Civil and Environmental Engineering Courses (CEE)

CEE Courses

This is a list of courses with the subject code CEE. For more information, see Civil and Environmental Engineering (College of Engineering) in the catalog.

CEE:1010 Introduction to Careers in Environmental Engineering 0 s.h.
Past, present, and future roles of environmental engineers in society; introduction to the discipline's historical roots and early visionary leaders in sanitation engineering and public health; growth during the environmental movement, and current role of environmental engineers in modern society as stewards for clean air, water, and energy; range of career opportunities available to environmental engineering majors, particularly in the emerging role of ambassadors for sustainable development.

CEE:1030 Introduction to Earth Science 3-4 s.h.
Relationships between plate tectonics, geologic time, and the rock cycle with volcanoes and igneous, sedimentary, metamorphic rocks; fossils; radioactive isotopes; landscape evolution; mountain building; natural resources; their impacts on civilization. GE: Natural Sciences with Lab; Natural Sciences without Lab. Same as EES:1030.

CEE:1031 Introduction to Earth Science Laboratory 1 s.h.
Laboratory component of EES:1030. Requirements: completion of 3 s.h. in EES:1030 or CEE:1030. GE: Natural Sciences Lab only. Same as EES:1031.

CEE:2010 Civil and Environmental Engineering Professional Practice and Ethics 1 s.h.
Introduction to the Civil and Environmental Engineering department, its curriculum, and the profession; explore the fields of civil and environmental engineering and provide a primer on the steps necessary to become a licensed professional engineer; introduce professional ethics, engineering work products, and project lifecycle.

CEE:2015 Civil Engineering Tools 2 s.h.
Tools and methods used in civil engineering career: AutoCAD, programming, project estimating, heavy equipment productivity estimation, and earthwork estimation.

CEE:2050 Severe and Unusual Weather 3 s.h.
Basic weather concepts behind severe weather phenomena and essential safety information; how weather events cause billions of dollars in damage and thousands of casualties; winter storms can impact half of the nation, paralyzing the transportation network with icy roads and wind driven snow; tornadoes can strike within minutes tearing apart homes; hurricanes can destroy entire communities with strong winds, heavy rain, and deadly storm surge; how understanding severe weather and knowing what to do before, during, and after an event can significantly reduce injury, deaths, and property damage. Same as CBE:2050.

CEE:2240 Digital Drafting with AutoCAD 3 s.h.
Basic principles of 2D and 3D computer-aided drafting; use of AutoCAD software to draw plans, elevations, and sections for objects and interior spaces. Prerequisites: ARTS:1510 and ARTS:1520 and (CERM:2010 or DSGN:2500 or DRAW:2310 or MTLS:2910 or PHTO:2600 or PHTO:2610 or PRNT:2810 or SCLP:2810 or TDSN:2210). Same as TDSN:2240.

CEE:3001 Leadership Skills for Engineers 1 s.h.
Survey of leadership ideas and principles as applied to situations commonly encountered in civil engineering practice, especially as they relate to challenges that beginning engineers face; speakers in selected engineering professions provide context and examples; exercises on leadership principles. Requirements: junior standing in civil and environmental engineering.

CEE:3002 Technical Communication in Civil and Environmental Engineering 1 s.h.
Development of communication skills through writing and oral presentations; impact of engineering solutions in a global, economic, environmental, and societal context; writings and presentations on current or historical engineering solutions; exposure to professionals with significant experiences to share in these areas. Requirements: junior standing.

CEE:3003 Project Management Skills 1 s.h.
Review and extension of civil and environmental engineering project management skills in preparation for capstone senior design course; project scheduling, cost estimating, contract types, construction phasing; review for Fundamentals of Engineering Exam (FE) and practice tests in four subdisciplinary areas. Requirements: senior standing.

CEE:3142 Quality Control 3 s.h.
Basic techniques of statistical quality control; application of control charts for process control variables; design of inspection plans and industrial experimentation; modern management aspects of quality assurance systems. Offered fall semesters. Prerequisites: STAT:3100 and STAT:3101 and STAT:3200. Same as ISE:3600, STAT:3620.

