

CEE - Civil and Environmental Engineering

CIVIL AND ENVIRONMENTAL ENGINEERING Courses

CEE 111. Information Literacy and Research. 2 Credits.

This course will introduce students to the needs, access, evaluation, use, impact and ethical/legal aspects of information, as well as to the application of information literacy and research in the fields of civil and environmental engineering. Prerequisite: ENGN 110.

CEE 195. Topics in Civil and Environmental Engineering. 1-3 Credits.

Special topics in civil and/or environmental engineering at the introductory level. Prerequisite: Permission of the department chair.

CEE 204. Statics. 3 Credits.

Introduction to engineering problems and their solutions through a study of the statics of particles and rigid bodies. Pre- or corequisite: PHYS 231N. Prerequisite: MATH 211 with a C or higher.

CEE 219. Surveying for Engineers. 1 Credit.

This course will provide an introduction to Land Surveying theory and practices as they relate to Civil Engineering. Upon successful completion of this course, prospective engineers will have a working knowledge of: survey computations; survey field methods; survey benchmarks and data; survey elements of land development; and survey legal issues.

CEE 220. Mechanics of Deformable Bodies. 3 Credits.

This course provides fundamental theories to understand the strength of materials focused on civil engineering applications. It will cover stress-strain relationship, equilibrium of deformable bodies and behavior of axially loaded members. It will also analyze for stresses, strains, and deformation of members subjected to torsions in both elastic and inelastic ranges. Other topics, such as buckling and stability of columns, Mohr circle, and energy methods will also be discussed. Prerequisites: CEE 204 with a grade of C or better.

CEE 240. Geographic Information Systems in Civil and Environmental Engineering. 3 Credits.

Geographic Information Systems as they apply to civil and environmental engineering. Spatial data acquisition, generation and analysis methods from terrestrial, aerial and satellite sources. Modeling of terrain, land, and hydrographic information using CADD. Use of GIS software in the creation and application of GIS spatial data bases to engineering problems. Prerequisite: MATH 212, sophomore standing or higher.

CEE 295. Topics in Civil and Environmental Engineering. 1-3 Credits.

Topics in civil and/or environmental engineering at the basic engineering level. Prerequisite: Permission of the department chair.

CEE 304. Probability Statistics and Risk in Civil and Environmental Engineering. 3 Credits.

CEE infrastructure systems definitions and methodology. CEE economics basics and use. Probability theory and applications. Statistics parameters, functions, variance, regression, and correlation analysis. Professional practice issues of ethics, licensure, procurement of work, and professional interaction. Prerequisite: junior standing in CEE.

CEE 305. Civil and Environmental Computations. 3 Credits.

Introduction to selected numerical methods and their specific application to solving problems in many of the areas of civil and environmental engineering. Further development of computer programming proficiency. Prerequisites: junior standing, MATH 307, CS 150.

CEE 310. Structures I. 3 Credits.

Analysis of statically determinate structures. Influence lines and structural design. Displacement calculations. Introduction to analysis of indeterminate structures. Prerequisites: CEE 220 with a grade of C or better.

CEE 320. Civil Engineering Materials. 3 Credits.

Properties of steel, portland cement concrete, bituminous concrete, aggregates, and timber. Prerequisites: CEE 220.

CEE 323. Soil Mechanics. 3 Credits.

Fundamental engineering properties of soil and their application to earth structures and foundations. Topics include seepage, compaction, strength, and deformation characteristics of soils. Corequisite: CEE 335. Prerequisite: CEE 220.

CEE 330. Hydromechanics. 3 Credits.

Fluid properties, fluid statics and fundamentals of fluid kinematics. Steady, incompressible conservation laws for mass, momentum and energy including real fluid energy losses. Turbulent, incompressible fluid flows in closed conduits and with a free surface. Introduction to thermodynamics. Prerequisites: MATH 212 and MAE 205.

CEE 335. CE Soils and Hydraulics Laboratory. 1 Credit.

Soils and hydraulics tests, including index testing, compaction, permeability, consolidation, shear tests for soils. Pipe flow, open channel flow, surface hydrology, groundwater, and hydraulic structures for hydraulics. Corequisites: CEE 323 and CEE 340.

CEE 340. Hydraulics and Water Resources. 3 Credits.

Analysis of closed-conduit flow and open-channel flow. Principles of surface water hydrology and groundwater hydraulics. Economics and probability concepts in water resources planning. Corequisite: CEE 335. Prerequisites: CEE 304; CEE 330 with a grade of C or better.

CEE 350. Environmental Pollution and Control. 3 Credits.

Introduction to the fundamental principles of environmental engineering. Topics in water quality, water and wastewater treatment, air quality, and solid waste and landfills are discussed. Prerequisites: CHEM 121N-CHEM 122N, MATH 211, PHYS 231N.

CEE 367. Cooperative Education. 1-3 Credits.

May be repeated for credit. Available for pass/fail grading only. Student participation for credit based on the academic relevance of the work experience, criteria, and evaluative procedures as formally determined by the department and Career Development Services prior to the semester in which the work experience is to take place. Prerequisites: approval by the department and Career Development Services in accordance with the policy for granting credit for cooperative education programs.

CEE 368. Internship. 1-3 Credits.

May be repeated for credit. Available for pass/fail grading only. Academic requirements will be established by the department and will vary with the amount of credit desired. Allows students to gain short duration career-related experience. Prerequisites: approval by department and Career Development Services.

CEE 369. Practicum. 1-3 Credits.

May be repeated for credit. Available for pass/fail grading only. Academic requirements will be established by the department and will vary with the amount of credit desired. Allows students to gain short duration career-related experience. Prerequisites: approval by department and Career Development Services.

CEE 370. Transportation Fundamentals. 3 Credits.

