 Hours**

Application of Geotechnical engineering principles of analysis and design of shallow and deep foundations and earth retaining structures. Topics include site exploration and characterization, foundation types, bearing capacity, settlement analysis, shallow foundation design, earth pressures theories, design of retaining walls, flexible retaining structures and braced excavations, design of pile foundations and drilled piers. Prerequisite(s): CEE 312 or equivalent.

**CEE 526. Retaining Structures & Slopes. 3 Hours**

Earth pressure theories; design of earth retaining structures, such as rigid walls, anchored sheet pile walls, and reinforced soil structures; stability of excavation, cut, and natural slopes; slope stabilization methods. Prerequisite(s): CEE 312 or equivalent.

**CEE 528. Soil Dynamics & Earthquake Engineering. 3 Hours**

Soil behavior under dynamic loading conditions; foundation design for vibratory loadings; introductory earthquake engineering; field and laboratory techniques for determining dynamic soil properties and liquefaction potential. Prerequisite(s): CEE 312 or equivalent.

**CEE 533. Theory of Elasticity. 3 Hours**

Three-dimensional stress and strain at a point; equations of elasticity in Cartesian and curvilinear coordinates; methods of formulation of equations for solution, plane stress and plane strain, energy formulations, numerical solution procedures. Prerequisite(s): EGM 303 or equivalent. Corequisite(s): EGM 503.

**CEE 534. Theory of Plates & Shells. 3 Hours**

Theory of plates; small and large displacement theories of thin plates; shear deformation; buckling; sandwich plate theory. Thin shell theory; theory of surfaces; thin shell equations in orthogonal curvilinear coordinates; bending, membrane, and shallow shell theories. Prerequisite(s): EGM 533.

**CEE 535. Advanced Mechanical Vibrations. 3 Hours**

Review of undamped, damped, natural, and forced vibrations of one and two degrees of freedom systems. Lagrange's equation, eigenvalue/eigenvector problem, modal analysis for discrete and continuous systems. Computer application for multi-degree of freedom, nonlinear problems. Prerequisite(s): MEE 319 or equivalent; computer programming.

**CEE 539. Theory of Plasticity. 3 Hours**

Fundamentals of plasticity theory including elastic, viscoelastic, and elastic-plastic constitutive models; plastic deformation on the macroscopic and microscopic levels; stress-strain relations in the plastic regime; strain hardening; limit analysis; numerical procedures. Prerequisite(s): EGM 503 or EGM 533.

**CEE 540. Composites Design. 3 Hours**

Design with fiber reinforced composite materials. Fiber and resin selection, laminate design, bending and torsion of stiffening elements, open and filled holes, joining methods, fatigue, damage tolerance, building block approach, design allowables. Prerequisite(s): EGM 303 or equivalent.

**CEE 541. Mechanics of Composite Materials. 3 Hours**

Introduction to the mechanical response of fiber-reinforced composite materials with emphasis on the development of experimental methodology. Analytical topics include stress-strain behavior of anisotropic materials, laminate mechanics, and strength analysis. Theoretical models are applied to the analysis of experimental techniques used for characterizing composite materials. Lectures are supplemented by laboratory sessions in which characterization tests are performed on contemporary composite materials. Prerequisite(s): EGM 303 or equivalent.

**CEE 543. Analytical Mechanics Composite Materials. 3 Hours**

Analytical models are developed for predicting the mechanical and thermal behavior of fiber-reinforced composite materials as a function of constituent material properties. Both continuous and discontinuous fiber-reinforced systems are considered. Specific topics include basic mechanics of anisotropic materials, micro-mechanics and lamination theory, free edge effects, and failure criteria. Prerequisite(s): EGM 303 or equivalent.

**CEE 546. Finite Element Analysis I. 3 Hours**

Fundamental development of the Finite Element Method (FEM), and solution of field problems and comprehensive structural problems. Variational principles and weak forms; finite element discretization; shape functions; finite elements for field problems; bar, beam, plate, and shell elements; isoparametric finite elements, stiffness, nodal force, and mass matrices; matrix assembly procedures; computer coding techniques; modeling decisions; program output interpretation. Emphasis on a thorough understanding of FEM theory and modeling techniques. Prerequisite(s): CEE 503 or CEE 533.

**CEE 550. Highway Geometric Design. 3 Hours**

Advanced topics in horizontal and vertical alignment design controls and criteria, sight distance, intersection and interchange design. Prerequisite(s): CEE 403 or equivalent.

**CEE 551. Traffic Engineering. 3 Hours**

Characteristics of traffic, including the road user, vehicle, traffic control devices, accident analysis, signal operations and design and the fundamentals of signal system progression. Prerequisite(s): CEE 403 or equivalent.

**CEE 552. Intelligent Transportation Systems. 3 Hours**

Fundamentals of planning, design, deployment and operations of ITS. Integrated application of ITS architecture, traffic flow principles, advanced equipment, communications technologies and management strategies to provide traveler information and increase the safety and efficiency of the surface transportation system. Prerequisite(s): CEE 403 or equivalent.

