CIVIL AND ENVIRONMENTAL ENGINEERING (CEE)

Degrees Offered: Ph.D., M.Eng., M.S.

This program is offered in Durham.

The Department of Civil and Environmental Engineering offers the master of engineering degree in civil engineering, the master of science degree in civil engineering, and a Ph.D. degree in civil engineering with the following areas of specialization: structural, materials, geotechnical, water resources, and environmental engineering. Interested applicants are encouraged to visit the department website for information on current research in the department and to contact faculty members in their area of interest directly. The department website has information on program requirements and frequently asked questions. Applicants with questions not answered by the department or graduate school website should write to the graduate program coordinator for specific information.

Admission Requirements
An applicant must have completed a baccalaureate science degree in engineering, mathematics, or science at an accredited college or university. If coursework or laboratory experience is deficient, an admitted student will be required to fulfill, without graduate credit, all undergraduate prerequisites for graduate courses. In some cases, the student's adviser may require additional undergraduate courses in order to achieve a well-integrated program of study. Applicants must submit current scores (within five years) from the general test of the GRE, unless waived by the graduate coordinator (for current UNH CEE undergraduates CIVE - civil engineering or ENVE - environmental engineering).

For more information on the Civil and Environmental Engineering Graduate Program, please email CEE.Graduate@unh.edu.

https://ceps.unh.edu/cee/graduate-programs

Courses

Civil and Environmental Engineering (CEE)

CEE 800 - Building Information Modeling
Credits: 3
Building Information Modeling (BIM) is the process of generating and managing project data during its life cycle by integrating 3D multidisciplinary drawings with dynamic scheduling and visualization. BIM provides a digital representation of project data to facilitate the exchange of information beyond the standard two dimensional plan set. This course introduces students to the fundamentals of model creation, scheduling, material take-offs, visualizations, and animations that improve the communication of information to potential clients. Prereq: AUTOCAD Experience or by permission.
Equivalent(s): CIE 880

CEE 804 - Transportation Engineering and Planning
Credits: 3
Fundamental relationships of traffic speed, density, and flow applied to public and private modes of transport. Principles of demand forecasting and urban systems planning. Prereq: permission.
Equivalent(s): CIE 854

CEE 805 - Introduction to Sustainable Engineering
Credits: 3
Course begins with exploration of the precept that we live in, and must design engineering works for, a world with a finite supply of natural resources and with limited life support capacity. Tools for sustainability engineering are the major focus of the course, which include life cycle, analysis and life cycle impact analysis, the metrics and mass and energy flow analyses used in the field of industrial ecology, and environmental management systems.
Equivalent(s): CIE 851

CEE 806 - Environmental Life Cycle Assessment
Credits: 3
This course teaches knowledge and hands-on skills in conducting environmental life cycle assessment (LCA), which is a widely used technique by industries, academics, and governments. Students will learn to use popular LCA software (e.g., SimaPro), apply proper LCA techniques, critically analyze LCA results, and provide client-oriented suggestions during this course. Class time is primarily devoted to a combination of lectures and computer labs.
Equivalent(s): CIE 881

CEE 819 - Green Building Design
Credits: 3
This course gives an overview of green designs and sustainable practices in building construction. We cover technical topics and requirements of a nationally recognized rating system (LEED), with a specific focus on Green Building Design and Construction. Students are introduced to basic building designs and systems related to sustainability. Additionally, they learn about green design topics such as site plans, water and energy efficiency, material and resources usage, environmental quality and renewable energy source. As an outcome of the course, students are able to assess and incorporate green technologies and designs into building projects. They are prepared to contribute in building projects that target LEED certifications. Students are also capable to engage in green practices within their existing built environments.
Equivalent(s): CIE 881

Programs

- Civil and Environmental Engineering (Ph.D.) (http://catalog.unh.edu/graduate/programs-study/civil-environmental-engineering/civil-environmental-engineering-phd)
- Civil and Environmental Engineering (M.Eng.) (http://catalog.unh.edu/graduate/programs-study/civil-environmental-engineering/civil-environmental-engineering-meng)
- Civil and Environmental Engineering (M.S.) (http://catalog.unh.edu/graduate/programs-study/civil-environmental-engineering/civil-environmental-engineering-ms)
CEE 820 - Solid and Hazardous Waste Engineering
Credits: 3
A thorough examination of the problems which exist in hazardous
and solid waste management will be presented in terms of the current
regulations and engineering approaches used to develop solutions.
Topics will include risk-based decision making, transport and fate of
contaminants, and the fundamental physical, chemical and biological
concepts which make up the basis for technological solutions to these
waste management problems. Case studies will be used throughout the
course to highlight key concepts and provide real-world examples.
Equivalent(s): CIE 842

CEE 821 - Environmental Sampling and Analysis
Credits: 4
Theory of analytical and sampling techniques used in environmental
ingeniering. Topics include potentiometry, spectroscopy,
chromatography, automated analysis, quality control, sampling design,
and collection methods. Methods discussed in lecture are demonstrated
in labs.