This course surveys the current practice of transportation engineering in the United States. It focuses on various ground transportation modes and covers policy, institutional planning and operational issues. Students are introduced to planning models, capacity analysis, and traffic impact analysis. Prerequisite: Junior standing.

CEE 395. Topics. 1-3 Credits.

Topics in civil and/or environmental engineering. Prerequisite: permission of the instructor.

CEE 402. Professional Practice of Engineering. 1 Credit.

The course will cover the practice and business aspects of engineering including concepts in management, business, public policy, and leadership. It will also cover public and private procurement of work, project management and execution, responsibility to clients, contracting, project finances, professional liability, and public safety. Prerequisite: Senior standing.

CEE 403W. Civil Engineering Design Project and Professional Practice. 3 Credits.

For graduating seniors only. Group design project of civil engineering systems requiring synthesis, data gathering, preliminary investigation, master planning, conceptual designs, layouts, support studies, cost estimates and report writing. Emphasis will be on alternatives, constraints, economics, ethics and professional practice, business and project management, public policy and leadership. This is a writing intensive course. Prerequisites: grade of C or better in ENGL 211C or ENGL 221C or ENGL 231C.

CEE 410. Concrete Design. 3 Credits.

Fundamental concepts of reinforced concrete analysis and design by ultimate strength and working stress methods. Prerequisites: CEE 310 with a grade of C or better.

CEE 414/514. Masonry Structures Design. 3 Credits.

Masonry materials, reinforced beams and lintels, walls, columns and pilasters, shear walls, and buildings. Prerequisite: CEE 310.

CEE 415/515. Steel Structures Design. 3 Credits.

Load and resistance factor design methods for steel structures. Prerequisite: CEE 310.

CEE 416/516. Wood Structures Design. 3 Credits.

Design of wood structures based on national design specification and load and resistance factor design. Prerequisite: CEE 310.

CEE 430/530. Foundation Engineering. 3 Credits.

Subsurface exploration, site preparation, design of shallow and deep foundations, and retaining structures. Prerequisites: CEE 323 with a grade of C or better.

CEE 431/531. Earth Structures Design with Geosynthetics. 3 Credits.

Seepage and stability analysis and design of manmade and natural slopes and retaining structures. Applications of geosynthetic material to seepage control, reinforcement of earth works, and containment of hazardous materials. Prerequisite: CEE 323.

CEE 432/532. Introduction to Earthquake Engineering. 3 Credits.

An overview of earthquake processes and details of the characteristics of destructive ground motion; the effects of such motion on civil engineering structures; reviews of current design practice in mitigating earthquake hazards for various civil engineering structures such as buildings, bridges, dams, lifelines, ports and harbors, etc. Prerequisites: senior standing and permission of the instructor.

CEE 433/533. Geomaterials Stabilization. 3 Credits.

This course studies soil and aggregate's physical, chemical and biological stabilization procedures. Students are introduced to chemical stabilization analysis and design using materials such as cement, lime, and fly ash. Physical ground modification, compaction methods and mechanical stabilization application and design are also studied. Prerequisite: CEE 323.

CEE 440/540. Hydraulic Engineering. 3 Credits.

Hydraulic transients; flow control structures; computer analysis of hydraulic systems; design of pipelines, open channels and culverts. Prerequisite: CEE 340.

CEE 446/546. Urban Stormwater Hydrology. 3 Credits.

Storm rainfall analysis, design rainfall hyetographs, runoff calculation procedures, detention basins, use of mathematical models to analyze and design urban storm drainage systems. Prerequisite: CEE 340.

CEE 447/547. Groundwater Hydraulics. 3 Credits.

Description of well hydraulics in single and multiple well systems. Determination of aquifer parameters from pumping tests. Use of computer models to determine drawdowns due to multiple well systems. Prerequisite: CEE 340.

CEE 450/550. Water Distribution and Wastewater Collection System Design. 3 Credits.

Design of water distribution systems, sanitary sewer systems and appurtenances. Corequisite: CEE 340. Prerequisite: CEE 330.

CEE 451. Water and Wastewater Treatment. 3 Credits.

Discussion of water quality constituents and introduction to the design and operation of water and wastewater treatment facilities. Prerequisites: CEE 330, CEE 350.

CEE 452/552. Air Quality. 3 Credits.

Study of air quality management standards and regulations and pollutant dynamics. Design and operation of emission control equipment for mobile and stationary sources of air pollution. Prerequisite: CEE 350.

CEE 454/554. Hazardous Waste Treatment. 3 Credits.

Study of sources, generation rates and characteristics of hazardous wastes and their regulation, handling, and design of treatment and disposal facilities. Prerequisite: CEE 350.

CEE 458/558. Sustainable Development. 3 Credits.

Overview of social, economical, technical environmental aspects of regional, national and international efforts to achieve sustainable development. Discussion of the integration of industrial activity and ecological concerns utilizing principles of zero emissions, pollution prevention and design for the environment. Prerequisite: junior standing or permission of instructor. (WEB Based, On-Line Course).

CEE 459/559. Biofuels Engineering. 3 Credits.

Course covers the overview of renewable energy sources; fundamentals of biofuels; biomass and types of biomass (e.g., woody biomass, forest residues, agricultural residues, energy crops); composition of lignocelluloses (cellulose, hemicellulose, and lignin); biomass conversion technologies; thermochemical, supercritical water, and biochemical conversion processes; types of biofuels from biomass; liquid fuels (bioethanol, bio-oil, biocrude, and hydrocarbons); gaseous fuels (synthesis gas, hydrogen, biodiesel); solid fuels (biochar, torrefied biomass); biodiesel from vegetable oils, algae to biofuels; value-added processing of biofuel residues; economic and environmental assessments; policies and future R&D. Prerequisite: permission of the instructor.