CEE:3155 Principles of Environmental Engineering 4 s.h.
Water supply and treatment processes; wastewater treatment processes; processes for air pollution control, groundwater remediation; solid and hazardous waste management. Prerequisites: CHEM:1110.

CEE:3328 Fluvial Geomorphology 3 s.h.
Hydrologic principles, stream channel processes, and fluvial geomorphology within drainage basin systems; spatial and temporal variations in water distribution, analysis of hydrological data, flow mechanisms, sediment transport, forecasting procedures, hydrograph construction, modeling. Requirements: EES:3020 or another 3000-level geology or hydraulics course. Same as EES:3380.

CEE:3371 Principles of Hydraulics and Hydrology 3 s.h.
Hydraulics of pressure conduits and open channels, dimensional analysis, flow measurements, hydraulic machinery, laboratory. Prerequisites: ENGR:2510.

CEE:3380 Water Treatment 4 s.h.
Physical, chemical, and biological processes and operations to remove and treat chemical and pathogenic pollutants and protect human and environmental health; relevant to drinking water, municipal wastewater, water reuse, stormwater, industrial process water, agricultural wastewater; modern technologies and appropriate designs for the developing world; theory and applications; hands-on laboratory. Prerequisites: CEE:3155 and ENGR:2510.
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<tr>
<th>Course Code</th>
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<th>Description</th>
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<tr>
<td>CEE:3530</td>
<td>4 s.h.</td>
<td>Geomechanics: Identification and classification of earth materials; hydraulic and mechanical properties of soils; soil improvement; laboratory testing. Prerequisites: ENGR:2750.</td>
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<tr>
<td>CEE:3533</td>
<td>4 s.h.</td>
<td>Principles of Structural Engineering: Fundamental principles of structural analysis applied to statically determinate and indeterminate structures, continuous beams, trusses, and frames; external and internal equilibrium; compatibility of deformation, influence lines, virtual work; parallel use of classical and matrix formulation; slope deflection, flexibility and stiffness methods; use of computers. Prerequisites: ENGR:2750.</td>
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<tr>
<td>CEE:3586</td>
<td>3 s.h.</td>
<td>Civil Engineering Materials: Structure, strength and failure, durability, deformation, practice, and processing for primary construction materials systems, including steel, aluminum, concrete, asphalt, fiber-reinforced composites, masonry, timber. Prerequisites: ENGR:2750.</td>
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<tr>
<td>CEE:3763</td>
<td>3 s.h.</td>
<td>Principles of Transportation Engineering: History of transportation modes, new transport technologies, traffic operations and control, economic evaluation of transport alternatives, transportation planning, roadway design and construction, route location, preventive maintenance strategies. Requirements: sophomore standing.</td>
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<tr>
<td>CEE:3790</td>
<td>3 s.h.</td>
<td>Resilient Infrastructure and Emergency Response: Concepts of resilient cities with specific emphasis on role of infrastructure and built environment; risk analysis, hazard mitigation and emergency response to various threats; resiliency through good design.</td>
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<tr>
<td>CEE:3996</td>
<td>1 s.h.</td>
<td>Civil and Environmental Engineering: Engineering Project: Support for student learning associated with an engineering project; students work as a team to design and fabricate a product; student projects are often associated with a contest or competitions (e.g., steel bridge, concrete canoe).</td>
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<tr>
<td>CEE:3997</td>
<td>1-3 s.h.</td>
<td>Engineering Service Project: Provides support of student learning associated with a variety of international engineering service projects facilitated by the Department of Civil and Environmental Engineering; service projects are usually designed and built as part of an Engineers Without Borders USA and/or a Bridges to Prosperity (Continental Crossings) approved program; active involvement by students in these organizations required.</td>
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<tr>
<td>CEE:3998</td>
<td>arr.</td>
<td>Individual Investigations: Civil Engineering: Individual projects for civil engineering undergraduate students: laboratory study, engineering design project, analysis and simulation of an engineering system, computer software development, research.</td>
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<tr>
<td>CEE:4102</td>
<td>3 s.h.</td>