**CEE 553. Travel Demand Modeling. 3 Hours**

Introduction to the theory, concepts and methods underlying the practice of urban travel demand modeling. The course involves model data inputs, model development, forecasting applications, and model evaluation techniques. Prerequisite(s): CEE 403 or equivalent.

**CEE 554. Urban Public Transportation. 3 Hours**

Planning and analysis of urban public transportation service and operations with a focus on bus and rail modes. Provides fundamental knowledge and methods for route and network planning, service planning and analysis, performance monitoring, operations control, and frequency and headway determination. Prerequisite(s): CEE 403 or equivalent.

**CEE 555. Highway Traffic Safety. 3 Hours**

Issues involved in transportation safety, strategic highway safety planning at state and local levels. Extent of the highway safety problem, elements of traffic accidents, common accident countermeasures, collection and analysis of accident data, evaluation of safety-related projects and programs, and litigation issues. Prerequisite(s): CEE 403 or equivalent.

**CEE 558. Traffic Engineering Research. 3 Hours**

Practical problems in control or capacity restraints based on studies of actual local situations. Prerequisite(s): CEE 403 or equivalent.

**CEE 560. Biological Processes in Wastewater Engineering. 3 Hours**

Measuring the characteristics of wastewater produced from domestic and industrial sources. Principles of designing and operating microbiological processes for the treatment of wastewater. Mechanisms and kinetics of biological reactions emphasized. Prerequisite(s): CHM 124 and (CEE 434 or CME 406) or equivalent.

**CEE 562. Physical & Chemical Water & Wastewater Treatment Processes. 3 Hours**

Principles and design of physical and chemical unit processes to treat water and wastewater. Industry pretreatment technologies and the basis for their development. Prerequisite(s): CHM 124 and (CEE 434 or CME 406) or equivalent.

**CEE 563. Hazardous Waste Engineering. 3 Hours**

The fundamental principles of the design and operation of hazardous waste control and hazardous substances remediation processes. Hazardous waste regulations, risk assessment and management. Prerequisite(s): CHM 124 or equivalent.

**CEE 564. Solid Waste Engineering. 3 Hours**

Characterizing solid waste. Managing solid waste collection, transport, minimization, and recycling. The design of solid waste disposal and resource recovery facilities.

**CEE 574. Fundamentals of Air Pollution Engineering I. 3 Hours**

Air pollution, combustion fundamentals, pollutant formation and control in combustion, pollutant formation and control methods in internal combustion engines, particle formation in combustion. Prerequisite(s): ((CME 311 or MEE 301); (CME 324 or MEE 410)) or permission of instructor.

**CEE 575. Fundamentals of Air Pollution Engineering II. 3 Hours**

Review of the concepts of air pollution engineering; aerosols; removal of gaseous pollutants from effluent streams; optimal air pollution control strategies. Prerequisite(s): CME 574 or permission of instructor.

**CEE 576. Environmental Engineering Separation Processes. 3 Hours**

Discussion of the unit operations associated with environmental engineering separation processes of solid-liquid, liquid-liquid, and gas-liquid systems; general use, principles of operation, and design procedures for specific types of equipment. Prerequisite(s): Permission of instructor.

**CEE 580. Hydrology & Seepage. 3 Hours**

Detailed study of the hydrologic cycle with a focus on rainfall/runoff generation techniques. Practical application of hydrologic fundamentals is demonstrated through the design of urban storm water systems. Introduction to sub-surface hydrology and groundwater modeling. Prerequisite(s): CEE 312, CEE 333 or equivalent.

**CEE 582. Advanced Hydraulics. 3 Hours**

Detailed examination of unsteady flow in closed-conduits and open channels. Practical methods for solving waterhammer and flood routing problems are presented. Physical modeling integrated with dimensional analysis and similitude is presented. Prerequisite(s): CEE 313, CEE 333 or equivalent.

**CEE 584. Open Channel Flow. 3 Hours**

Open channel flow in its various forms will be studied. Major topics to be covered include energy and momentum principles, uniform and gradually varied flow, rapidly varied flow, spatially varied flow and an introduction to unsteady flow. Pragmatic applications such as channel design, water surface profile computations, and culvert analysis will also be covered. Well-established solution approaches and widely accepted computer methods will be used to solve real-world problems. Prerequisite(s): CEE 313, CEE 333 or equivalent.

**CEE 590. Selected Readings in Civil Engineering. 3 Hours**

Directed readings in a designated area arranged and approved by the student's faculty advisor and the department chair. May be repeated.

**CEE 595. Special Problems in Civil Engineering. 3 Hours**

Special assignments in civil engineering subject matter to be arranged and approved by the student's advisor and the department chair.

**CEE 598. Project. 3 Hours**

Project in Civil and Environmental Engineering.

**CEE 599. Thesis. 3-6 Hours**

Thesis in Civil and Environmental Engineering.