CEE 460/560. Advanced Analytical Techniques in Environmental Engineering. 3 Credits.

The objective of this class is to introduce students to the analytical, experimental, and process engineering techniques that are utilized to support decision making in environmental engineering. Prerequisite: CEE 350.

CEE 471/571. Transportation Operations I. 3 Credits.

This is the first course in transportation operations and traffic flow theory. Topics include traffic engineering studies, capacity analysis, intersection control, traffic flow models, shockwave analysis, signal warrant analysis, and safety analysis. Course includes applications of modeling and simulation to isolated intersections. Prerequisite: CEE 470.

CEE 474/574. Transportation Data Analytics. 3 Credits.

This course presents the basic techniques for transportation data analytics. It will discuss statistical modeling, prominent algorithms, and visualization approaches to analyze both small- and large-scale data sets generated from transportation systems. Practices of using different data for various real-world traffic/transportation applications and decision making will also be discussed. Prerequisites: Basic probability and statistics (e.g., STAT 330); any programming language such as C, Python or Java is beneficial but not required.

CEE 482/582. Introduction to Coastal Engineering. 3 Credits.

Classical small amplitude wave theory, wave transformations in shallow water, shoaling, refraction, diffraction, reflection, breaking. Wave induced near shore currents and sediment transport processes. Alternatives to mitigate coastal erosion processes. Introduction to coastal structures. Prerequisites: CEE 330 and permission of the instructor.

CEE 495/595. Topics in Civil and Environmental Engineering. 1-3 Credits.

Special topics of interest with emphasis placed on recent developments in civil and/or environmental engineering. Prerequisite: Permission of the department chair.

CEE 497. Independent Study in Civil and Environmental Engineering. 1-3 Credits.

Individual analytical, experimental and/or design study selected by the student and supervised by the advisor. Prerequisites: approval of the advisor.

CEE 514. Masonry Structures Design. 3 Credits.

Masonry materials, reinforced beams and lintels, walls, columns and pilasters, shear walls, and buildings. Prerequisites: CEE 310.

CEE 515. Steel Structures Design. 3 Credits.

Load and resistance factor design methods for steel structures. Prerequisites: CEE 310.

CEE 516. Wood Structures Design. 3 Credits.

Design of wood structures based on national design specification and load and resistance factor design. Prerequisites: CEE 310.

CEE 530. Foundation Engineering. 3 Credits.

Subsurface exploration, site preparation, design of shallow and deep foundations, and retaining structures. Prerequisites: CEE 323 with a grade of C or better.

CEE 531. Earth Structures Design with Geosynthetics. 3 Credits.

Seepage and stability analysis and design of manmade and natural slopes and retaining structures. Applications of geosynthetic material to seepage control, reinforcement of earth works, and containment of hazardous materials. Prerequisites: CEE 323.

CEE 532. Introduction to Earthquake Engineering. 3 Credits.

An overview of earthquake processes and details of the characteristics of destructive ground motion; the effects of such motion on civil engineering structures; reviews of current design practice in mitigating earthquake hazards for various civil engineering structures such as buildings, bridges, dams, lifelines, ports and harbors. Prerequisites: permission of the instructor.

CEE 533. Geomaterials Stabilization. 3 Credits.

This course studies soil and aggregate's physical, chemical and biological stabilization procedures. Students are introduced to chemical stabilization analysis and design using materials such as cement, lime, and fly ash. Physical ground modification, compaction methods and mechanical stabilization application and design are also studied. Prerequisite: CEE 323.

CEE 540. Hydraulic Engineering. 3 Credits.

Hydraulic transients; flow control structures; computer analysis of hydraulic systems; design of pipelines, open channels and culverts. Prerequisites: CEE 340.

CEE 546. Urban Stormwater Hydrology. 3 Credits.

Storm rainfall analysis, design rainfall hyetographs, runoff calculation procedures, detention basins, use of mathematical models to analyze and design urban storm drainage systems. Prerequisites: CEE 340.

CEE 547. Groundwater Hydraulics. 3 Credits.

Description of well hydraulics in single and multiple well systems. Determination of aquifer parameters from pumping tests. Use of computer models to determine drawdowns due to multiple well systems. Prerequisites: CEE 340.

CEE 550. Water Distribution and Wastewater Collection System Design. 3 Credits.

Design of water distribution systems, sanitary sewer systems and appurtenances. Prerequisites: CEE 330. Pre- or corequisite: CEE 340.

CEE 552. Air Quality. 3 Credits.

Study of air quality management standards and regulations and pollutant dynamics. Design and operation of emission control equipment for mobile and stationary sources of air pollution. Prerequisites: CEE 350.

CEE 554. Hazardous Waste Treatment. 3 Credits.

Study of sources, generation rates and characteristics of hazardous wastes and their regulation, handling, and design of treatment and disposal facilities. Prerequisites: CEE 350.

CEE 558. Sustainable Development. 3 Credits.

Overview of social, economical, technical environmental aspects of regional, national and international efforts to achieve sustainable development. Discussion of the integration of industrial activity and ecological concerns utilizing principles of zero emissions, pollution prevention and design for the environment. Prerequisites: permission of instructor.

CEE 559. Biofuels Engineering. 3 Credits.

Course covers the overview of renewable energy sources; fundamentals of biofuels; biomass and types of biomass (e.g., woody biomass, forest residues, agricultural residues, energy crops); composition of lignocelluloses (cellulose, hemicellulose, and lignin); biomass conversion technologies; thermochemical, supercritical water, and biochemical conversion processes; types of biofuels from biomass; liquid fuels (bioethanol, bio-oil, biocrude, and hydrocarbons); gaseous fuels (synthesis gas, hydrogen, biodiesel); solid fuels (biochar, torrefied biomass); biodiesel from vegetable oils, algae to biofuels; value-added processing of biofuel residues; economic and environmental assessments; policies and future R&D. Prerequisite: permission of the instructor.