<td>Groundwater: Groundwater quality and quantity; Darcy's Law, 2D flow equation, unsaturated zone, contaminant transport, redox reactions, drinking water quality, bioremediation; laboratories in permeameter testing, porous media grain size analysis, pump testing, monitoring well installation.</td>
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<tr>
<td>CEE:4104</td>
<td>3 s.h.</td>
<td>Groundwater Modeling: Groundwater flow and contaminant transport modeling; numerical methods, applications of groundwater modeling to water supply, groundwater resources evaluation, remediation design using software; GMS (MODFLOW, MODPATH, and MT3D). Prerequisites: MATH:1860 and EES:4630. Same as EES:4660.</td>
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<tr>
<td>CEE:4107</td>
<td>3 s.h.</td>
<td>Sustainable Systems: New and emerging concepts in sustainable systems design and assessment. Same as CBE:4410.</td>
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<tr>
<td>CEE:4118</td>
<td>3 s.h.</td>
<td>Statistical Methods in Water and the Environment: Basic methods required for data analysis and interpretation of processes related to water and the environment; emphasis on formulating questions, choosing appropriate statistical tools for a given problem, drawing appropriate conclusions from analyses; concepts related to statistical inference and common probabilistic models, linear regression, non-parametric statistics; how to perform these analyses using R programming language; introduction to statistical methods through use of hands-on analyses with real data. Prerequisites: STAT:2020 and MATH:2560.</td>
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<tr>
<td>CEE:4119</td>
<td>3 s.h.</td>
<td>Hydrology: Overview of fundamental processes in water cycle, including precipitation, evaporation, infiltration, and runoff; quantitative approaches for predicting streamflow and design discharges; applications to flood hazard assessment and stormwater management. Prerequisites: ENGR:2750.</td>
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<tr>
<td>CEE:4150</td>
<td>3 s.h.</td>
<td>Environmental Chemistry: Principles of general, physical, organic chemistry applied in water and air systems; emphasis on qualitative and quantitative understanding of chemical kinetics and equilibrium; acid-base reactions, complex formation, precipitation, dissolution, and oxidation-reduction reactions; organic nomenclature. Prerequisites: CHEM:1120. Same as CBE:4420.</td>
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<tr>
<td>CEE:4157</td>
<td>3 s.h.</td>
<td>Environmental Engineering Design: Application of physical, chemical, and biological operations and processes to the design of water and wastewater treatment systems; applications in solid and hazardous waste treatment. Prerequisites: CEE:3155.</td>
</tr>
<tr>
<td>CEE:4158</td>
<td>3 s.h.</td>
<td>Solid and Hazardous Wastes: Sources, characteristics, collection, disposal of solid and hazardous wastes; environmental impacts of hazardous waste management; resource recovery systems. Requirements: for OEH:4920—OEH:4240. Same as OEH:4920.</td>
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<tr>
<td>CEE:4159</td>
<td>3 s.h.</td>
<td>Air Pollution Control Technology: Sources, environmental and health impacts, regulations, modeling of air pollution; processes and alternative strategies for control; global climate considerations. Same as CBE:4459, IGPI:4159.</td>
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<tr>
<td>CEE:4160</td>
<td>3 s.h.</td>
<td>Introduction to Bridge Engineering: Bridge engineering and design; history of the bridge; factors that affect bridge design; bridges according to use (e.g., road, rail, pedestrian and bicycle) and type (e.g., suspension, cable stay, truss); how sustainability concepts may impact bridge design; substantial design exercise. Prerequisites: CEE:3533.</td>
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</table>
CEE:4162 Structural Systems for Buildings 3 s.h.
Detailed analysis and design of gravity and lateral force resisting systems for buildings; roof, floor, and bearing wall gravity systems; steel braced frames, steel and concrete moment frames, and masonry and timber shear walls lateral systems; introduction to tall building structures. Prerequisites: CEE:3533.

CEE:4164 Design of Wood Structures 3 s.h.
Framing layout and analysis of wood frame structures for gravity and lateral loads; design of structural members for bending, axial load, and shear, including joists, beams, columns, engineered lumber, bearing walls, shear walls, and diaphragms; introduction to connection design. Prerequisites: CEE:3533.

CEE:4176 Transportation Research Methods and Analysis 3 s.h.
Methods for measuring current and future transportation demand based on changes in population, preferences, built environment, and changing policy objectives; survey design and analysis; basics of travel demand modeling. Same as URP:4262.

