SCHOOL OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE

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General Information

Vision

Through a community of scholars committed to excellence in research and teaching, the mission of CEES is to provide our students with the technical education and critical thinking skills needed to lead the country in addressing the complex infrastructure and environmental problems facing today's society.

Careers in Architectural Engineering

Architectural engineers design buildings and other structures and understand the design of a building involves more than its appearance. Buildings also must be functional, safe and economical and meet the needs of the people who use them. Architectural engineers design a variety of structures, including office and apartment buildings, schools, churches, factories, hospitals, houses and airport terminals. They also design such complexes as urban centers, college campuses, industrial parks and communities. In addition, they may advise on the selection of building sites, prepare cost analysis and land-use studies and do long-range planning for land development.

Careers in Civil Engineering

Civil engineering is the oldest of the modern engineering disciplines with historical roots dating back to the 1700s. Responsibilities of the first civil engineers increased during the industrial revolution and included the construction of canals, roads and railroads.

Civil engineers are responsible for the design and construction of society's infrastructure, such as buildings, highways, bridges, mass transit systems, dams and locks, and municipal water and sewage treatment systems. They often are responsible for planning, managing, operating and maintaining these facilities. Consequently, civil engineering is frequently referred to as the "the people-serving profession."

Spurred by general population growth and an expanding economy, more civil engineers will be needed to design and construct higher-capacity transportation, water supply and pollution control systems as well as large buildings and building complexes. They also will be needed to repair or replace existing roads, bridges and other public structures.

Careers in Environmental Engineering

Using the principles of physics, biology and chemistry, environmental engineers develop methods to meet such environmental challenges as water and air pollution control, recycling, waste disposal, hydrology, river management and control, and public health issues. Environmental engineers conduct hazardous waste management studies in which they evaluate the significance of the hazard, offer analysis on treatment and containment and develop regulations to prevent mishaps. They also design municipal sewage and industrial wastewater systems, analyze scientific data, conduct research projects and perform quality control checks.
Past environmental engineering graduates have been employed by state and federal environmental agencies, including the Oklahoma Department of Environmental Quality, the U.S. Environmental Protection Agency and the U.S. Geological Survey as well as various private industries and consulting firms.

Careers in Environmental Science

Environmental scientists have a variety of job responsibilities, including collecting and analyzing air, water and soil samples, monitoring compliance with environmental laws and regulations, assisting industrial companies in complying with environmental regulations, and addressing public meetings on local environmental challenges.

Past environmental science graduates have been employed by the U.S. Environmental Protection Agency, Oklahoma Department of Environmental Quality, Oklahoma Department of Health and numerous private industrial and consulting firms.

Programs & Facilities

CEES is currently housed in the Carson Engineering Center, the Engineering Laboratory Building and Sarkey's Energy Center on the main campus as well as in the Donald G. Fears Structurual Engineering Laboratory and the National Weather Center on the south research campus.

Student Team Room and Computing Laboratory

The student team room and computing laboratory is located in Carson Engineering Center and is available to all CEES students.

Teaching and Research Laboratories

CEES has laboratory facilities for teaching and research in environmental science and engineering, geotechnical engineering and structural engineering.

- The traditional wet laboratories in the Carson Engineering Center are associated with teaching and research efforts in environmental science and environmental engineering.
- The materials and soils laboratory is located in Carson Engineering Center and is used for teaching and research in soils and materials science.
- The Donald G. Fears Structural Engineering laboratory is devoted to teaching and research programs in geotechnical and structural engineering.
- The Ray Broce Materials laboratory is devoted to teaching and research in asphalt and other transportation materials.
- The Transportation, Risk, and Information Commons (TRICS) laboratory focuses on how transportation systems depend on social and other physical systems in the context of natural and man-made hazards.

Undergraduate

Civil Engineering and Environmental Science Program Educational Objectives

Program educational objectives (PEOs) are broad statements that describe what graduates are expected to attain within a few years of graduation. The PEOs were developed to meet the needs of the constituencies of CEES. The primary constituents of CEES programs are our students, alumni and the employers that hire our graduates. The

PEO's are focused on providing well trained engineers for employers and to empower those engineers to advance during their careers. The PEOs for CEES engineering graduates are:

Program Educational Objective 1

CEES alumni will embark on successful careers in areas associated with the development, implementation, and management of architectural, civil, and environmental engineering systems, or will continue their education through graduate or professional school.

Program Educational Objective 2

CEES alumni will advance in their careers by employing the latest technical knowledge, creativity, inclusive teamwork, and ethical decision making to find sustainable solutions for pressing environmental and infrastructure problems; they will continue their professional development through lifelong learning; and they will support the profession and the University.

Civil Engineering and Environmental Science Undergraduate Student Outcomes

Student Outcomes describe what students are expected to know and be able to do by the time of graduation. The Student Outcomes for engineering students in CEES are:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Bachelor of Science

Students enrolled in the Bachelor of Science in Architectural Engineering[1] program take the same core engineering, mathematics, science and English courses taken by other engineering students. They also take a series of architectural planning and methods courses from the College of Architecture.

The Bachelor of Science in Civil Engineering[2] curriculum is comprised of four areas of emphasis; environmental, geotechnical, structural, and transportation engineering. The undergraduate civil engineering student must complete a sequence of core engineering courses plus one or two courses in each of these areas. Students then choose three upper division Professional Electives in their preferred area of emphasis.

The core curriculum for the Bachelor of Science in Environmental Engineering[3] is similar to civil engineering; however, the last two years of the program focus strictly on environmental courses. Students are required to take courses in air pollution control engineering; water and wastewater engineering, and solid and hazardous waste management.

Students pursuing the Bachelor of Science in Environmental Science complete fundamental courses in chemistry, math, physics, biology, microbiology, and environmental science. Students then choose three upper division track electives electives in one of four areas: chemistry, biology, math, or physical sciences. Students also choose two upper division Professional Electives in the preferred area of emphasis within environmental science. This flexible program prepares students for careers in government, consulting, and industry.

1. Bachelor of Science in Architectural Engineering accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Architectural and Similarly Named Program Criteria.
2. Bachelor of Science in Civil Engineering accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Civil and Similarly Named Program Criteria.
3. Bachelor of Science in Environmental Engineering accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Environmental Engineering and Similarly Named Program Criteria.

Minor

Students earning a bachelor's of science degree in specific areas are eligible to apply for the Environmental Science Engineering Minor. Additional majors will be considered on a case-by-case basis.

The Water and Sanitation for Health and Sustainable Development Minor is designed for engineering and non-engineering majors who have an interest in development work in emerging regions, particularly the sectors of water, sanitation, and health.

Accelerated Bachelor of Science/Master of Science

The combined BS/MS program is offered to qualified undergraduate students in the School of Civil Engineering and Environmental Science, University of Oklahoma, who wish to pursue their graduate education while completing their undergraduate degree requirements. The Bachelor of Science portion is accredited by the Engineering Accreditation Commission of ABET.

- Architectural Engineering, Bachelor of Science/Civil Engineering, Master of Science
- Civil Engineering, Bachelor of Science/Master of Science
- Environmental Engineering, Bachelor of Science/Master of Science
- Environmental Science, Bachelor of Science/Master of Environmental Science

Graduate

Master of Science Civil Engineering

The Civil Engineering Master of Science program is open to students with undergraduate degrees in environmental or civil engineering or related engineering or science disciplines who have completed certain minimum undergraduate coursework.

- Civil Engineering: Geotechnical Engineering, Master of Science
- Civil Engineering: Geotechnical Engineering (Online), Master of Science

- Civil Engineering: Structural Engineering, Master of Science
- Civil Engineering: Structural Engineering (Online), Master of Science
- Civil Engineering: Transportation Engineering (Online), Master of Science
- Civil Engineering: Water Resources Engineering, Master of Science
- Civil Engineering: Water Resources Engineering (Online), Master of Science

Master of Science in Environmental Engineering

The Master of Science in Environmental Engineering program is open to students with undergraduate degrees in environmental or civil engineering or related engineering or science disciplines who have completed certain minimum undergraduate coursework.