CEE 822 - Introduction to Marine Pollution and Control
Credits: 4
Introduction to the sources, effects, and control of pollutants in the
marine environment. Dynamic and kinetic modeling; ocean disposal of
on-shore wastes, shipboard wastes, solid wastes, dredge spoils, and
radioactive wastes; and oil spills. Prereq: CEE 620 or permission.
Equivalent(s): CIE 847

CEE 823 - Environmental Water Chemistry
Credits: 4
Emphasizes the use of chemical equilibrium principles and theory,
calculations, and applications of ionic equilibrium stresses. Topics
include thermodynamics, kinetics, acid/base, complexation, precipitation/
dissolution, and redox equilibria. Computer equilibrium modeling is
presented. Prereq: general chemistry or equivalent.
Equivalent(s): CIE 849

CEE 824 - Environmental Engineering Microbiology
Credits: 4
Concepts of environmental engineering microbiology including microbial
metabolism, growth kinetics, bioremediation applications, mass transfer
kinetics and effects of environmental parameters. Coursework includes
reading and discussion of the microbial literature. Laboratories cover
microbiological monitoring and biological treatment experiments. Prereq:
CEE 620 or permission. Lab.
Equivalent(s): CIE 856

CEE 830 - Public Health Engineering for Rural and Developing
Communities
Credits: 3
The design principles are to impart to the student specific information
that can be used to design public health control facilities such as small
water treatment systems and on-site wastewater disposal systems. The
engineering control methods taught are particularly applicable to rural
areas and developing countries. Prereq: permission.
Equivalent(s): CIE 840

CEE 831 - Advanced Water Treatment Design
Credits: 4
Selection, design, and evaluation of advanced unit processes employed
in the treatment of water, wastewater, and hazardous wastes. Emphasis
given on treatment schemes based on experimental laboratory or pilot
studies.

CEE 832 - Solid and Hazardous Waste Design
Credits: 4
Selection, design, and evaluation of unit processes employed in the
treatment of solid wastes and hazardous wastes will be studied. Topics
include design of materials recovery facilities, landfills, waste-to-energy
facilities and hazardous waste site remedial technologies. A group
term project taken from a real-world project will be required. An oral
presentation by the group and preparation of a final written engineering
report including alternative evaluation, permits, scheduling and economic
analysis will be required from each group. Prereq: CEE 720. permission.
Equivalent(s): CIE 848

CEE 833 - Public Infrastructure Asset Management
Credits: 4
The course provides a thorough examination of the growing engineering
field of Public Infrastructure Assess Management (IAM). The course
enables the student to design an IAM system. It touches upon all types
of public infrastructure with a particular focus on water infrastructure
for the semester design project. Students build upon their engineering
economics and project engineering skills and use simple IAM software
along with GIS applications. Practice leaders from the industry provide
guest lectures throughout the semester. A focus on triple bottom line or
the Societal, Environmental and Economic aspects of IAM are included.
The format is a modified team base design learning experience providing
practice in processing of technical lecture material, personal performance
evaluation (frequent quizzes) and team based performance evaluation.
Student groups will present their design to the class and provide a written
engineering report. Pre- or Coreq: CEE 502 and CEE 620.
Equivalent(s): CIE 839

CEE 835 - Properties and Production of Concrete
Credits: 3
Basic properties of hydraulic cements and mineral aggregates and
their interactions in the properties of plastic and hardened concrete;
modifications through admixtures; production handling and placement
problems; specifications; quality control and acceptance testing;
lightweight, heavyweight, and other special concretes. Prereq: CEE 635 or
permission.
Equivalent(s): CIE 822

CEE 836 - Asphalt Mixtures and Construction
Credits: 3
Specification of asphalt cements, aggregates and proportioning of
mixture constituents for paving applications. Asphalt mixture design
methods, production, construction, and quality control are discussed.
Current and new material production and construction technologies are
introduced. Prereq: CEE 635 or permission.
Equivalent(s): CIE 823

CEE 837 - Pavement Rehabilitation, Maintenance, and Management
Credits: 3
This course covers the technical and financial strategies to extend the
life of highway and airfield pavements. The course topics will include:
Assessment of pavement functional and structural condition, suitability
of pavement maintenance and repair techniques, use of pavement
preservation processes, and application of asset management to extend
the life of pavement infrastructure.