CEE:4180 Fundamentals of Atmospheric Science 3 s.h.
Review of fundamental principles in atmospheric sciences needed for study of interdisciplinary topics involving the Earth's atmosphere; understanding weather and climate processes to address problems in engineering; hydrometeorology of rainfall and its measurement by remote sensing; impact of climate anomalies and climate change on water resources; exchange of water, energy, and chemicals at the land-atmosphere boundary; forecasting of atmospheric chemistry and air quality. Prerequisites: ENGR:2510.

CEE:4187 Statistics for Experimenters 3 s.h.
Application of statistical techniques to evaluate data derived from experimental samples designs; use of spreadsheets, statistical software; design and analysis of experiments; regression analysis; model building; practical applications. Same as OEH:4540.

CEE:4317 Remote Sensing 3 s.h.
Fundamentals of electromagnetic waves, atmospheric radiative transfer, passive remote sensing, weather radar, hydrologic application of remote sensing.

CEE:4370 Open Channel Flow and Sediment Transport 3 s.h.
In-depth analysis of governing flow equations; steady uniform flow in channels of different resistance and cross section; flow control sections; specific energy considerations; analysis and computation of gradually varied profiles and spatially varied flow effected by lateral outflow and inflow; unsteady flow; flood routing. Prerequisites: CEE:3371.

CEE:4371 Water Resources Engineering 3 s.h.
Planning and economics of varied water resources projects; stochastic basis for design; flood damage mitigation, reservoirs, river morphology, economic analysis of water projects, urban water requirements, water supply, hydroelectric power systems, river navigation; contemporary civil-engineering problems and issues associated with water infrastructure development. Corequisites: CEE:3371.

CEE:4374 Water Resource Design 3 s.h.
Prerequisites to storm water management systems design, including design flows and rates; analysis and design of storm sewers, detention basins, street and highway drainage facilities, culverts, dams, spillways, measures for energy dissipation; review of wastewater transfer systems and design. Prerequisites: CEE:3371.

CEE:4385 Water Scarcity in Rural India 3 s.h.
Scientific, engineering, economic, and social aspects contributing to water scarcity in rural India; experiential learning using instruments and analysis of water enhancement projects.

CEE:4506 Design of Concrete Structures 3 s.h.
Fundamental analysis and design of reinforced concrete members and structures, flexure, shear, bond, continuity, beams, one-way slab system; columns. Prerequisites: CEE:3533.

CEE:4511 Scientific Computing and Machine Learning 3 s.h.
Numerical methods in scientific computing; root problems and optimization; linear algebraic equations; eigenvalue problems; numerical differentiation and integration; interpolation and curve-fitting; initial value and boundary value problems; machine learning in regression, classification, and clustering problems; Python programming and packages. Prerequisites: MATH:2560. Same as ME:4111.

CEE:4512 Engineering Design Optimization 3 s.h.
Engineering design projects involving modeling, formulation, and analysis using optimization concepts and principles; linear and nonlinear models, optimality conditions, numerical methods. Prerequisites: ENGR:2110 and MATH:2550. Requirements: junior standing. Same as ME:4112.

CEE:4515 Computer-Aided Engineering 3 s.h.

CEE:4532 Fundamentals of Vibrations 3 s.h.
Vibration of linear discrete and continuous mechanical and structural systems; harmonic, periodic, and arbitrary excitation; modal analysis; applications. Prerequisites: ENGR:2750. Same as ME:4153.

CEE:4533 Finite Element I 3 s.h.
One- and two-dimensional boundary value problems; heat flow, fluid flow, torsion of bars; trusses and frames; isoparametric mapping; higher order elements; elasticity problems; use of commercial software. Prerequisites: ENGR:2750. Same as IGPI:4115.

CEE:4535 Design of Steel Structures 3 s.h.
Concepts and procedures in steel design; LRFD (load and resistance factor design) methodology for beams/columns; analysis and design of indeterminate structures. Prerequisites: CEE:3533.

CEE:4539 Foundations of Structures 3 s.h.
Application of soil mechanics to analysis of structural foundations; slope stability analysis; bearing capacity and settlement of shallow and deep foundations; retaining structures, braced cuts, reinforced earth structures; usage of computational models; subsurface exploration methods. Prerequisites: CEE:3530.