- Environmental Engineering Master of Science

Master of Environmental Science

The Master of Environmental Science programs are open to students with undergraduate degrees in the physical, natural, or life sciences or related disciplines who have completed certain minimum undergraduate coursework.

- Environmental Science
- Environmental Science: Hydrology and Water Security Online

Doctoral Programs

The School of Civil Engineering and Environmental Science offers doctoral programs in environmental science, environmental engineering, and civil engineering. A master's degree in a related discipline is typically required for admission to all CEES Ph.D. degree programs, although students who have outstanding academic credentials and a documented record of research experience at the undergraduate level may occasionally be admitted to the doctoral program without a master's degree.

Courses

CEES 1000 CEES Seminar 0 Credit Hours
Seminar provides a common meeting time for students and faculty for department activities, such as invited speakers, project presentations, educational surveys, cross-course project coordination, and policy announcements. Students must enroll every semester that they are matriculated in CEES at OU after the freshman year, but in no case can a student graduate without successfully completing four semesters of seminar. (F, Sp)

CEES 1111 Exploring CEES 1 Credit Hour
Prerequisite: Majors only. Introduction to fundamental concepts (principles of mechanics, energy balances, simple circuits), problem solving and design, simple computing software, and disciplinary topics for architectural, civil or environmental engineers and environmental scientists. (Sp)

CEES 1112 Introduction to Civil Engineering and Environmental Science 2 Credit Hours
Prerequisite: Freshman only. Introduction to fundamental concepts (mass/flow balance), problem solving and design, and simple computing software for architectural, civil or environmental engineers and environmental scientists. (F)

CEES 2113 Statics 3 Credit Hours
Prerequisite: PHYS 2514 and MATH 2433 or MATH 2934 or concurrent enrollment in MATH 2433 or MATH 2934. Vector representation of forces and moments; general three-dimensional theorems of statics; centroids and moments of area and inertia. Free-body diagrams, equilibrium of a particle and of rigid bodies, distributed loads, friction and internal shear and moment loads. Analysis of trusses, frames, and machines. (F)

CEES 2153 Mechanics of Materials 3 Credit Hours
Prerequisites: 2113 or AME 2113 or PE 2113. Basic principles of mechanics, including the definition of stress and strain, transformations and principal values for the stress and strain tensors, kinematic relations, review of conservation equations and the development and application of constitutive laws for idealized materials. Elementary elastostatics utilizing Hooke's law; constitutive relations for a linear-elastic continuum, including elastic parameters such as Young's modulus, shear and bulk moduli and Poisson's ratio. Solution of elementary one- and two-dimensional mechanics problems, including thermal stresses and strains, beam flexure, shear and deflections, pressure vessels and buckling of columns. (Sp)

CEES 2213 CADD Fundamentals 3 Credit Hours
Prerequisite: CEES Majors only and Sophomore standing. Introduction to computer aided design and drafting with a focus on the AutoCAD and MicroStation platforms. This course is primarily about learning to use the software and learning how to convey an engineering design graphically. (F)

CEES 2223 Fluid Mechanics 3 Credit Hours
Prerequisites: 2113 or AME 2113 or PE 2113, and Math 3113 or concurrent enrollment. Coverage of the fundamentals of fluid statics and dynamics. Formulation of the equation of fluid flow, i.e., Navier-Stokes equation, Eulers equations, Bernoulli equations, etc. and their application. Examples of ideal fluid flow, such as flow in open and closed conduits. (Sp)

CEES 2313 Water Quality Fundamentals 3 Credit Hours
Prerequisite: CHEM 1415, MATH 2423 or MATH 2924. Introduction to environmental mass balance and fate processes. Studies of mass and energy transfer, introductory environmental chemistry, water quality parameters, mathematics of growth, statistics and data analysis, introduction to environmental laws and regulations. (F)

CEES 2323 Environmental Transport and Fate Process 3 Credit Hours
Prerequisite: 2313. Physicochemical and biological processes controlling contaminant distribution and fate; hydrological processes controlling contaminant transport; sources, prevention and remediation of environmental pollutants. (Sp)

CEES 2412 Earth Systems and Processes 2 Credit Hours
Prerequisite: CHEM 1315, and MATH 1823 or MATH 1914. This course provides environmental engineering and science students with a working knowledge of earth systems and their processes, specifically emphasizing the atmosphere, hydrological systems, limnology, soils, and ocean systems. This course will exam the physical structure of these systems, as well as their physical-chemical processes, and how the transfer of energy and mass between earth systems influences the global climate. (Sp)

CEES 2970 Special Topics/Seminar 1-3 Credit Hours
Special Topics. 1 to 3 hours. May be repeated; Maximum credit nine hours. Special topics course for content not currently offered in regularly scheduled courses. May include library and/or laboratory research, and field projects. (Irreg.)

CEES 3213 Water Resources Engineering 3 Credit Hours
Prerequisite: 2223 or permission of instructor. Municipal water demands, surface water hydrology, ground water hydrology, water distribution systems, pump design, wastewater collection systems, storm water management, water law. (F)

CEES 3243 Water and Wastewater Treatment Design 3 Credit Hours
Prerequisite: CEES 2223. Design of municipal water and wastewater treatment plants. Emphasis is placed on the characterization of water and wastewater and physical, chemical and biological treatment methods. Sludge processing advanced treatment methods and treatment plant hydraulics are also considered. (Sp)

CEES 3251 WaTER Center Integrated Seminar 1 Credit Hour
Prerequisite: permission of instructor. This course is a weekly hour-long seminar in which students will hear from guest speakers discussing WASH projects in emerging regions, present their intercultural experience in the form of a case study, and listen to other case study presentations. Students may also read and discuss assigned readings (e.g., published peer-reviewed papers of other researchers doing similar work). (F,SP)

CEES 3263 Introduction to Dynamics for Architectural and Civil Engineers 3 Credit Hours
Prerequisite: CEES 2153 and MATH 3113. Kinematics and kinetics of rigid bodies; free and forced vibrations of undamped and damped single degree-of-freedom systems; concept of mass, stiffness, and damping for typical structures; introduction to vibrations of two and more degrees-of-freedom systems; and determination of loads on structures from dynamic events such as earthquakes. (F)

CEES 3361 Soil Mechanics Laboratory 1 Credit Hour
Prerequisite: CEES 2153 or PE 2153; CEES 3363 or concurrent enrollment (you must be enrolled in both lecture and lab section together the first time you attempt either). This is one of two complimentary courses taken in the area of Geotechnical Engineering and serves as an introduction to soil mechanics. During this course, the student will conduct simple laboratory tests to identify and classify soils, characterize the compacted properties of soil, and quantify soil permeability, compressibility and strength. (F)

CEES 3363 Soil Mechanics 3 Credit Hours
Prerequisite: CEES 2153 or PE 2153; CEES 3361 or concurrent enrollment (you must be enrolled in both lecture and a lab section together the first time you attempt either). General treatment of the physical and mechanical properties of soils. Topics include soil composition, classification, phase relationships, compaction, effective stress, consolidation, shear strength and permeability and seepage. (F)

CEES 3403 Materials 3 Credit Hours
Prerequisite: CEES 2153 or PE 2153 or concurrent enrollment. Study of the properties of materials utilized by architectural and civil engineers; analyses of aggregates, concrete, masonry, steel, asphalt, plastics and wood. Laboratory. (Sp)

CEES 3413 Structural Analysis I 3 Credit Hours
Prerequisite: CEES 2153 or PE 2153. Loads, reactions and force systems; introduction to design codes; analysis of frames and trusses; calculation of structural deformations; and analysis of indeterminate structures. Emphasis on classical solutions and time-tested approaches to structural engineering. Introduction to structural analysis computer programs to solve complex problems. (F)