CEE 848 - Pavement Design Project
Credits: 1
Semester long design project accompanying CEE 849 Pavement Design
Analysis. The design project will require weekly meetings (either online
or in person) for the duration of the semester. Meeting times will be
arranged based on student schedules.
Co-requisite: CEE 849
CEE 849 - Pavement Design Analysis
Credits: 3
Introduction to flexible and rigid pavement design and analysis for highways and airports. Examines design inputs, materials, analysis methods, design tools, and maintenance treatments. Prereq: CEE 635 and CEE 665.
Equivalent(s): CIE 821

CEE 850 - Echohydrology
Credits: 3
Introduction to echohydrological concepts in terrestrial and riverine systems. Topics include the historical practices, resources management impacts, hydrologic variability and the relationships among water and ecology, vegetation, biology, geomorphology, and water quality. Prereq: CEE 854 or ESCI 805; or permission.
Equivalent(s): CIE 850

CEE 851 - Open Channel Flow
Credits: 3
Energy and momentum principles in open channel flow; flow resistance; channel controls and transitions; unsteady flow concepts and dam failure studies. Modeling with HEC programs. Prereq: CEE 650 or permission.
Equivalent(s): CIE 841

CEE 854 - Engineering Hydrology
Credits: 3
Hydrologic cycle, probability theory related to hydrology and the design of water resources structures, water flow, flood discharge prediction, hydrograph development, hydraulic and hydrologic river routing, reservoir routing, theory of storage, reservoir operations, hydropower development, modeling of watershed hydrology with program HEC-1, HEC-HMS, multipurpose projects.
Equivalent(s): CIE 845

CEE 855 - Design of Pressurized Water Transmission Systems
Credits: 4
Theory developed for individual components to large complex systems. Analysis and designs of components and systems. Topics include steady and unsteady closed conduit flow, valves and meters, pump requirements, pump selection, system planning and layout, water hammer, and system operation and maintenance. Pressure system modeling with program EPANET. Prereq: Fluid mechanics, or permission.
Equivalent(s): CIE 855

CEE 857 - Coastal Engineering and Processes
Credits: 3
Introduction to small amplitude and finite amplitude wave theories. Wave forecasting by significant wave and wave spectrum method. Coastal processes and shoreline protection. Wave forces and wave-structure interaction. Design of coastal structures. Introduction to mathematical and physical modeling. Prereq: CEE 650 or permission. (Also offered as ME 857 and OE 857.)
Equivalent(s): CIE 857, ME 857, OE 857

CEE 858 - Stormwater Management Designs
Credits: 3
Historic review of stormwater management leading up to the current regulatory framework. Overview of stormwater management strategies, strategy selection and the targeting of specific contaminants, contaminant removal efficiencies, construction and site selection, and system maintenance. Hydrologic concepts including watershed and storm characteristics, design hydrology (peak flows, storm and treatment volumes), hydrograph routing, and critical review of hydrology and drainage reports. Design and sizing of treatment systems including conventional BMPs, low impact development, and manufactured devices. Rainfall runoff calculations with US SCS TR55 model. Prereq: Fluid mechanics or permission.
Equivalent(s): CIE 858

CEE 859 - Stream Restoration
Credits: 4
Explores the assessment, planning, design, engineering, and monitoring of stream and watershed practices intended to protect and restore the quality and quantity of flowing and surface waters and stream corridors. Lecture material covers hydrology, geomorphology, and ecosystems, with the intent of understanding the variables associated with stream systems and their interplay. Students measure field variables and then are challenged with actual designs. Examples of stream restoration issues include in-stream flow, dam removal, induced recharge, improvements to fish habitat, and channel stabilization. Prereq: CEE 650.
Equivalent(s): CIE 859