CEE:4560 Pavement Engineering 3 s.h.
Fundamental design principles; characterization and testing of asphalt and concrete paving materials; stresses and stain development within pavement structure; basic principles of mechanistic-empirical pavement design procedures. Prerequisites: CEE:3763.
CEE:4730 Transportation Infrastructure Construction and Management 3 s.h.
Analytical methods for developing transportation infrastructure construction and management systems; e-construction, transportation infrastructure condition evaluation, performance modeling, maintenance and rehabilitation optimization, asset management, development of transportation infrastructure construction and management system; application of information technology and mobile computing to solving transportation infrastructure construction and management problems. Prerequisites: CEE:3763.

CEE:4762 Design of Transportation Systems 3 s.h.
Overview of different modes within transportation systems; concepts of sustainability and livability in transportation system design; derivation of standards for geometric design of highways; roundabout design; cross-sectional and longitudinal geometric design of highways. Prerequisites: CEE:3763.

CEE:4763 Traffic Engineering 3 s.h.
Design of traffic control devices; evaluation and analysis of intersections and transportation networks using appropriate computer software. Prerequisites: CEE:3763.

CEE:4850 Project Design and Management in Civil Engineering 3 s.h.
Design of civil engineering systems, individual and team design projects oriented toward the solution of local problems, project management, construction management, contracts, budgeting, bidding. Corequisites: CEE:3003. Requirements: final semester.

CEE:5083 Introduction to Comp Flow in Pipes and Channels 3 s.h.
General review of numerical methods in hydraulics (finite-difference, finite-element, and method of characteristics); stability and accuracy of numerical schemes; steady free surface flows; flow transients in pipelines and channels.

CEE:5095 Career Paths in Sustainable Water Development 0 s.h.
Introduction to different career paths in the food, energy, and water (FEW) sector; speakers from a variety of different careers—including researchers, professors, entrepreneurs, consultants, and civic, professional, and global engineers—discuss their own career paths as well as current opportunities in their fields; students prepare individual development plans that identify their preferred career (i.e., training) path, a plan of study (i.e., path coursework), mentors, and their preferred research area. Requirements: graduate standing in sustainable water development program.

CEE:5096 Water, Energy, and Food Nexus Seminar 0 s.h.
Invited presentations on research, policy, economics, and social drivers of water, energy, and food in the 21st century.

CEE:5097 Coaching Seminar on Communicating Water Science 0 s.h.
Presentation of student research on water, energy, and food in the 21st century; students receive live, immediate feedback from their peers and faculty coaches on best practices to improve their oral communication skills.

CEE:5098 Graduate Seminar in Structures, Materials, Mechanics, and Transportation 0 s.h.
Presentation and discussion of recent advances and research in structures, mechanics, materials, and transportation engineering by guest lecturers, faculty, and students. Requirements: graduate standing.

CEE:5110 Managing and Sharing Your Research Data 1 s.h.
Overview of essential practices in managing the data you collect and generate during research. Topics include file organization; documenting your work and lab notebooks; optimizing spreadsheet data and cleanup tools; reproducibility; funder and publisher requirements; and conclude with how and where to share and publish data, from choosing a repository to creating a data record, including licensing, ownership, preservation of access, reuse, and citation. Applicable for any student currently doing research, or planning to do so. Same as OEH:5110.

CEE:5115 Atmospheric Chemistry and Physics 3 s.h.
Principal chemical and physical processes affecting atmospheric trace gas and pollutant cycles; emphasis on atmospheric photochemistry, aerosol science, major sources, and removal processes. Corequisites: CBE:3120. Same as CBE:5425.

CEE:5137 Composite Materials 3 s.h.
Mechanical behavior of composite materials and their engineering applications; composite constituents (fibers, particles, matrices) and their properties and behavior; macromechanical behavior of composite laminae; micromechanical predictions of composite overall properties; classical lamination theory; composite beams and plates. Prerequisites: ENGR:2750. Same as ME:5167.

CEE:5151 Building Future Leaders in Sustainable Development 3 s.h.
Focus on competencies needed to translate training and research into action for social good; topics include ethics, cultural competency, collaboration and team science, use-inspired design, and engagement. Same as SDG:5100.