CEES 3422 Intercultural Immersion Experience in an Emerging Region 2 Credit Hours
Prerequisite: permission of instructor. This course is intended to be a 3-6 week summer international immersion experience with a WaTER component (technological, cultural, business lens on water, sanitation, hygiene in a particular context). Students design their own experience/internship, write a proposal of planned activities, and secure CEES faculty advisor approval. After completion, students submit a written report and oral presentation to a review committee. (Su)

CEES 3440 Mentored Research Experience 3 Credit Hours
0 to 3 hours. Prerequisites: ENGL 1113 or equivalent, and permission of instructor. May be repeated; maximum credit 12 hours. For the inquisitive student to apply the scholarly processes of the discipline to a research or creative project under the mentorship of a faculty member. Student and instructor should complete an Undergraduate Research & Creative Projects (URCP) Mentoring Agreement and file it with the URCP office. Not for honors credit. (F, Sp, Su)

CEES 3453 Introduction to Construction Management 3 Credit Hours
Prerequisite: CEES 2213 and junior level standing in CEES. Introduction to methods for managing construction projects including scheduling, cost estimating, contracts, pay request, change orders, and requests for information. Students will also learn how to read construction documents and understand project specifications. (Sp)

CEES 3663 Structural Design - Steel I 3 Credit Hours
Prerequisite: CEES 3413 and CEES 3403 or concurrent enrollment in CEES 3403. Design of steel structural members including tension elements, columns, beams, and beam-columns; bolted and welded connection design; composite beam design; introduction to plastic design. Laboratory. (Sp)

CEES 3673 Structural Design - Concrete I 3 Credit Hours
Prerequisite: CEES 3403, CEES 3413. Analysis and design of reinforced concrete beams, columns, slabs, footings, etc., along with discussion of current building practice. Laboratory (F or Sp)

CEES 3883 Transportation Engineering 3 Credit Hours
Prerequisite: CEES 2153 or P E 2153 and CEES 3403 or concurrent enrollment. Introduction to transportation planning, design, construction, operations and maintenance emphasizing the highway/street mode. Includes demand modeling, route location and design, pavements including hot mix asphalt volumetrics and stability, drainage, and traffic control devices. (Sp)

CEES 3960 Honors Reading 1-3 Credit Hours
1 to 3 hours. Prerequisite: admission to Honors Program. May be repeated; maximum credit six hours. Consists of topics designated by the instructor in keeping with the student's major program. The topics will cover materials not usually presented in the regular courses. (F, Sp, Su)

CEES 3970 Honors Seminar 1-3 Credit Hours
1 to 3 hours. Prerequisite: admission to Honors Program. May be repeated; maximum credit six hours. The projects covered will vary. Deals with concepts not usually presented in regular coursework. (Irreg.)

CEES 3980 Honors Research 1-3 Credit Hours
1 to 3 hours. Prerequisite: admission to Honors Program. May be repeated; maximum credit six hours. Provides an opportunity for the gifted Honors candidate to work on a special project in the field. (Sp)

CEES 3990 Independent Study 1-3 Credit Hours
1 to 3 hours. Prerequisite: permission of instructor and junior standing. May be repeated once with change of content. Independent study may be arranged to study a subject not available through regular course offerings. (F, Sp, Su)

CEES 4113 Building Lighting and Electrical Systems 3 Credit Hours
Prerequisite: MATH 2423 or MATH 2924; PHYS 2524; and ENGR 2431 or concurrent enrollment, CEES majors only. Fundamentals of building lighting and electrical systems. Lighting topics include the determination of appropriate lighting quantity and quality, luminaires and lighting design procedures for residential, commercial and industrial buildings. Electrical topics will include service voltages, overcurrent protection, short circuit analysis and branch circuit design for residential, commercial and industrial buildings. (F or Sp)

CEES 4114 Aquatic Chemistry 4 Credit Hours
(Slashlisted with CEES 5114) Prerequisite: CHEM 1415 and CEES 2323 or permission of instructor. Environmental kinetics and thermodynamics in aquatic systems; acid/base, precipitation/solubility, metal complexation and oxidation/reduction reactions; environmental colloidal and solid-liquid interface chemistry. No student may earn credit for both 4114 and 5114 or Environmental Science 4114 and 5114. Laboratory. No student may earn credit for both 4114 and 5114. (F)

CEES G4123 Open Channel Flow 3 Credit Hours
Prerequisite: CEES 2223. Theory, analysis and design of channels, aqueducts, headworks, siphons, spillways and hydraulic structures. An in-depth study of critical flow and measurement techniques. Backwater analysis by analytical, calculator and computer methods. Special emphasis on practical problems of general interest. (F)

CEES G4243 Water Technologies for Emerging Regions 3 Credit Hours
Prerequisite: 2223 or 2323 or equivalent or instructor permission. Students will gain an understanding of water and sanitation issues in remote villages of developing countries. Explore and design sustainable technologies appropriate to these settings including cultural, political and economic factors. (Sp)

CEES G4253 Statistics and Probability 3 Credit Hours
Prerequisite: MATH 2423 or 2924 and PHYS 2524 or 2424. Designed to help students understand the fundamentals of probability, statistics, reliability, and risk methods in support of decision making for future engineers and scientists. Fundamental concepts in probability and statistics will be reviewed and used. Engineering decisions are often based on data that contain uncertainty; future scientists and engineers should understand how uncertainty affects calculated quantities, accuracy, precision, and reliability. (Sp)

CEES G4263 Hazardous and Solid Waste Management 3 Credit Hours
Prerequisite: junior or above status in CEES or permission of instructor. Sources and types of solid wastes; identification and classification of hazardous wastes; waste handling, transportation, treatment and disposal techniques, federal and state legislation; and environmental and health effects. (F)

CEES G4273 WaTER Technical Field Methods 3 Credit Hours
Prerequisite: permission of instructor. A hands-on practicum for construction and implementation of water and sanitation projects in developing countries. Course modules reflect the typical projects and skills needed by development workers in organizations such as Peace Corps, USAID, Engineers Without Borders, and faith-based organizations. Emphasis will be on sustainable technologies using methods and materials appropriate to emerging regions. Non-engineering students are encouraged to participate. (Su)

CEES 4281 Engineering Co-Op Program 1 Credit Hour
(Crosslisted with AME, CH E, C S, ECE, EPHY, ISE and BME 4281) Prerequisite: Departmental permission and junior standing. May be repeated; maximum credit 6 hours. The Co-Op program provides students an opportunity to enhance their education via career exploration in related professional work experiences. Course assignments help students articulate their experiences by completing journals; mid-term paper; final paper and/or final presentation. Faculty receive an evaluation from the student's Co-Op supervisor who monitors performance. Faculty collaborate with the Co-Op supervisor to ensure student success. (F, Sp, Su)

CEES 4324 Environmental Biology and Ecology 4 Credit Hours
(Slashlisted with CEES 5324) Prerequisite: CEES 2323. Examines applied environmental biology; biological consequences of environmental impacts; mitigation of environmental impacts via biogeochemical, ecological and microbial processes. No student may earn credit for both 4324 and 5324. Laboratory (F)

CEES G4333 Foundation Engineering 3 Credit Hours
Prerequisite: CEES 3363. Substructure analysis and design to meet various soil conditions; footings and rafts, shoring and underpinning, piles, cofferdams, caissons, breakwaters, piers, wharves, vibratory effects on foundations. (Sp)

CEES 4363 Ecological Engineering Science 3 Credit Hours
(Slashlisted with 5363) Prerequisite: Senior standing or permission of instructor. Exploration of the design of sustainable ecosystems integrating human society with its natural environment for the benefit of both. Uses a systems perspective that resilient and sustainable solutions involve working with natural ecological and biogeochemical processes and not against them, and require less fossil fuel input, produce less pollution, and represent cost-effective alternatives to traditional energy- and resource-intensive technologies. No student may earn credit for both 4363 and 5363. (Sp)