CEE 865 - Engineering Behavior of Soils
Credits: 4
Equivalent(s): CIE 867

CEE 866 - Introduction to Geotechnical Earthquake Engineering
Credits: 3
Overview of earthquake source mechanisms; magnitude and intensity; seismicity of the U.S.A. Dynamics of simple structures; response spectra. Selection of design parameters; source, magnitude, input records. Measurement of dynamic characteristics of soils; site response, liquefaction, and ground deformation. Prereq: CEE 878 or permission.
Equivalent(s): CIE 862

CEE 867 - Geological Engineering
Credits: 3
Equivalent(s): CIE 863
CEE 868 - Geo-Environmental Engineering
Credits: 3
Soil composition and structure; hydrogeology; attenuation and contaminant transport; containment design including landfills, geosynthetics for liners and covers, leachate collection systems, vertical cutoff walls, and stability analyses; geo-environmental site characterization and investigation using geotechnical and geophysical methods; ground water, soil and gas monitoring, and sampling; remediation including in-situ and ex-situ techniques and treatment methods. Prereq: CEE 665 or permission.
Equivalent(s): CIE 866

CEE 878 - Foundation Design I
Credits: 4
Foundation design based on subsurface investigation and characterization using current methods of laboratory and in situ testing. Use of consolidation theory and bearing capacity theory for the design of shallow foundations, including footings and rafts. Basic design of pile foundations. Earth pressure theory applied to design of retaining walls. Slope stability theory and applications. Prereq: CEE 665 or permission.
Equivalent(s): CIE 860

CEE 879 - Foundation Design II
Credits: 3
Advanced pile and pier design under vertical and lateral loads. Slope stability by circular and noncircular arc methods. Design of flexible bulkhead walls and mechanically stabilized walls. Excavation and dewatering. Soil and site improvement. Prereq: CEE 878 or permission.
Equivalent(s): CIE 861

CEE 880 - Matrix Structural Analysis and Modeling
Credits: 3
Modeling and analysis of determinate and indeterminate structures by matrix computer methods. Creation of matrix elements using compatibility, equilibrium, and consecutive relationships. Plane trusses, beams, frames, and space trusses. Prereq: CEE 680 or permission.
Equivalent(s): CIE 883

CEE 881 - Dynamics of Structures
Credits: 3
Equivalent(s): CIE 887

CEE 882 - Structural Design in Masonry
Credits: 3
Introduces the design of reinforced masonry structural members by the stress and strength method and considering deflection and other serviceability performance criteria. Includes development of wind and seismic load, curtain wall, shear wall, lintels and columns. Prereq: CIE 635, 680; or permission.
Equivalent(s): CIE 876

CEE 891 - Reinforced Concrete Design
Credits: 4
Introduction to the design of reinforced concrete structural members by the strength method and considering deflection performance. Includes loads, approximate analysis, slabs, beams, and columns. Prereq: CEE 635, 680; or permission.
Equivalent(s): CIE 874

CEE 892 - Pre-stressed Concrete
Credits: 3
Analysis and design of pre-stressed and post-tensioned concrete sections in flexure and shear. Strength, deflection, and losses in flexural members. Optimization of section and pre-stressing force selection. Prereq: CEE 891 or permission.
Equivalent(s): CIE 891

CEE 893 - Structural Design in Steel
Credits: 4
Introduction to steel member design, including horizontal and vertical members for design and analysis of buildings. Examines design inputs, material choice, analysis methods and design and construction methodologies. Prereq: CEE 635 and CEE 680.
Equivalent(s): CIE 893

CEE 894 - LRFD Bridge Design
Credits: 3
AASHTO LRFD Bridge Design Specifications using SI units. Design objectives, loads, load case analysis and selection, load distributions, static analysis, and design for axial loads, flexure, and shear. Design of slender columns, composite beams, and plate girders. Prereq: senior-level structural design course or permission.
Equivalent(s): CIE 892

CEE 895 - Independent Study
Credits: 1-4
A limited number of qualified graduate students will be permitted to pursue independent studies under faculty guidance. May be repeated.
Equivalent(s): CIE 895

CEE 896 - Special Topics
Credits: 1-4
Advanced or specialized topics not normally covered in regular course offerings. May be repeated, but not in duplicate areas. Prereq: permission. Special Fee.
Equivalent(s): CIE 896

CEE 897 - Masters Student Seminar
Credits: 1
Topics of interest to graduate students and staff; reports of research ideas, progress, and results; lectures by outside speakers. Continuing course: instructor may assign IA grade (continuous grading) at the end of one semester. Course held simultaneously with CEE 997.
Repeat Rule: May be repeated for a maximum of 2 credits.
Equivalent(s): CIE 900