CEE:5156 Physical and Chemical Environmental Processes 3 s.h.
Theory of physical and chemical operations and processes in water and wastewater treatment, including fundamental aspects of process dynamics; lectures, laboratory. Prerequisites: CEE:4150. Corequisites: CEE:3155.

CEE:5179 Continuum Mechanics arr.
Mechanics of continuous media; kinematics of deformation, concepts of stress and strain; conservation laws of mass, momentum and energy; constitutive theories; boundary and initial value problems. Prerequisites: ENGR:2750 or ENGR:2510. Same as ME:5179.

CEE:5225 Communicating Data Through Stories 3 s.h.
How to communicate science effectively and responsibly with multiple audiences from peers and professors to potential employers, policymakers, and the lay public; focus on speaking about science clearly and vividly in ways that can engage varied audiences, especially those outside the student’s own field; connecting and finding common ground with an audience, defining goals, identifying main points, speaking without jargon, explaining meaning and context, using storytelling techniques and multimedia elements. Same as GRAD:5225, SDG:5225.

CEE:5236 Optimization of Structural Systems 3 s.h.
Advanced topics; optimization of structural topology, shape, and material; finite dimensional dynamic response optimization, sensitivity analysis, distributed parameter systems; projects. Same as BME:5720.
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<tr>
<td>CEE:5310</td>
<td>Informatics for Sustainable Systems</td>
<td>3 s.h.</td>
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<tr>
<td>CEE:5350</td>
<td>Watershed Hydrology and Ecosystem Processes</td>
<td>3 s.h.</td>
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<tr>
<td>CEE:5360</td>
<td>Water Quality and Flow</td>
<td>3 s.h.</td>
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<tr>
<td>CEE:5369</td>
<td>Intermediate Mechanics of Fluids</td>
<td>3 s.h.</td>
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<tr>
<td>CEE:5370</td>
<td>Experimental Methods in Fluid Mechanics and Heat Transfer</td>
<td>3 s.h.</td>
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<tr>
<td>CEE:5380</td>
<td>Fluid Flows in Environmental Systems</td>
<td>3 s.h.</td>
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<tr>
<td>CEE:5390</td>
<td>PCBs in the Environment</td>
<td>3 s.h.</td>
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<tr>
<td>CEE:5410</td>
<td>Politics and Economics of the Food, Energy, Water Nexus</td>
<td>3 s.h.</td>
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<tr>
<td>CEE:5440</td>
<td>Foundations of Environmental Chemistry and Microbiology</td>
<td>3 s.h.</td>
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<td>Informatics for Sustainable Systems</td>
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<td>Water Quality and Flow</td>
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<tr>
<td>CEE:5480</td>
<td>Intermediate Mechanics of Deformable Bodies</td>
<td>3 s.h.</td>
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<tr>
<td>CEE:5490</td>
<td>Fracture Mechanics</td>
<td>3 s.h.</td>
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<tr>
<td>CEE:5510</td>
<td>Mathematical Methods in Engineering</td>
<td>3 s.h.</td>
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<tr>
<td>CEE:5520</td>
<td>Mechanics of Fluids</td>
<td>3 s.h.</td>
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<td>CEE:5530</td>
<td>Mechanics of Deformable Bodies</td>
<td>3 s.h.</td>
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<tr>
<td>CEE:5549</td>
<td>Application Simulation to Transportation</td>
<td>3 s.h.</td>
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<tr>
<td>CEE:5570</td>
<td>Perspectives in Biotechnology</td>
<td>1 s.h.</td>
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<td>CEE:5590</td>
<td>Structural Engineering Practicum A</td>
<td>2 s.h.</td>
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</table>
CxEE:5991 Structural Engineering Practicum B 1 s.h.  Detailed design development of one of the concepts developed in CxEE:5990; students perform detailed design calculations using applicable structural analysis and design software, produce professional quality structural plans including connection details, and defend design to a three-member advisory committee. Prerequisites: CxEE:5990.

CxEE:5998 Individual Investigations: Civil and Environmental Engineering arr.  Individual projects for civil and environmental engineering graduate students; laboratory study, engineering design project, analysis and simulation of an engineering system, computer software development, research. Requirements: graduate standing.