CEES 4373 Water Resources Systems Modeling 3 Credit Hours
(Slashlisted with CEES 5373) Prerequisite: CEES 3213 or concurrent enrollment or instructor permission. Theory and concept of water resources management. An in-depth study of theory of optimization, hydrologic modeling, reservoir and dams operation. Data analysis and computational methods for hydrology and water resources management. Special emphasis on system modeling and parameter tuning using automatic calibration approaches. Basic level of scientific programming. No student may earn credit for both 4373 and 5373. (F)

CEES 4423 CEES Professional Internship or Co-op 3 Credit Hours
Prerequisite: completion of at least 19 hours of Civil Engineering and Environmental Science (CEES) coursework (for Civil Engineering and Environmental Engineering majors); or completion of at least 19 hours of CEES and science coursework (for Environmental Science majors); or completion of at least 19 hours CEES and Architecture (ARCH) coursework (for Architectural Engineering majors). Provides three hours of professional elective credit for 400 hours of internship. Prior to starting the internship, students should write a proposal of planned activities and secure the approval from a CEES faculty member to serve as an of the advisor. After completion of the internship or co-op, the students should enroll in this course. The student must then submit a written report, and make an oral presentation for a three-member review committee that includes the faculty advisor. (F, Sp, Su)

CEES G4453 Geomatics Engineering 3 Credit Hours
Prerequisites: CEES 2213, CEES 3403 and MATH 2433 or MATH 2934 or instructor permission. Geomatics engineering deals with the science of determining relative positions of features for mapping, engineering and construction plans. Topics include digital leveling, orientation, distance measurement, traversing and control surveys, accuracy, error sources, precise horizontal and zenith angle measurements, and introduction of global navigation satellite system. Laboratory (F)

CEES G4663 Introduction to Matrix Methods in Structural Analysis 3 Credit Hours
Prerequisite: CEES 3413. Review of matrix algebra and solution of linear equations; energy concepts and principle of virtual work; fundamentals of flexibility and stiffness methods; coordinate transformation and matrix assemblage; computer-oriented direct stiffness method and computer code developments; secondary effects; support settlement and temperature change; method of finite differences and application to beam and plate problems. (F or Sp)

CEES G4753 Structural Design - Wood 3 Credit Hours
Prerequisite: CEES 3413 or equivalent. Material properties and behavior of wood. Analysis and design of solid and laminated structural members, connections, systems, trusses and arches. Current developments in structural wood design and research. (F)

CEES 4843 Hydrology 3 Credit Hours
(Slashlisted with CEES 5843) Prerequisite: MATH 2924/2423 and CEES 4253 (pre-or co-requisite) or instructor permission. Hydrology is the study of water across the globe. This is an applied course on hydrology dealing with environmental water problems; principles of hydrologic systems, their structure and components; and methods of analysis and their application to various purposes of water resources planning and development. No student may earn credit for both 4843 and 5843. (Sp)

CEES G4883 Traffic Analysis, Design and Control 3 Credit Hours
Prerequisite: CEES 3883 or Permission of Instructor. Study of fundamentals of traffic engineering; components of the traffic system; intersection types and design elements; basic variables of the traffic system (flow, capacity, level of service, delay); design and analysis of traffic signals and intersections; traffic control and traffic impact analysis; safety performance and traffic crash analysis; use of the Highway Capacity Manual and traffic analysis software. (F)

CEES 4901 Introduction to CE Capstone 1 Credit Hour
Prerequisite: CEES 3213, CEES 3363, and CEES 3663 or CEES 3673 (or concurrent enrollment). Introduction to the capstone design project, which is a two-semester-long, open-ended engineering design problem that requires applying the skills and techniques acquired in earlier engineering course work. This course will focus on introducing the project requirements; forming multi-disciplinary teams of students; developing team identities; assigning team roles; evaluating project constraints; and developing a project design schedule. (F)

CEES 4903 Civil Engineering Capstone 3 Credit Hours
Prerequisite: CEES 3213, and CEES 3363, and CEES 3663 or CEES 3673, and CEES 4901. Solution of major design problems by a team approach of disciplines. Problems to be varied within the areas of civil engineering (structural; geotechnical; and transportation) according to the student's major interest. The capstone project will be under direct faculty supervision. (Sp) [V].

CEES 4911 Introduction to ES Capstone 1 Credit Hour
Prerequisite: CEES 4114 or CEES 5114 (or concurrent enrollment), CEES 4324 or CEES 5324 (or concurrent enrollment). Introduction to the capstone design project, which is a two-semester-long, open-ended engineering design problem that requires applying the skills and techniques acquired in earlier engineering course work. This course will focus on introducing the project requirements; forming multi-disciplinary teams of students; developing team identities; assigning team roles; evaluating project constraints; and developing a project design schedule. (F)

CEES 4913 Environmental Science Capstone 3 Credit Hours
Prerequisite: CEES 4911 and CEES 4253 (or concurrent enrollment). The capstone experience draws upon undergraduate course work in environmental science, biology, chemistry, physics, mathematics, and related sciences. Student teams address a client-driven, open-ended, real-world problem. Faculty coordinators serve in advisory capacities only, introducing field, laboratory, and computer methods and coordinating class meetings and presentations. Any other in-class presentations cover non-traditional (non-technical) topics. (Sp) [V].

CEES 4921 Introduction to EE Capstone 1 Credit Hour
Prerequisite: CEES 3213, CEES 4114 or CEES 5114 (or concurrent enrollment), CEES 4324 or CEES 5324 (or concurrent enrollment). Introduction to the capstone design project, which is a two-semester-long, open-ended engineering design problem that requires applying the skills and techniques acquired in earlier engineering course work. This course will focus on introducing the project requirements; forming multi-disciplinary teams of students; developing team identities; assigning team roles; evaluating project constraints; and developing a project design schedule. (F)

CEES 4923 Environmental Engineering Capstone 3 Credit Hours
Prerequisite: CEES 4921 and CEES 4253 (or concurrent enrollment). The capstone experience is a course where students draw upon their undergraduate course work for analysis of an open-ended, real world problem. Faculty coordinators serve in advisory capacities only. All in-class presentations will cover non-traditional (non-technical) topics. Students are presumed to have been trained in basic natural and engineering sciences and introduced to environmental sampling/analysis and impact/risk assessment methods. (Sp) [V].

CEES 4943 Air Quality Management 3 Credit Hours
Prerequisite: CEES 2313 or CEES 2223 or instructor permission. Important aspects of air quality will be covered, including air quality legislation, major sources and effects of air pollutants, monitoring, atmospheric dispersion, and air quality modeling. (Sp)

CEES 4951 Contemporary Topics in Professional Practice 1 Credit Hour
Prerequisite: Junior standing in Civil Engineering or Environmental Engineering. Civil engineering is a dynamic profession, as methods of practice evolve to address the many pressing problems in today's built and natural environment. This course provides an introduction to contemporary topics in professional practice, such as basic concepts of sustainability in engineering design, modern tools for project management, and the role of business/policy considerations in practice. (F)

CEES 4960 Directed Readings 1-4 Credit Hours
1 to 4 hours. Prerequisite: good standing in University; permission of instructor and dean. May be repeated; maximum credit four hours. Designed for upper-division students who need opportunity to study a specific problem in greater depth than formal course content permits. (Irreg.)

CEES 4970 Special Topics/Seminar 1-3 Credit Hours
1 to 3 hours. Prerequisite: Senior standing or permission of instructor. May be repeated; maximum credit nine hours. Special topics or seminar course for content not currently offered in regularly scheduled courses. May include library and/or laboratory research and field projects. (Irreg.)