CEE 560. Advanced Analytical Techniques in Environmental Engineering. 3 Credits.

The objective of this class is to introduce students to the analytical, experimental, and process engineering techniques that are utilized to support decision making in environmental engineering.

CEE 571. Transportation Operations I. 3 Credits.

This is the first course in transportation operations and traffic flow theory. Topics include traffic engineering studies, capacity analysis, intersection control, traffic flow models, shockwave analysis, signal warrant analysis, and safety analysis. Course includes applications of modeling and simulation to isolated intersections. Prerequisite: CEE 570.

CEE 574. Transportation Data Analytics. 3 Credits.

This course presents the basic techniques for transportation data analytics. It will discuss statistical modeling, prominent algorithms, and visualization approaches to analyze both small- and large-scale data sets generated from transportation systems. Practices of using different data for various real-world traffic/transportation applications and decision making will also be discussed. Prerequisites: Basic probability and statistics (e.g., STAT 330); any programming language such as C, Python or Java is beneficial but not required.

CEE 582. Introduction to Coastal Engineering. 3 Credits.

Classical small amplitude wave theory, wave transformations in shallow water, shoaling, refraction, diffraction, reflection, breaking. Wave induced near shore currents and sediment transport processes. Alternatives to mitigate coastal erosion processes. Introduction to coastal structures. Prerequisites: permission of the instructor.

CEE 595. Topics in Civil and Environmental Engineering. 1-3 Credits.

Special topics of interest with emphasis placed on recent developments in civil and/or environmental engineering. Prerequisites: Permission of the instructor.

CEE 650. Pollution Prevention. 3 Credits.

Application of engineering methods to the prevention of pollution. Review of the Pollution Prevention Act and related regulations. Study of source reduction methods analysis for manufacturing, materials, and processing changes. Pollution prevention case studies.

CEE 659. Carbon-Free Clean Energy. 3 Credits.

The course presents an overview of carbon-free energy sources (nuclear, wind, solar, hydropower, and geothermal). The current status, conversion processes, economics, and environmental issues of these forms of energy will be discussed.

CEE 667. Cooperative Education. 1-3 Credits.

Available for pass/fail grading only. May be repeated for credit. Student participation for credit based on the academic relevance of the work experience, criteria, and evaluative procedures as formally determined by the department and Career Development Services prior to the semester in which the work experience is to take place. Prerequisites: approval by the department and Career Development Services in accordance with the policy for granting credit for cooperative education programs.

CEE 668. Internship. 1-3 Credits.

Academic requirements will be established by the department and will vary with the amount of credit desired. Allows students an opportunity to gain short duration career-related experience. Prerequisites: approval by department and Career Development Services.

CEE 669. Practicum. 1-3 Credits.

Academic requirements will be established by the department and will vary with the amount of credit desired. Allows students an opportunity to gain short duration career-related experience. Prerequisites: approval by department and Career Development Services.

CEE 695. Topics in Civil and Environmental Engineering. 1-3 Credits.

Special topics of interest with emphasis placed on recent developments in civil and/or environmental engineering. Prerequisites: Permission of the instructor.

CEE 697. Independent Study in Civil and Environmental Engineering. 1-3 Credits.

Individual analytical, experimental and/or design study selected by the student. Approved and supervised by the advisor. Prerequisites: permission of the instructor.

CEE 698. Master's Project. 1-3 Credits.

Individual project, investigation under the direction of the student's major professor.

CEE 699. Thesis. 1-6 Credits.

Research leading to the Master of Science thesis.

CEE 700. Civil and Environmental Engineering Experimental Design. 3 Credits.

Graduate-level overview of engineering experimental design and analysis with emphasis on statistical methods; practical and proper statistical methods applicable to multidisciplinary, real-world civil and environmental engineering problems.

CEE 701. Applied Mathematics for Civil and Environmental Engineers. 3 Credits.

An examination of numerical and approximate mathematical methods for civil and environmental engineers with applications; finite-difference and finite-integral techniques for single and simultaneous ordinary differential equations; classical and finite-difference solutions of partial differential equations such as heat, wave, Laplace, and plate equation; and finite element applications selected from geotechnical, environmental, hydraulics/water resources, ocean, transportation, and structural engineering.

CEE 710. Structural Dynamics. 3 Credits.

Free and forced vibration of discrete and continuous systems; elastic and inelastic response of structures under dynamic loads.

CEE 711. Finite Element Analysis. 3 Credits.

To provide an understanding of the finite element method (FEM) as derived from an integral formulation perspective. To demonstrate the solutions of (1-D and 2-D) continuum mechanics problems such as solid mechanics, fluid mechanics and heat transfer.

CEE 712. Advanced Reinforced Concrete. 3 Credits.

Ultimate-strength theory, yield line methods, limit design, and other relevant advanced topics in the theory and design of concrete structures.

CEE 713. Prestressed Concrete. 3 Credits.

Analysis and design of prestressed concrete members and structures. Shrinkage, creep and losses, shear, bond and anchorages are discussed.

CEE 714. Advanced Structural Analysis. 3 Credits.

Elastic analysis of framed structures using matrix and numerical techniques.

CEE 715. Engineering Optimization I. 3 Credits.

Formulation and solution algorithms for Linear Programming (LP) problems. Unconstrained and constrained nonlinear programming (NLP) problems. Optimum solution for practical engineering systems. (Cross-listed with MAE 715 and MAE 815).

CEE 717. Bridge Structures Design. 3 Credits.