CxEE:5999 Research: Civil and Environmental Engineering MS Thesis arr.  Experimental and/or analytical investigation of an approved topic for partial fulfillment of requirements for the MS with thesis in civil and environmental engineering. Requirements: graduate standing.

CxEE:6225 Communicating Science 3 s.h.  Writing and speaking about environmental engineering and science research; key principles of writing with clarity and cohesion, and practice applying these principles on a piece of research writing that students are currently working on; review best practices for presenting research to peers and at conferences; students are required to share their work with peers through writing and presentations. Recommendations: graduate standing in earth and environmental sciences; MS students must be thesis option.

CxEE:6250 Environmental Biotechnology 3 s.h.  Environmental biotechnology utilizes microorganisms to improve sustainability of human society; basic concepts and quantitative tools needed for microbiological processes to behave in ways that are understandable, predictable, and unified; application of these fundamental principles to a variety of modern applications. Prerequisites: CxEE:5440.

CxEE:6253 Environmental Organic Chemistry 3 s.h.  Environmental factors that govern processes that determine fate of organic chemicals in natural and engineered systems; knowledge of chemical fate applied toward quantitatively assessing environmental behavior of organic chemicals; holistic view on physical-chemical properties of organic compounds, including aspects of gas-solid partitioning, bioaccumulation, and transformations in the atmosphere.

CxEE:6255 Environmental Biotechnology and Bioremediation 3 s.h.  Concepts in molecular microbial ecology and bioremediation; microbial diversity and genetics, evolution of biodegradation pathways, application of quantitative PCR, high-throughput amplicon and metagenomic and transcriptomic sequencing, proteomics, stable isotopes; bioremediation research and practice.

CxEE:6299 Advanced Topics in Water and the Environment 1-3 s.h.  Advanced topics or areas of study not formally offered in other civil and environmental courses; topics include environmental engineering and science, hydraulics, hydrology, water resources, and sustainable water development.

CxEE:6310 Analytical Methods in Mechanical Systems 3 s.h.  Vector and function spaces; functionals and operators in Hilbert spaces; calculus of variations and functional analysis with application to mechanics; Ritz and Galerkin methods. Prerequisites: ME:5113. Same as ME:6214.

CxEE:6376 Viscous Flow 3 s.h.  Equations of viscous flow; classical analytical and numerical solutions; flow regimes and approximations; laminar boundary layers—equations, solution methods, applications; stability theory and transition; incompressible turbulent flow—mean-flow and Reynolds-stress equations, modeling, turbulent boundary layers and free shear flows. Requirements: for ME:6260—ME:5160; for CxEE:6376—CEE:5369. Same as ME:6260.

CxEE:6520 Watershed Sedimentation 3 s.h.  Exploration of rich and complex field of sediment transport, geomorphology, and contaminant transport; associated physical, chemical, and biological processes with associated mathematical modeling; investigation of current topics not covered elsewhere, including physical processes affecting stability/mobility, transport, and fate of soil/sediments; lack of general understanding in development of fine-scale sedimentary structure in different systems, particularly contamination and contamination release; suspension effects on turbulent flows. Prerequisites: CxEE:4370.

CxEE:6532 Finite Element II 3 s.h.  Computer implementation; plate and shell elements; mixed and hybrid formulations; nonlinear analysis; recent development; introduction to boundary element method. Prerequisites: CxEE:4533. Same as IGPI:6216, ME:6215.

CxEE:6599 Advanced Topics in Infrastructure Systems 1-3 s.h.  Advanced topics or areas of study not formally offered in other structures and transportation courses; topics may include one or more areas (e.g., structural dynamics, advanced structural systems, earthquake engineering, sustainable systems).

CxEE:7250 Advanced Fracture Mechanics 3 s.h.  Fracture of modern engineering materials; linear-elastic fracture; computational methods; functionally graded materials; elastic-plastic fracture; multiscale fracture and fatigue crack initiation. Prerequisites: ME:5113 and (ME:5159 or CxEE:4533). Same as ME:7250.

CxEE:7999 Research: Civil and Environmental Engineering PhD Dissertation arr.  Experimental and/or analytical investigation of an approved topic for partial fulfillment of requirements for the PhD in civil and environmental engineering.