CEES 4980 Environmental Science Senior Research 1-12 Credit Hours
Prerequisite: senior standing. Maximum credit twelve hours. Intensive research investigation of a special project under the direction of a faculty member. (F, Sp, Su)

CEES 4990 Independent Study 1-3 Credit Hours
1 to 3 hours. Prerequisite: Senior standing and permission of instructor. May be repeated; maximum credit nine hours. Contracted independent study for a topic not currently offered in regularly scheduled courses. Independent study may include library and/or laboratory research and field projects. (Irreg.)

CEES 4991 Introduction to AE Capstone 1 Credit Hour
Prerequisite: CEES 3663 (or concurrent enrollment), CEES 3673 (or concurrent enrollment), CEES 4113, and AME 4653 (or concurrent enrollment). Introduction to the capstone design project, which is a two-semester-long, open-ended engineering design problem that requires applying the skills and techniques acquired in earlier engineering course work. This course will focus on introducing the project requirements; forming multi-disciplinary teams of students; developing team identities; assigning team roles; evaluating project constraints; and developing a project design schedule. (F)

CEES 4993 Architecture Engineering Capstone 3 Credit Hours
Prerequisite: CEES 3663, CEES 3673, CEES 4991 and AME 4653; CEES 4113 and CEES 4333 or concurrent enrollment. A capstone course emphasizing design of structural components and environmental systems of buildings. Requires students to have knowledge and skills from prerequisite courses to address a real-world, open-ended design problem. (Sp) [V].

CEES 5010 Civil Engineering Problems 1-4 Credit Hours
Prerequisite: senior or graduate standing and permission of instructor. May be repeated; maximum credit four hours for a master's program or six hours for a doctoral program, including hours taken as part of another graduate program. Independent or small group study under the supervision of one or more faculty members. (F, Sp, Su)

CEES 5020 Special Topics in Civil Engineering 1-6 Credit Hours
1 to 6 hours. Prerequisite: senior or graduate standing and permission of instructor. May be repeated with change of topic; maximum credit twelve hours. Examines subject matter in civil engineering not covered by existing course offerings as a regular course. (F, Sp, Su)

CEES 5021 Technical Communications 1 Credit Hour
Prerequisite: CEES graduate standing or permission of instructor. Focused on enabling students to improve oral and written communications skills. Examines appropriate formats for various technical publications, as well as methods and practices for developing effective oral presentations. Each student will be required to develop an oral presentation about his/her written product. (Sp)

CEES 5103 Water Policy and Institutions 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. This course examines the evolution of water policy in the United States and the substantive roles that federal and state water resource institutions have played. Students will gain an understanding of the legal and institutional frameworks within which water resources are managed and the broader implications of climate change for water security. (F)

CEES 5113 Water Management Chemistry 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. This course provides knowledge of water chemistry encountered in the management and assessment of water quality. Course goals are: 1) to become proficient interpreting water chemistry data so to be able to successfully evaluate the water quality status of a water resource, and 2) to know which specific water chemistry parameters are essential to measure for monitoring water quality problems. (F)

CEES 5114 Aquatic Chemistry 4 Credit Hours
(Slashlisted with 4114) Prerequisite: graduate standing, one year general chemistry. Environmental kinetics and thermodynamics in aquatic systems; acid/base, precipitation/solubility, metal complexation and oxidation/reduction reactions; environmental colloidal and solid-liquid interface chemistry. No student may earn credit for both 4114 and 5114 or Environmental Science 4114 and 5114. Laboratory. (F)

CEES 5123 Climate Change and Impacts on Water Energy Food Nexus 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. An interdisciplinary course to learn the basics of climate change and its impacts on the interactions among water, energy and food nexus. The course provides fundamental theories of climate change, water cycle, and technologies about renewable energy (hydro, wind, solar, ocean, biomass, geothermal) and non-renewable energy (fossil fuels). The course talks about global food production and teaches basic Python programming. (Sp)

CEES 5133 Water Sustainability 3 Credit Hours
(Crosslisted with CH E 5133) Prerequisite: Civil Engineering, Environmental Engineering, or Environmental Science Graduate standing; or permission of instructor. Introduction to water reclamation and reuse. Wastewater characteristics. Conventional approaches for wastewater treatment. Emerging materials and technologies for water remediation. Water reuse applications and outlook. (Irreg.)

CEES 5153 Water Innovation: Technology, Policy, and Organizational Issues 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. This course encompasses water technologies and their extended innovation processes in three substantive sections. A basic understanding of technological innovation frameworks precedes discussion of water systems. The second section addresses water policy in general as well as specific cases of policy innovation. The final section covers organizations and how they can become more innovative with respect to water systems. (Sp)

CEES 5233 Biological Waste Treatment Design 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. Waste treatment design using biological processes; emphasis on treatment biokinetics, municipal wastewater treatment processes, and design of municipal wastewater unit processes; application of biological treatment concepts to other wastes including industrial wastes, groundwater, and solid or hazardous wastes. (F)

CEES 5243 Physical-Chemical Water Treatment 3 Credit Hours
Prerequisite: graduate standing or permission of instructor. The course covers physical and chemical processes for water purification, primarily for drinking water treatment, including governing regulations (the Safe Drinking Water Act), reactor kinetics, coagulation, flocculation, sedimentation, filtration, disinfection, demineralization, taste and odor removal, and advanced treatment. (Sp)

CEES 5244 Physicochemical Water Treatment Processes 4 Credit Hours
Prerequisite: graduate standing or permission of instructor. Physical and chemical processes for drinking water, ground water and industrial water treatment. Processes discussed include coagulation/flocculation, gravity separation, filtration, disinfection, adsorption, advanced oxidation, and phase transfer (e.g., air stripping). (Sp even years)

CEES 5313 Engineering Geology 3 Credit Hours
Prerequisites: CEES 3363, CEES 3361 and permission of instructor. Understanding geology in engineering design and mitigation: topics include weathering and soil-forming processes; engineering properties of rock; landslides and debris flow (slope stability); fluvial processes and hazards; land subsidence; expansive soil; hazard, risk and land-use planning. (F)

CEES 5323 Geosynthetics 3 Credit Hours
Prerequisites: CEES 3363 and CEES 3361. To introduce students to concepts and design methods involving the use of geosynthetics in geotechnical and transportation engineering applications. (F)

CEES 5324 Environmental Biology and Ecology 4 Credit Hours
(Slashlisted with CEES 4324) Prerequisite: Graduate standing in CEES. Examines applied environmental biology; biological consequences of environmental impacts; mitigation of environmental impacts via biogeochemical, ecological and microbial processes. Laboratory No student may earn credit for both 4324 and 5324. (F)

CEES 5343 Advanced Soil Mechanics 3 Credit Hours
Prerequisites: CEES 3363, CEES 3361 and permission of instructor. Advanced treatment of theories and principles of shearing strength, stress distribution and settlement analysis. (F)

CEES 5353 Introduction to Soil Dynamics 3 Credit Hours
Prerequisite: Graduate Standing, CEES 3363 or permission of instructor. Review of basic concepts (single- and multi-degree of freedom system, wave propagation, behavior of dynamically loaded soils), liquefaction, vibrations of footings on elastic half space, analog models, dynamics of pile foundations, machine foundations, design of foundations for dynamic loads including earthquake loading. (Irreg.)