Design of steel, concrete, and composite bridges using modern techniques and current specifications. Prerequisites: CEE 410 and CEE 415/CEE 515 or equivalent.

CEE 719. Inelastic Structures. 3 Credits.

Inelastic analysis and behavior of framed structures.

CEE 720. Structural Stability. 3 Credits.

Fundamentals of elastic and inelastic stability of beams, columns and frames.

CEE 721. Plates. 3 Credits.

Classical and modern methods for the solution of plates of various shapes and boundary conditions, continuous and axially loaded plates and plates on elastic supports. Design examples.

CEE 722. Cluster Parallel Computing. 3 Credits.

Detailed numerical step-by-step procedures to exploit parallel and sparse computation under MPI (Message, Passing, Interface) computer environments are explained. Large-scale engineering/science applications are emphasized. Simultaneous linear equations are discussed.

CEE 723. Seismic Design of Steel Structures. 3 Credits.

Analysis and design of steel structures under seismic loading conditions, introduction to design specifications for steel structures. Prerequisites: CEE 310 or equivalent.

CEE 724. Retrofitting Methods for Bridges and Buildings. 3 Credits.

Retrofitting methods for bridges and buildings combined with related advanced structural analysis and design techniques. Prerequisites: CEE 310 or equivalent.

CEE 725. Smart Structures. 3 Credits.

This course covers structural systems integrated with sensing, data processing, and control devices, which control and reduce the vibration of structures. Students will learn about basic theories of smart structures, smart materials, sensors, structural health monitoring (SHM) as well as their application to civil infrastructures.

CEE 726. Green Buildings. 3 Credits.

This course covers fundamental concepts in design, construction and operation of Green Buildings, including introduction to Green Buildings rating systems and assessment of energy consumption in buildings.

CEE 730. Advanced Foundation Engineering. 3 Credits.

Advanced analysis and design of shallow and deep foundations and retaining structures. Prerequisites: CEE 430/CEE 530.

CEE 731. Advanced Soil Mechanics. 3 Credits.

Detailed study of shear strength of soils and its application to slope stability and embankment design and analysis. Advanced laboratory shear tests are included. Prerequisites: CEE 323.

CEE 732. Engineering Behavior of Soils. 3 Credits.

Detailed study of physiochemical behavior of soils, fabric, rheology, effective stress path, and their applications to various geotechnical engineering problems. Prerequisites: CEE 323.

CEE 733. Soil Dynamics. 3 Credits.

Study of soil behavior under dynamic loadings. Laboratory and field techniques for determining soil properties and liquefaction potential. Design examples. Prerequisites: CEE 323.

CEE 734. Marine/Offshore Geotechnology. 3 Credits.

Understand the dynamic nature of the offshore environment and the available in-situ geotechnical tools to investigate and characterize offshore soils. Study static and dynamic behavior of marine sediments. Design different types of foundation systems such as suction bucket, pile-supported, and gravity base foundations for different offshore structures.

CEE 741. Open Channel Flow. 3 Credits.

Momentum and energy principles, design of open channels, use of mathematical models for flow calculations in rivers, introduction to unsteady open channel flow. Prerequisites: CEE 340.

CEE 747. Groundwater Flow. 3 Credits.

Mathematical formulations of laws governing groundwater flow and contaminant transport. Unsaturated flow. Use of computer models for modeling groundwater aquifers. Prerequisites: CEE 340.

CEE 751. Physicochemical Treatment Processes. 3 Credits.

Physical and chemical processes used in the treatment of water and waste water are covered. Separation, isolation and reaction processes are characterized as well as reactor engineering. Prerequisites: CEE 350.

CEE 752. Biological Wastewater Treatment. 3 Credits.

The use of microorganisms to treat domestic and industrial waste waters for organics and nutrient removal are studied. Characteristics of individual waste water components and the appropriate treatment processes to remove these components are covered. Prerequisites: CEE 350.

CEE 753. Advanced Processes for Water and Wastewater Treatment. 3 Credits.

Theory, operation and application of advanced water and waste water treatment systems, including land application, dissolved solids, organic contaminant and nutrient removal processes. Emphasis on system development for waste water reclamation/recycling. Prerequisites: CEE 751 and CEE 752.

CEE 754. Environmental Engineering Microbiology. 3 Credits.

A lecture and laboratory course dealing with the study of the principles and applications of microbiology in waste water treatment, water treatment, stream self-purification and their effects in environmental engineering. Prerequisites: CEE 350.

CEE 755. Water Quality Management. 3 Credits.

Characterization of water quality in natural systems and the human activities that result in contaminant input to these systems are studied. Management practices for minimizing contaminant input and for restoring contaminated waters are discussed.

CEE 756. Water Quality Modeling. 3 Credits.

Formulation of mathematical equations to describe the fate and transport of aqueous contaminants in dynamic surface water systems. Use of water quality computer models to predict various contamination scenarios. Prerequisites: MATH 307, CEE 340, CEE 350 or permission of the instructor.

CEE 761. Water Resources Processes and Analysis Methods. 3 Credits.

This course examines interactive hydrologic processes in water resource; modifications of climate change to these processes; and modern simulation and systematic analysis methods incorporating the modifications into practices of water resource planning, utilization, protection, and engineering.

CEE 762. Aquatic Chemistry in Environmental Engineering. 3 Credits.

Chemical reactions in natural and engineered systems are studied with emphasis placed on developing kinetic expressions and assessing chemical equilibrium. Kinetic and equilibrium expressions are applied to engineering problems to predict the reaction time and products of specific reactions. Prerequisites: CHEM 123N.

CEE 770. Transportation Safety. 3 Credits.

