

# Civil and Environmental Engineering

**Web Site:** <http://www.odu.edu/cee> (<http://www.odu.edu/cee/>)

Sandeep Kumar, Chair

The Department of Civil and Environmental Engineering offers an undergraduate four-year program leading to the Bachelor of Science in Civil Engineering. The program is accredited by the Engineering Accreditation Commission (EAC) of ABET, <http://www.abet.org>. The department also offers a varied program of graduate study and research leading to the Master of Science, Master of Engineering, Doctor of Engineering, and Doctor of Philosophy degrees with concentrations in civil or environmental engineering. Areas of specialization include coastal, environmental, geotechnical, hydraulics and water resources, transportation, and structural engineering. For further information, please visit the web site: <http://www.odu.edu/cee> (<http://www.odu.edu/cee/>).

## Programs

### Bachelor of Science in Civil Engineering Program

- Civil Engineering (BSCE) (<http://catalog.odu.edu/undergraduate/engineering-technology/civil-environmental-engineering/civil-engineering-bsce/>)

### Minor Programs

- Civil Engineering Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/civil-environmental-engineering/civil-engineering-minor/>)
- Engineering Solutions for Climate Adaptation and Resilience Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/civil-environmental-engineering/engineering-solutions-climate-adaptation-resilience-minor/>)
- Environmental Engineering Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/civil-environmental-engineering/environmental-engineering-minor/>)

## Courses

### Civil and Environmental Engineering (CEE)

#### CEE 111 Information Literacy and Research (2 Credit Hours)

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.

**Prerequisites:** ENGN 110

#### CEE 195 Topics in Civil and Environmental Engineering (1-3 Credit Hours)

Special topics in civil and/or environmental engineering at the introductory level.

**Prerequisites:** Permission of the department chair

#### CEE 204 Statics (3 Credit Hours)

Introduction to engineering problems and their solutions through a study of the statics of particles and rigid bodies.

**Prerequisites:** MATH 211 with a C or higher

**Pre- or corequisite:** PHYS 231N

#### CEE 205 Engineering Dynamics (3 Credit Hours)

This course is designed to assist engineering students in acquiring a more thorough knowledge and proficiency in engineering mechanics. The course follows CEE 204 in the mechanics sequence. In this course, kinematics of particles and rigid bodies, mass moments of inertia, acceleration, work, energy, power, and special applications in the civil engineering field, such as inertia problems in vehicle collisions, rudiments of wave dynamics, etc. are included.

**Prerequisites:** CEE 204 with a grade of C or better

#### CEE 220 Mechanics of Deformable Bodies (3 Credit Hours)

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 (2 Credit Hours)

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 CAD and GIS software in the creation and application of CAD design and GIS spatial databases to engineering problems.

**Prerequisites:** MATH 212, sophomore standing or higher

#### CEE 295 Topics in Civil and Environmental Engineering (1-3 Credit Hours)

Topics in civil and/or environmental engineering at the basic engineering level.

**Prerequisites:** Permission of the department chair

#### CEE 304 Probability and Statistics for Civil Infrastructure (3 Credit Hours)

This course studies the fundamentals of probability and statistics that are widely used in various fields of engineering. Specific areas of study include probability theory, counting methods, statistics and parameters, propagation of error, probability distribution functions, central limit theorem, hypothesis testing, linear regression, and correlation analysis. Applications of statistics and probability analysis in civil and environmental engineering will be discussed through examples. Furthermore, an introduction to data science and an overview of applications of artificial intelligence in CEE problems will also be discussed.

**Prerequisites:** junior standing in CEE

#### CEE 305 Numerical Methods for Civil and Environmental Engineering (1 Credit Hour)

Introduction to selected numerical methods and their applications in solving civil and environmental engineering problems.

**Prerequisites:** ENGN 150 or ENGN 122 and sophomore standing or higher

#### CEE 310 Structures I (3 Credit Hours)

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 Credit Hours)

Properties of steel, portland cement concrete, bituminous concrete, aggregates, and timber.

**Prerequisites:** CEE 220

#### CEE 323 Soil Mechanics (3 Credit Hours)

Fundamental engineering properties of soil and their application to earth structures and foundations. Topics include seepage, compaction, strength, and deformation characteristics of soils.

**Prerequisites:** CEE 220

**Corequisites:** CEE 324

#### CEE 324 Soil Mechanics Laboratory (1 Credit Hour)

Performance of various soil mechanics tests, including gradation, index testing, compaction, density, permeability, consolidation, shear tests for soils are conducted for students to gain hand-on experiences. The relevant principles are covered in CEE 323.

**Prerequisites:** Junior standing

**Corequisites:** CEE 323

**CEE 330 Hydromechanics (3 Credit Hours)**

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 CEE 205 and junior standing in CEE

**CEE 340 Hydraulics and Water Resources (3 Credit Hours)**

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.

**Prerequisites:** CEE 304; CEE 330 with a grade of C or better

**Corequisites:** CEE 341

**CEE 341 CE Hydraulics and Water Resources Laboratory (1 Credit Hour)**

Performing various labs and experiments for hydraulics, hydrology, and water resources for students to gain hand-on experiences. The relevant principles are covered in CEE 340.