CEES 5363 Ecological Engineering Science 3 Credit Hours
(Slashlisted with CEES 4363) Prerequisite: senior or graduate standing. Exploration of the design of sustainable ecosystems integrating human society with its natural environment for the benefit of both. Uses a systems perspective that resilient and sustainable solutions involve working with natural ecological and biogeochemical processes and not against them, and require less fossil fuel input, produce less pollution, and represent cost-effective alternatives to traditional energy-and resource-intensive technologies. No student may earn credit for both 4363 and 5363. (Sp)

CEES 5373 Water Resources Systems Modeling 3 Credit Hours
(Slashlisted with CEES 4373) Prerequisite: Graduate standing or permission of instructor. Theory and concept of water resources management. An in-depth study of theory of optimization, hydrologic modeling, reservoir and dams operation. Data analysis and computational methods for hydrology and water resources management. Special emphasis on system modeling and parameter tuning using automatic calibration approaches. Basic level of scientific programming. No student may earn credit for both 4373 and 5373. (F)

CEES 5383 Earthquake Engineering 3 Credit Hours
Prerequisite: senior or graduate standing. To provide students with an understanding of the effects of earthquakes on civil engineering structures and analytical tools for their seismic analysis. (F)

CEES 5393 Reinforced Soil Structures 3 Credit Hours
Prerequisites: CEES 3363 and CEES 3361. Introduce students to the analysis and design methods related to geotechnical structures reinforced with geosynthetics. The main focus of this course will be on reinforced soil walls, slopes and embankments. (Sp)

CEES 5413 Soil-Structure Interaction 3 Credit Hours
Prerequisite: Graduate standing and CEES 3363, or permission of instructor. Introduction-definition, methods of solution; beams on deformable foundations; analysis and design of axially loaded structures -- single pile, pile groups, retaining walls; plates on deformable foundations; role of interfaces and joints; wave equation for pile behavior. (Irreg.)

CEES 5433 In-Situ Soil Testing 3 Credit Hours
Prerequisites: CEES 3363, CEES 3361 and permission of instructor. This is a "hands-on" course that focuses on conducting and interpreting laboratory and in-situ tests for geotechnical engineering. Topics can include but are not limited to drilling, sampling, soil characterization, triaxial shear testing, one-dimensional compression, flexible wall permeability testing, pressuremeter, cone penetrometer, borehole shear, and pile load testing. Laboratory (Sp)

CEES 5443 Unsaturated Soil Mechanics 3 Credit Hours
Prerequisites: CEES 3363 and CEES 3361. Provide students with an understanding of the theoretical and practical fundamentals of unsaturated soil mechanics with applications in geotechnical engineering. (F)

CEES 5473 Forensic Geotechnical Engineering 3 Credit Hours
Prerequisites: CEES 3363 and CEES 3361. Examines methods for investigating and analyzing geotechnical failures. Examples include slope failures, pavement subgrade failures, foundation failures, excessive seepage from earth dams, and excavation failures. The course also addresses the role of the engineer as a consultant and/or expert witness in legal cases involving geotechnical failures. (F or Sp)

CEES 5493 Transportation and Land Development 3 Credit Hours
(Crosslisted with RCPL 5493) Prerequisite: graduate standing or permission. Study of interactions between land development activity and the transportation network. Application of planning and design techniques to manage the impacts of development upon the transportation system.

CEES 5503 Highway Engineering 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. In this course, students will study geometric elements of highway design, with emphasis on highway safety and traffic flow, design controls, route analysis, and alignment. Highway engineering includes corridor selection, design of vertical and horizontal alignments, evaluation of earthwork requirements, drainage and culvert design, and safety considerations. (Su)

CEES 5513 Traffic Engineering 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. This course focuses on traffic flow theory, analysis of traffic data, and advanced technology applications for data collection, traffic control, and real-time system management. It will include emphasis on highway capacity, signal integration, intelligent transportation systems (ITS), and impacts of advanced technology, including automated vehicles. (Sp)

CEES 5523 Transportation Asset Management 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. This course focuses on fundamental elements of transportation asset management and application of its principles; explores the impetus, philosophy, and policy for implementing a long term, comprehensive plan for managing infrastructure assets; presents engineering and economic analysis concepts and processes used to evaluate and support strategic and systematic planning, finance, investment, performance, measurement, management, and preservation of a transportation system. (Su)

CEES 5533 Multimodal Transportation 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. Course focuses on fundamental elements of system performance for the multimodal transportation system and application of its principles; explores the impetus, philosophy, and policy for implementing a long term, comprehensive plan; presents transportation modes, including land, air and marine, modal shift and impact; presents engineering/economic analysis concepts used to evaluate and support planning, design, and financing processes for multimodal system. (Sp)

CEES 5543 Hazards Mitigation & Community Resilience 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. This course will address, describe, and quantify in time and space the physical phenomena of several natural and man-made hazards. Students will learn about the current best practices and identify novel approaches to mitigate such risks and hazards to be able to sustain and protect the well-being of the residents as well as the infrastructure systems in the community. (F)

CEES 5583 Water Law 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. A course for non-lawyers that explores systems of water rights; riparian, appropriation, and prescriptive rights; stream, surface, and ground water; development of water supplies; nationwide conflicts; water pollution control; federal and Indian rights and federal water resource issues and problems, so that water managers, environmental scientists or policy makers can provide needed input to threats to and protection of water. (Su)

CEES 5623 Watershed Management and Restoration 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. Course provides a comprehensive examination of watershed assessment, management, planning, protection, and restoration. Processes governing drainage-basin scale physiography, hydrology, hydrogeomorphology, and ecology are examined, emphasizing water quality-driven approaches to watershed management and restoration. (F even years)

CEES 5624 Biological Waste Treatment 4 Credit Hours
Treatment of waste using biological processes; emphasis on treatment kinetics, municipal wastewater treatment processes, and design of municipal wastewater unit processes; application of biological treatment concepts to other wastes including industrial wastes, groundwater, and solid or hazardous wastes. Laboratory (F)

CEES 5643 Quantitative Hydrometeorology 3 Credit Hours
(Crosslisted with METR 5643) Prerequisite: Graduate standing or permission of instructor. Theory and concept of hydrometeorology and remote sensing, across atmospheric science and hydrology and across water science and engineering. An in-depth study of precipitation estimation from in-situ, radar, satellite, uncertainty modeling and decision making. Data analysis and computational methods for hydrometeorology. Special emphasis on probabilities/statistics and decision making. Basic level of scientific programming is helpful but not mandatory. (Irreg.)

CEES 5653 Advanced Mechanics of Materials 3 Credit Hours
Prerequisite: CEES 2153 or PE 2153 and senior or graduate standing. Principal stresses and strains; theories of failure; introduction to elasticity; unsymmetrical bending and shear; torsion of noncircular solid cross sections, cellular sections and open sections; introduction to plate bending and buckling. (F)

CEES 5663 Structural Analysis II 3 Credit Hours
Prerequisite: Graduate standing and CEES 3413, or permission of instructor. This course addresses many of the classical methods used in the analysis of structures before the advent of the computer, such as virtual work, force method, slope-deflection, and approximate methods. Second-order analysis, stability, and matrix methods are also covered, and modern structural analysis software is introduced. (Sp)

CEES 5673 Colloid and Surface Science 3 Credit Hours
(Crosslisted with CH E 5673) Prerequisite: Civil Engineering, Environmental Engineering, or Environmental Science Graduate standing or permission of instructor. Capillarity, surface thermodynamics, adsorption from vapor and liquid phases, contact angles, micelle formation, solubilization, emulsions and foams. Applications to be discussed include detergency, enhanced oil recovery and adsorption for pollution control. (Irreg.)

CEES 5683 Dynamics of Structures 3 Credit Hours
Prerequisite: Graduate standing, CEES 3263, and CEES 3413. Topics covered include free vibration, forced vibration, and transient response of structures having one, multiple or infinite number of degrees-of-freedom; structural damping effects; numerical solution techniques; Lagrange's equation of motion; and Rayleigh-Ritz method. General matrix formulation for multiple degrees-of-freedom and modal coordinate transformation. Introduction to earthquake engineering concepts. (F)

CEES 5693 Structural Design of Pavements 3 Credit Hours
Prerequisites: CEES 3363, 3361 and 3883. Effect of load and climate on the design of rigid and flexible pavements and interaction of pavement components. (Irreg.)