This course focuses on major transportation safety issues including transportation safety goals, safety of various transportation modes, identification of problematic locations, selection of safety countermeasures and their evaluation, safety data and modeling issues. Prerequisites: CEE 470/CEE 570 and CEE 471/CEE 571.

CEE 771. Transportation Operations II. 3 Credits.

This is the second course in transportation operations and traffic flow theory. Topics covered include design of progressive signal systems, queuing theory, car following models, and applications of microscopic traffic simulation to corridor studies. Prerequisites: CEE 470/CEE 570 and CEE 471/CEE 571.

CEE 772. Intelligent Transportation Systems. 3 Credits.

This course examines how ITS can be used to enhance mobility and safety. The topics covered in the course include systems engineering approach to ITS, traveler response to technologies and information, ITS planning and evaluation, and ITS deployment and operational performance. Prerequisites: CEE 470/CEE 570.

CEE 773. Transportation Planning. 3 Credits.

This course covers transportation planning processes that include policy direction, transportation data, travel demand forecasting models, and decision-making/stakeholders issues.

CEE 774. Transportation Network Flow Models. 3 Credits.

This course provides a rigorous introduction to transportation network modeling, with special emphasis on network equilibrium problems. Topics include: elementary graph theory, shortest path problem nonlinear optimization, optimization of univariate functions, deterministic and stochastic user equilibrium. Prerequisites: CEE 470 or equivalent.

CEE 775. Transportation Network Algorithms. 3 Credits.

Fundamental models and algorithms in optimization, stochastic modeling and parallel computing will be discussed and illustrated with transportation applications.

CEE 776. Simulation in Transportation Networks. 3 Credits.

Principles of simulation modeling. Microscopic, mesoscopic and macroscopic traffic simulation models. Driver behavior in networks. Calibration and validation of traffic simulation models. Traffic simulation software.

CEE 777. Discrete Choice Theory and Modeling in Transportation. 3 Credits.

This course will provide the student with an understanding of the theory and models that are capable of analyzing discrete choices. While the first part of the course covers topics including data assembly, preliminary descriptive analysis, and multivariate regression methods, the second part of the course focuses extensively on discrete econometric models such as binary logit, multinomial logit, mixed logit/probit, ordered response, count, and multiple-discrete continuous choice models. Methods of model estimation with particular emphasis on maximum likelihood and composite likelihood approaches will also be discussed. Prerequisites: Graduate student status.

CEE 782. Design of Coastal Structures. 3 Credits.

Nonlinear wave theories; wave forces on slender piles and seawalls; design of rubblemound structures; design philosophy, initial costs, maintenance costs, optimized design using stochastic methods; design of renourished beaches. Advanced alternative solutions for shore protection. Prerequisites: CEE 482/CEE 582.

CEE 787. Dredging and Beach Engineering. 3 Credits.

Types of dredges, factors affecting dredge performance; hydraulic dredges (cutter, hopper) and mechanical dredges systems (bucket, clamshell, etc.); shoaling rate determination; inlet sand bypassing systems; beach renourishment schemes. Design of beach renourishment/projects. Prerequisites: CEE 330.

CEE 788. Coastal Hydrodynamics and Sediment Processes. 3 Credits.

This course discusses the hydrodynamics of the coastal environment and reviews waves, low-frequency motions, and coastal responses, including sediment processes and beach evolution. Specific topics to be covered include: review of linear wave theory; introduction to nonlinear waves; wave-averaged motions and radiation stresses; wave and current boundary layers; wave setup, longshore current, rip current, undertow, and nearshore circulation; wave dissipation mechanisms; and fluid-sediment interaction. An introduction to cohesive sediments, sediment concentration and transport models, and beach morphology will also be addressed. Prerequisites: CEE 482/CEE 582.

CEE 789. Computational Environmental Fluid Dynamics. 3 Credits.

Fluid dynamics conservation laws as transport phenomena. Classical, finite-difference models for advection, diffusion and combined fluid flows. Explicit and implicit schemes to solve unsteady, free-surface fluid flow and diffusion (dispersion) problems in one and multi-dimensions. Turbulence models. Prerequisites: CEE 330.

CEE 795. Topics in Civil and Environmental Engineering. 1-3 Credits.

Special topics of interest with emphasis placed on recent developments in civil and/or environmental engineering. Prerequisites: Permission of the instructor.

CEE 797. Independent Study. 1-3 Credits.**CEE 800. Civil and Environmental Engineering Experimental Design. 3 Credits.**

Graduate-level overview of engineering experimental design and analysis with emphasis on statistical methods; practical and proper statistical methods applicable to multidisciplinary, real-world civil and environmental engineering problems.

CEE 801. Applied Mathematics for Civil and Environmental Engineers. 3 Credits.

An examination of numerical and approximate mathematical methods for civil and environmental engineers with applications; finite-difference and finite-integral techniques for single and simultaneous ordinary differential equations; classical and finite-difference solutions of partial differential equations such as heat, wave, Laplace, and plate equation; and finite element applications selected from geotechnical, environmental, hydraulics/water resources, ocean, transportation, and structural engineering.

CEE 810. Structural Dynamics. 3 Credits.

Free and forced vibration of discrete and continuous systems; elastic and inelastic response of structures under dynamic loads.

CEE 811. Finite Element Analysis. 3 Credits.

To provide an understanding of the finite element method (FEM) as derived from an integral formulation perspective. To demonstrate the solutions of (1-D and 2-D) continuum mechanics problems such as solid mechanics, fluid mechanics and heat transfer.

CEE 812. Advanced Reinforced Concrete. 3 Credits.

Ultimate-strength theory, yield line methods, limit design, and other relevant advanced topics in the theory and design of concrete structures.

CEE 813. Prestressed Concrete. 3 Credits.