**Prerequisites:** Junior standing

**Corequisites:** CEE 340

**CEE 350 Environmental Pollution and Control (3 Credit Hours)**

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 and junior standing in CEE

**CEE 367 Cooperative Education (1-3 Credit Hours)**

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 Credit Hours)**

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 Credit Hours)**

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 Credit Hours)**

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.

**Prerequisites:** Junior standing

**CEE 395 Topics (1-3 Credit Hours)**

Topics in civil and/or environmental engineering.

**Prerequisites:** permission of the instructor

**CEE 402 Professional Practice of Engineering (1 Credit Hour)**

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.

**Prerequisites:** Senior standing

**CEE 403W Civil Engineering Design Project and Professional Practice (3 Credit Hours)**

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 CEE 401, ENGL 211C or ENGL 221C or ENGL 231C

**CEE 410 Concrete Design (3 Credit Hours)**

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 412/512 Computational Methods in Structures (3 Credit Hours)**

Analysis of 2-D and 3-D determinate and indeterminate truss/beam/frame structures by the unified direct stiffness matrix method, for both hand-calculation and computer implementation. Popular commercialized (NASTRAN) software will also be discussed.

**Prerequisites:** CEE 310

**CEE 414/514 Masonry Structures Design (3 Credit Hours)**

Masonry materials, reinforced beams and lintels, walls, columns and pilasters, shear walls, and buildings.

**Prerequisites:** CEE 310

**CEE 415/515 Steel Structures Design (3 Credit Hours)**

Load and resistance factor design methods for steel structures.

**Prerequisites:** CEE 310

**CEE 416/516 Wood Structures Design (3 Credit Hours)**

Design of wood structures based on national design specification and load and resistance factor design.

**Prerequisites:** CEE 310

**CEE 430/530 Foundation Engineering (3 Credit Hours)**

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 Slope Stability and Earth Structures Design (3 Credit Hours)**

Slope stability analysis, including limit equilibrium procedures, finite element method, seepage analysis, and advanced topics such as rapid drawdown, construction of embankments on soft soil, and seismic slope stability. Lateral earth retention systems, including gravity walls, excavation support systems, and applications of geosynthetic material, will be covered.

**Prerequisites:** CEE 323

**CEE 432/532 Introduction to Earthquake Engineering (3 Credit Hours)**

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 Credit Hours)**

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.

**Prerequisites:** CEE 323

**CEE 440/540 Hydraulic Engineering (3 Credit Hours)**

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

**Prerequisites:** CEE 340

**CEE 446/546 Urban Stormwater Hydrology (3 Credit Hours)**

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 447/547 Groundwater Hydraulics (3 Credit Hours)**

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 450/550 Water Distribution and Wastewater Collection System Design (3 Credit Hours)**

Design of water distribution systems, sanitary sewer systems and appurtenances.

**Prerequisites:** CEE 330

**Corequisites:** CEE 340

**CEE 451 Water and Wastewater Treatment (3 Credit Hours)**

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 Credit Hours)**

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 454/554 Hazardous Waste Treatment (3 Credit Hours)**

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 455/555 Pollution Prevention and Green Engineering (3 Credit Hours)**

Application of engineering methods for the prevention of pollution. Review of the pollution prevention related regulations. Study of source reduction methods, analysis for environmentally conscious manufacturing methods, process changes, life cycle analysis, and water/energy conservation methods. Evaluation of pollution prevention case studies.

**Prerequisites:** CEE 350

**CEE 457/557 Adaptation to Sea Level Rise (3 Credit Hours)**

Investigation of complex relationships between humans and coastlines and study of how humans adapt and develop adaptation measures and solutions to tackle flooding caused by rising sea levels and subsequent heavy storm events. This course also evaluates natural and nature-based systems, engineered systems, different flood-proofing methods, and impacts of sea level rise on coastal water quality and the potential impacts on disease transmission.

**Prerequisites:** CEE 340 or CET 332

**CEE 458/558 Sustainable Development (3 Credit Hours)**

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. (WEB Based, On-Line Course)

**Prerequisites:** junior standing or permission of instructor

**CEE 459/559 Biofuels Engineering (3 Credit Hours)**

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.

**Prerequisites:** permission of the instructor

**CEE 471/571 Transportation Operations I (3 Credit Hours)**

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.

**Prerequisites:** CEE 370

**CEE 474/574 Transportation Data Analytics (3 Credit Hours)**

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., STAT 330); any programming language such as C, Python or Java is beneficial but not required.

**Prerequisites:** Basic probability and statistics (e.g

**CEE 475/575 Geometric Design of Highways (3 Credit Hours)**

This course provides students with an understanding of basic principles and techniques in order to develop skills in the highway geometric design process. It introduces design methods for three-dimensional layout for roadways, considering cross section (lanes and shoulders, curbs, medians, roadside slopes and ditches, sidewalks), horizontal alignment (tangents and curves), and vertical alignment (grades and vertical curves).

**Prerequisites:** CEE 370

**CEE 482/582 Introduction to Coastal Engineering (3 Credit Hours)**

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 Credit Hours)**

Special topics of interest with emphasis placed on recent developments in civil and/or environmental engineering.

**Prerequisites:** Permission of the department chair

**CEE 497 Independent Study in Civil and Environmental Engineering (1-3 Credit Hours)**

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

**Prerequisites:** approval of the advisor