CEES 5713 Structural Design - Masonry 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. A course for students who desire to learn how to design structures using a composite material such as masonry. From its historical use to the modern design involving reinforced masonry, the student will become familiar with the material properties, the different structural elements and their role in transferring horizontal and vertical loads. Code provisions will be reviewed throughout the course. (Sp)

CEES 5723 Design of RC Structures with Fiber Reinforced Polymers 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. This class will be focused on understanding behavior of Fiber Reinforced Polymer (FRP) materials; the design of reinforced concrete structures using FRP reinforcement; the strengthening of existing structures using FRP materials. (F)

CEES 5733 Hydroclimatology 3 Credit Hours
(Crosslisted with METR 5733) Prerequisite: Graduate standing or permission of instructor. Theory and concept of hydroclimatology across atmospheric science and hydrology. An in-depth study of the local to global climate of precipitation with specific foci on drought, pluvials, and how they vary in a changing climate system. Data analysis and computational methods for hydroclimatology. Basic level of scientific programming is helpful but not mandatory. (Su)

CEES 5763 Introduction to Finite Element Method 3 Credit Hours
(Crosslisted with AME 5763) Prerequisite: graduate standing. Weighted residual and variational approaches. Finite element formulation for rod, truss and beam elements; plane stress and plane strain problem; axi-symmetric and three-dimensional analysis; isoparametric elements; conforming and nonconforming plate and shell elements. (Sp)

CEES 5773 Structural Design--Steel II 3 Credit Hours
Prerequisite: CEES 3663. Advanced structural steel design including steel deck diaphragms, column and beam bracing, composite beam design, rigid frame design, torsional member design, plate girder design, and design of building connections. (F or Sp)

CEES 5783 Structural Design--Concrete II 3 Credit Hours
Prerequisite: CEES 3673. Advanced reinforced concrete behavior and design including limit design, anchorage slender columns, truss models for shear and torsion on beams, two-way and flat slabs, and the art of detailing. (F or Sp)

CEES 5793 Design of Prestressed Concrete Structures 3 Credit Hours
Prerequisite: CEES 3673. Design procedures for pretensioned and post-tensioned concrete structures, with emphasis on the behavior of prestressed concrete. Topics include methods of analysis, time dependent effects, fabrication and construction procedures, connections, highway bridges, frames, composite construction, continuous structures, and anchorage zone detailing. (Irreg.)

CEES 5813 Water Treatment, Reuse, and Health Impacts 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. An introduction to water quality applications and the health impacts of water and wastewater. The course covers the basic principles of public health epidemiology and water-related diseases. Conventional and advanced water treatment methods are presented, along with various types of potable and non-potable water reuse to supplement public water supply in times of water stress. (Sp)

CEES 5833 Ground Water Quality Protection 3 Credit Hours
Prerequisite: graduate standing or permission. Introduction to ground water quality protection. Covers sources of ground water, ground water hydrology, ground water information sources, ground water pollution sources, subsurface transport and fate processes and monitoring of ground water systems. (F)

CEES 5843 Hydrology 3 Credit Hours
(Slashlisted with CEES 4843) Prerequisite: Graduate standing or permission of instructor. Hydrology is the study of water across the globe. This is an applied course on hydrology dealing with environmental water problems; principles of hydrologic systems, their structure and components; and methods of analysis and their application to various purposes of water resources planning and development. No student may earn credit for both 4843 and 5843. (Sp)

CEES 5853 Groundwater and Seepage 3 Credit Hours
Prerequisite: graduate standing in civil engineering, environmental engineering, environmental science, geology or permission of instructor. An applied course dealing with properties of aquifers, modeling of groundwater flow, groundwater hydrology and its interrelation with surface water, well hydraulics, pumping tests and safe yield of aquifers. (F)

CEES 5873 Water Quality Management 3 Credit Hours
Prerequisite: MATH 3113, and graduate standing, or instructor permission. Water quality in lakes, rivers, estuaries; chemical, physical and biological aspects of marine and fresh waters; waste assimilation; system modeling; water quality management; waste load allocation, and engineer controls. (Sp)

CEES 5883 Environmental Modeling 3 Credit Hours
Prerequisite: MATH 3113, graduate standing or instructor permission. Introduction to theoretical and practical issues of computer-based environmental modeling. Covers problem formulation, implementation, and application. Topical areas include conceptualizing problems, conservation laws, partial differential equations, numerical methods, and applications ranging from coastal hydrodynamics to contaminant transport. Emphasis on understanding the model process rather than using "canned" models. (F)

CEES 5903 Remote Sensing Hydrology 3 Credit Hours
Prerequisite: senior standing, or graduate standing, or permission of instructor. Overview of various orbital satellite platforms/sensors and introduces advances in remote sensing hydrology from space-borne observations, state-of-the-art retrieval algorithms for hydrological variables, and ground validation strategies. Required for Hydrology minors. (Sp)

CEES 5933 Climate Change and Water Sustainability 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. This seminar course is for students who wish to understand the Earth's climate variability and water sustainability. In the context of an integrated Earth climate system, the course provides an overview of global water resources, impacts of climate change on various systems, and recommends practical responses to mitigate climate change. (F)

CEES 5960 Directed Readings 1-3 Credit Hours
1 to 3 hours. Prerequisite: graduate standing and permission of department. May be repeated; maximum credit twelve hours. Directed readings and/or literature reviews under the direction of a faculty member. (F, Sp, Su)

CEES 5963 Water Security 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. This course defines water security as existing at the water quantity-quality-equity nexus, looks at historical examples of water insecurity, discusses major water security challenges (e.g., natural disasters, global warming, the water-food-energy nexus, urbanization, transboundary issues) as well as responses to these challenges (e.g., water resilience plans, LID, desalination/reuse technologies, developing a water ethic) and evaluates pioneering water security initiatives. (Sp)

CEES 5970 Special Topics/Seminar 1-3 Credit Hours
1 to 3 hours. Prerequisite: Graduate standing or permission of instructor. May be repeated; maximum credit nine hours. Special topics or seminar course for content not currently offered in regularly scheduled courses. May include library and/or laboratory research and field projects. (Irreg.)

CEES 5973 Fundamental Hydrology 3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. A science-based course for students who desire to be water managers, environmental scientists, or policy makers. The course provides a quantitative introduction to atmospheric, surface, and subsurface hydrology. Modules present the storage and movement of water between the environmental compartments, the effect of human activities on the natural water cycle, and the threats to and protection of water security. (Sp)

CEES 5980 Research for Master's Thesis 2-9 Credit Hours
Variable enrollment, two to nine hours; maximum credit applicable toward degree, four hours. (F, Sp, Su)

CEES 5982 CEES Non-Thesis Project 2 Credit Hours
Prerequisite: graduate standing and instructor permission. This is for all CEES non-thesis students to take as their final project for their non-thesis defense. Each student with their faculty advisor will determine what the project will cover. Each student will be required to develop an oral presentation about his/her written project. (F, Sp, Su)

CEES 5990 Independent Study 1-3 Credit Hours
1 to 3 hours. Prerequisite: Graduate standing and permission of instructor. May be repeated; maximum credit nine hours. Contracted independent study for a topic not currently offered in regularly scheduled courses. Independent study may include library and/or laboratory research and field projects. (Irreg.)

CEES 6663 Advanced Finite Element Methods 3 Credit Hours
(Crosslisted with AME 6663) Prerequisite: 5763. Selected topics such as: nonlinear material problems, plasticity, creep (visco-plasticity), fracture, etc.; geometrically nonlinear problems, large displacement and structural stability; dynamic problems and analytical solution procedures; soil-structure interactions; application of finite element method to fluid and heat transfer problem. (Irreg.)

CEES 6960 Directed Readings 1-3 Credit Hours
1 to 3 hours. Prerequisite: graduate standing or permission of instructor. May be repeated; maximum credit six hours. Directed readings and/or literature review under the direction of a faculty member. (Irreg.)