Analysis and design of prestressed concrete members and structures. Shrinkage, creep and losses, shear, bond and anchorages are discussed.

CEE 814. Advanced Structural Analysis. 3 Credits.

Elastic analysis of framed structures using matrix and numerical techniques.

CEE 815. Engineering Optimization I. 3 Credits.

Formulation and solution algorithms for Linear Programming (LP) problems. Unconstrained and constrained nonlinear programming (NLP) problems. Optimum solution for practical engineering systems. (Cross-listed with MAE 715/MAE 815).

CEE 817. Bridge Structures Design. 3 Credits.

Design of steel, concrete, and composite bridges using modern techniques and current specifications. Prerequisites: CEE 410 and CEE 415/CEE 515 or equivalent.

CEE 819. Inelastic Structures. 3 Credits.

Inelastic analysis and behavior of framed structures.

CEE 820. Structural Stability. 3 Credits.

Fundamentals of elastic and inelastic stability of beams, columns and frames.

CEE 821. Plates. 3 Credits.

Classical and modern methods for the solution of plates of various shapes and boundary conditions, continuous and axially loaded plates and plates on elastic supports. Design examples.

CEE 822. Cluster Parallel Computing. 3 Credits.

Detailed numerical step-by-step procedures to exploit parallel and sparse computation under MPI (Message, Passing, Interface) computer environments are explained. Large-scale engineering/science applications are emphasized. Simultaneous linear equations are discussed.

CEE 823. Seismic Design of Steel Structures. 3 Credits.

Analysis and design of steel structures under seismic loading conditions, introduction to design specifications for steel structures. Prerequisites: CEE 310 or equivalent.

CEE 824. Retrofitting Methods for Bridges and Buildings. 3 Credits.

Retrofitting methods for bridges and buildings combined with related advanced structural analysis and design techniques. Prerequisites: CEE 310 or equivalent.

CEE 825. Smart Structures. 3 Credits.

This course covers structural systems integrated with sensing, data processing, and control devices, which control and reduce the vibration of structures. Students will learn about basic theories of smart structures, smart materials, sensors, structural health monitoring (SHM) as well as their application to civil infrastructures.

CEE 826. Green Buildings. 3 Credits.

This course covers fundamental concepts in design, construction and operation of Green Buildings, including introduction to Green Buildings rating systems and assessment of energy consumption in buildings.

CEE 830. Advanced Foundation Engineering. 3 Credits.

Advanced analysis and design of shallow and deep foundations and retaining structures. Prerequisites: CEE 430/CEE 530.

CEE 831. Advanced Soil Mechanics. 3 Credits.

Detailed study of shear strength of soils and its application to slope stability and embankment design and analysis. Advanced laboratory shear tests are included. Prerequisites: CEE 323.

CEE 832. Engineering Behavior of Soils. 3 Credits.

Detailed study of physiochemical behavior of soils, fabric, rheology, effective stress path, and their applications to various geotechnical engineering problems. Prerequisites: CEE 323.

CEE 833. Soil Dynamics. 3 Credits.

Study of soil behavior under dynamic loadings. Laboratory and field techniques for determining soil properties and liquefaction potential. Design examples. Prerequisites: CEE 323.

CEE 834. Marine/Offshore Geotechnology. 3 Credits.

Understand the dynamic nature of the offshore environment and the available in-situ geotechnical tools to investigate and characterize offshore soils. Study static and dynamic behavior of marine sediments. Design different types of foundation systems such as suction bucket, pile-supported, and gravity base foundations for different offshore structures.

CEE 841. Open Channel Flow. 3 Credits.

Momentum and energy principles, design of open channels, use of mathematical models for flow calculations in rivers, introduction to unsteady open channel flow. Prerequisites: CEE 340.

CEE 847. Groundwater Flow. 3 Credits.

Mathematical formulations of laws governing groundwater flow and contaminant transport. Unsaturated flow. Use of computer models for modeling groundwater aquifers. Prerequisites: CEE 340.

CEE 851. Physiochemical Treatment Processes. 3 Credits.

Physical and chemical processes used in the treatment of water and waste water are covered. Separation, isolation and reaction processes are characterized as well as reactor engineering. Prerequisites: CEE 350.

CEE 852. Biological Wastewater Treatment. 3 Credits.

The use of microorganisms to treat domestic and industrial waste waters for organics and nutrient removal are studied. Characteristics of individual waste water components and the appropriate treatment processes to remove these components are covered. Prerequisites: CEE 350.

CEE 853. Advanced Processes for Water and Wastewater Treatment. 3 Credits.

Theory, operation and application of advanced water and waste water treatment systems, including land application, dissolved solids, organic contaminant and nutrient removal processes. Emphasis on system development for waste water reclamation/recycling. Prerequisites: CEE 751 and CEE 752.

CEE 854. Environmental Engineering Microbiology. 3 Credits.

A lecture and laboratory course dealing with the study of the principles and applications of microbiology in waste water treatment, water treatment, stream self-purification and their effects in environmental engineering. Prerequisites: CEE 350.

CEE 855. Water Quality Management. 3 Credits.

Characterization of water quality in natural systems and the human activities that result in contaminant input to these systems are studied. Management practices for minimizing contaminant input and for restoring contaminated waters are discussed.

CEE 856. Water Quality Modeling. 3 Credits.

Formulation of mathematical equations to describe the fate and transport of aqueous contaminants in dynamic surface water systems. Use of water quality computer models to predict various contamination scenarios. Prerequisites: MATH 307, CEE 340, CEE 350 or permission of the instructor.

CEE 861. Water Resources Processes and Analysis Methods. 3 Credits.

This course examines interactive hydrologic processes in water resource; modifications of climate change to these processes; and modern simulation and systematic analysis methods incorporating the modifications into practices of water resource planning, utilization, protection, and engineering.