CEES 6970 Special Topics/Seminar 1-3 Credit Hours
1 to 3 hours. Prerequisite: graduate standing or permission of instructor. May be repeated; maximum credit 12 hours. Special topics or seminar course for content not currently offered in regularly scheduled courses. May include library and/or research and field projects. (Irreg.)

CEES 6980 Research for Doctoral Dissertation 2-16 Credit Hours
2 to 16 hours. Prerequisites: Graduate standing and permission of instructor; may be repeated. Directed research culminating in the completion of the doctoral dissertation. (F, Sp, Su)

CEES 6990 Independent Study 1-3 Credit Hours
1 to 3 hours. Prerequisite: Graduate standing and permission of instructor. May be repeated; maximum credit nine hours. Contracted independent study for a topic not currently offered in regularly scheduled courses. Independent study may include library and/or laboratory research and field projects. (Irreg.)

Faculty

Last Name	First/Middle Name	Middle init.	OU Service start	Title(s), date(s) appointed	Degrees Earned, Schools, Dates Completed
Bounds	Tommy	D.	2023	ASSISTANT PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2023	PhD, Univ. of Oklahoma 2020; MS, Univ. of Oklahoma 2013; BS, Univ. of Oklahoma 2012
Bui	Ngoc		2020	ASSISTANT PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2020; ASSISTANT PROFESSOR OF CHEMICAL, BIOLOGICAL AND MATERIALS ENGINEERING, 2020	PhD, Univ. of Connecticut, 2014; MS, Chonnam National Univ., 2007; BS, HoChiMinh City Univ. of Technology, 2005
Butler	Elizabeth		1999	PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2010	PhD, Univ of Michigan, 1998; MS, Univ of Maryland, 1991; BS, Univ of Maryland, 1985
Cerato	Amy		2005	ROBERT GLENN RAPP FOUNDATION PRESIDENTIAL PROFESSOR, 2009; PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2016	PhD, Univ of Massachusetts, 2005; MS, Univ of Massachusetts, 2004; MS, Univ of Massachusetts, 2001; BS, Lafayette College, 1999
Dresback	Kendra	M	1997	ASSISTANT PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2023, RESEARCH ASSISTANT PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2008; ADJUNCT ASSISTANT PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2017	PhD, Univ of Oklahoma, 2005; MS, Univ of Oklahoma, 1999; BS, Univ of Oklahoma, 1997
Floyd	Royce		2012	ASSOCIATE PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2018	PhD, Univ of Arkansas, 2012; BS, Univ of Arkansas, 2008
Han	Lori	A.	2023	ASSISTANT PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2023	PhD, Univ. of Minnesota, 2018; MS, Univ. of Minnesota, 2012; BS, Univ. of Minnesota 2010
Harvey	Philip	S	2014	ASSOCIATE PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2020	PhD, Duke Univ, 2013; MS, Duke Univ, 2012; BS, Duke Univ, 2009
Hatami	Kianoosh		2004	PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2017; PRESIDENT'S ASSOCIATES PRESIDENTIAL PROFESSOR, 2018	PhD, McMaster Univ, 1997; MS, Univ of Iran, 1991; BS, Univ of Iran, 1987

Hong	Yang		2007	CIMMS FELLOW, 2007; ADJUNCT ASSOCIATE PROFESSOR OF METEOROLOGY, 2011; PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2012; VPR PRESIDENTIAL RESEARCH PROFESSOR, 2014; DIRECTOR, INSTITUTE FOR HYDROMETEOROLOG' AND WATER ENGINEERING, 2017	PhD, Univ of Arizona, 2003; MS, Peking Univ, 1999; BS, Peking Univ, 1996
Kibbey	Tohren	C	1999	PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2010; LLOYD G. AND JOYCE AUSTIN PRESIDENTIAL PROFESSOR, 2016	PhD, Univ of Michigan, 1997; MSE, Univ of Michigan, 1993; BSE, Univ of Michigan, 1991
Kirstetter	Pierre-Emmanuel		2019	ASSOCIATE PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2019; ASSOCIATE PROFESSOR OF METEOROLOGY, 2019	PhD, Joseph Fourier Universty, 2008; MS, Joseph Fourier University, 2005; MS Ecole Nationale Superieure d'Hydraulique et de Mecanique of Grenoble, 2004
Knox	Robert		1986	SAMUEL ROBERTS NOBLE PRESIDENTIAL PROFESSOR, 1998; PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2001; TED A. KRITIKOS PROFESSOR OF CIVIL ENGINEERING, 2006	PhD, Univ of Oklahoma, 1983; MS, Univ of Oklahoma, 1979; BS, Univ of Oklahoma, 1978
Kolar	Randall		1995	LLOYD G. AND JOYCE AUSTIN PRESIDENTIAL PROFESSOR, 2008; DAVID ROSS BOYD PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2014; SUN OIL COMPANY CHAIR IN CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2023	PhD, Univ of Notre Dame, 1992; BS, Univ of Idaho, 1983
Kyprioti	Aikaterini		2022	ASSISTANT PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2022	PhD, Univ of Notre Dame, 2022; MS, Univ of Notre Dame, 2022; MS, Aristotle Univ of Thessaloniki, 2016; BS, Aristotle Univ of Thessaloniki, 2014
Miller	Gerald	A	1994	PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2007; ROBERT GLENN RAPP FOUNDATION PRESIDENTIAL PROFESSOR, 2013	PhD, Univ of Massachusetts, 1994; MS, Clarkson, 1989; BS, Clarkson, 1987
Muraleetharan	Kanthasamy		1994	PRESIDENT'S ASSOCIATES PRESIDENTIAL PROFESSOR, 2005; DAVID ROSS BOYD PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2009; KIMMELL-BERNARD CHAIR IN ENGINEERING, 2010	PhD, Univ of California Davis, 1990; MS, Univ of California Davis, 1987; BS, Sri Lanka Univ, 1983
Nairn	Robert		1997	PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2012; SAM K. VIERSON FAMILY FOUNDATION PRESIDENTIAL PROFESSOR, 2014; DAVID L. BOREN PROFESSOR, 2017; ROBERT W. HUGHES PROFESSOR IN ENGINEERING, 2022	PhD, Ohio State Univ, 1996; BS, Juniata College, 1989
Nanny	Mark	A	1996	PROFESSOR OF EARTH AND ENERGY, 2010; PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2010	PhD, Univ of Illinois, 1994; MS, Univ of Illinois, 1989; BS, Wayne State, 1986
Pei	Jinsong		2002	ASSOCIATE PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2008	PhD, Columbia Univ, 2001; M Engr, Nanyang Tech Univ, 1997; B Engr, Xi'an Jiaotong Univ, 1989
Sadri	Arif		2022	ASSISTANT PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2022	Phd, Purdue Univ, 2016; MS, Purdue Univ, 2012; BS, Bangladesh Univ of Engr & Tech, 2011
Strevett	Keith		1995	DAVID ROSS BOYD PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2018	PhD, Univ of Connecticut, 1995; BS, Michigan State Univ, 1992; BS, Michigan State Univ, 1992
Vemuganti	Shreya		2021	ASSISTANT PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2021	PhD, Univ of New Mexico, 2021; MS, Univ of New Mexico, 2016; BE, Osmania Univ, 2014
Vogel	Jason	R	2017	PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2019; DIRECTOR, OKLAHOMA WATER SURVEY, 2017	PhD, Oklahoma State Univ, 2001; MS, Texas A&M Univ, 1997; BS, Univ of Nebraska, 1995

Volz	Jeffery	2013	ASSOCIATE PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2013	PhD, Pennsylvania State Univ, 2008; MS, Pennsylvania State Univ, 1987; BS, Pennsylvania State Univ, 1985
Yang	Tiantian	2018	ASSISTANT PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2018	PhD, Univ of California Irvine, 2015; MS, Univ of California, 2010; BS, Tsinghua Univ, 2009
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