CEE 862. Aquatic Chemistry in Environmental Engineering. 3 Credits.

Chemical reactions in natural and engineered systems are studied with emphasis placed on developing kinetic expressions and assessing chemical equilibrium. Kinetic and equilibrium expressions are applied to engineering problems to predict the reaction time and products of specific reactions. Prerequisites: CHEM 123N.

CEE 870. Transportation Safety. 3 Credits.

This course focuses on major transportation safety issues including transportation safety goals, safety of various transportation modes, identification of problematic locations, selection of safety countermeasures and their evaluation, safety data and modeling issues. Prerequisites: CEE 470/CEE 570 and CEE 471/CEE 571.

CEE 871. Transportation Operations II. 3 Credits.

This is the second course in transportation operations and traffic flow theory. Topics covered include design of progressive signal systems, queuing theory, car following models, and applications of microscopic traffic simulation to corridor studies. Prerequisites: CEE 470/CEE 570 and CEE 471/CEE 571.

CEE 872. Intelligent Transportation Systems. 3 Credits.

This course examines how ITS can be used to enhance mobility and safety. The topics covered in the course include systems engineering approach to ITS, traveler response to technologies and information, ITS planning and evaluation, and ITS deployment and operational performance. Prerequisites: CEE 470/CEE 570.

CEE 873. Transportation Planning. 3 Credits.

This course covers transportation planning processes that include policy direction, transportation data, travel demand forecasting models, and decision-making/stakeholders issues.

CEE 874. Transportation Network Flow Models. 3 Credits.

This course provides a rigorous introduction to transportation network modeling, with special emphasis on network equilibrium problems. Topics include: elementary graph theory, shortest path problem nonlinear optimization, optimization of univariate functions, deterministic and stochastic user equilibrium.

CEE 875. Transportation Network Algorithms. 3 Credits.

Fundamental models and algorithms in optimization, stochastic modeling and parallel computing will be discussed and illustrated with transportation applications.

CEE 876. Simulation in Transportation Networks. 3 Credits.

Principles of simulation modeling. Microscopic, mesoscopic and macroscopic traffic simulation models. Driver behavior in networks. Calibration and validation of traffic simulation models. Traffic simulation software.

CEE 877. Discrete Choice Theory and Modeling in Transportation. 3 Credits.

This course will provide the student with an understanding of the theory and models that are capable of analyzing discrete choices. While the first part of the course covers topics including data assembly, preliminary descriptive analysis, and multivariate regression methods, the second part of the course focuses extensively on discrete econometric models such as binary logit, multinomial logit, mixed logit/probit, ordered response, count, and multiple-discrete continuous choice models. Methods of model estimation with particular emphasis on maximum likelihood and composite likelihood approaches will also be discussed. Prerequisites: Graduate student standing.

CEE 882. Design of Coastal Structures. 3 Credits.

Nonlinear wave theories; wave forces on slender piles and seawalls; design of rubblemound structures; design philosophy, initial costs, maintenance costs, optimized design using stochastic methods; design of renourished beaches. Advanced alternative solutions for shore protection. Prerequisites: CEE 482/CEE 582.

CEE 887. Dredging and Beach Engineering. 3 Credits.

Types of dredges, factors affecting dredge performance; hydraulic dredges (cutter, hopper) and mechanical dredges systems (bucket, clamshell, etc.); shoaling rate determination; inlet sand bypassing systems; beach renourishment schemes. Design of beach renourishment/projects. Prerequisites: CEE 330.

CEE 888. Coastal Hydrodynamics and Sediment Processes. 3 Credits.

This course discusses the hydrodynamics of the coastal environment and reviews waves, low-frequency motions, and coastal responses, including sediment processes and beach evolution. Specific topics to be covered include: review of linear wave theory; introduction to nonlinear waves; wave-averaged motions and radiation stresses; wave and current boundary layers; wave setup, longshore current, rip current, undertow, and nearshore circulation; wave dissipation mechanisms; and fluid-sediment interaction. An introduction to cohesive sediments, sediment concentration and transport models, and beach morphology will also be addressed. Prerequisites: CEE 482/CEE 582.

CEE 889. Computational Environmental Fluid Dynamics. 3 Credits.

Fluid dynamics conservation laws as transport phenomena. Classical, finite-difference models for advection, diffusion and combined fluid flows. Explicit and implicit schemes to solve unsteady, free-surface fluid flow and diffusion (dispersion) problems in one and multi-dimensions. Turbulence models. Prerequisites: CEE 330.

CEE 892. Doctor of Engineering Project. 1-12 Credits.

Directed individual study applying advanced level technical knowledge to identify, formulate, and solve a complex, novel problem in Civil and Environmental Engineering.

CEE 895. Topics in Civil and Environmental Engineering. 1-3 Credits.

Special topics of interest with emphasis placed on recent developments in civil and/or environmental engineering. Prerequisites: Permission of the instructor.

CEE 897. Independent Study. 1-3 Credits.

Individual analytical, experimental and/or design study selected by the student. Approved and supervised by the advisor. Prerequisites: permission of the instructor.

CEE 899. Dissertation Research. 1-9 Credits.

Research for the dissertation.

CEE 998. Master's Graduate Credit. 1 Credit.

This course is a pass/fail course for master's students in their final semester. It may be taken to fulfill the registration requirement necessary for graduation. All master's students are required to be registered for at least one graduate credit hour in the semester of their graduation.

CEE 999. Doctoral Graduate Credit. 1 Credit.

This course is a pass/fail course doctoral students may take to maintain active status after successfully passing the candidacy examination. All doctoral students are required to be registered for at least one graduate credit hour every semester until their graduation.