CEE 898 - Master's Project Paper
Credits: 3
Concluding project paper required of Master's level students who utilize the non-thesis option. Prereq: permission. CEE majors only.
Equivalent(s): CIE 888

CEE 899 - Master's Thesis
Credits: 1-6
May be repeated up to maximum of 6 credits. Cr/F.
Repeat Rule: May be repeated for a maximum of 6 credits.
Equivalent(s): CIE 899
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
<th>Equivalent(s)</th>
<th>Notes</th>
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<tbody>
<tr>
<td>CEE 934</td>
<td>Advanced Bioenvironmental Engineering Design</td>
<td>4</td>
<td>Theoretical and experimental examination of the fundamental parameters used in selection, design, and operation of biological treatment processes for waters, wastewaters, and hazardous wastes. Topics include design and evaluation of aerobic and anaerobic processes, suspended and fixed-film processes, and advanced biological water and wastewater treatment processes. Prereq: environmental engineering microbiology course, or permission.</td>
<td>CIE 946</td>
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<tr>
<td>CEE 936</td>
<td>Advanced Asphalt Materials</td>
<td>3</td>
<td>Examination of chemical composition of asphalt cements, current technologies for modification, and inclusion of recycled materials to meet desired physical properties. Advanced characterization of asphalt materials, modelling, advanced mixture design tools. Prereq: CEE 836 or permission.</td>
<td>CEE 923</td>
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<tr>
<td>CEE 949</td>
<td>Advanced Pavement Design and Analysis</td>
<td>3</td>
<td>Advanced flexible pavement design and analysis including rehabilitation/overlay design. Includes development of mechanistic-empirical methods, advanced pavement structural analysis, and advanced material characterization. Prereq: CEE 893 or permission.</td>
<td>CEE 921</td>
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<tr>
<td>CEE 951</td>
<td>Statistical Hydrology</td>
<td>3</td>
<td>Course examines statistical methods used to address water resources planning and management problems involving uncertainty objectives and hydrologic inputs. Application of statistics and probability to uncertainty in the description, measurement, and analysis of hydrologic variables and processes, including extreme events, error models, simulation, and sampling. Prereq: A hydrology course, basic statistics, or permission.</td>
<td>CIE 951</td>
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<tr>
<td>CEE 953</td>
<td>Advanced Groundwater Topics</td>
<td>3</td>
<td>Review of Darcy’s Law for confined and unconfined aquifers, linearization techniques, draw down computations under varying boundary conditions, solutions to the inverse problem, drainage theory, recharge theory, two-phase flow, succession of steady states modeling, and borehole geophysics. Prereq: ESCI 810.</td>
<td>CIE 945</td>
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<tr>
<td>CEE 955</td>
<td>Advanced Surface Water Hydrology</td>
<td>3</td>
<td>Occurrence and distribution of water by natural processes including atmospheric thermodynamics, precipitation, runoff, infiltration, water losses, flood routing and catchment characteristics, analysis, and methods of runoff prediction. This course builds from a foundation of fluid mechanics in the environment to address essentials of modern hydrology. An emphasis is placed on fundamental concepts, first principles, and the scientific basis of approximations. Prereq: Calculus and Fluid Mechanics.</td>
<td>CIE 955</td>
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<tr>
<td>CEE 959</td>
<td>Advanced Stream Restoration Topics</td>
<td>3</td>
<td>Course focuses on: stream crossing analysis and design, dam removal, and designs for aquatic species passage. Pre- or Coreq: CEE 759 or equivalent.</td>
<td>CIE 959</td>
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<tr>
<td>CEE 965</td>
<td>Advanced Soil Mechanics</td>
<td>4</td>
<td>Numerical and physical modeling of the mechanical behavior of soils. Cam-clay and other predictive models. Laboratory studies of mechanical behavior and measurement of input parameters to soil models. Prediction of soil behavior based on laboratory results. Applications to numerical modeling of soil masses. Prereq: soil mechanics, and foundation design, or permission.</td>
<td>CIE 960</td>
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<tr>
<td>CEE 966</td>
<td>Laboratory Geotechnical Testing</td>
<td>4</td>
<td>Introduction to geotechnical modeling, soil constitutive modeling, introduction to numerical modeling and applications, physical modeling, centrifuge modeling, and theoretical modeling. Prereq: CEE 665, CEE 778, or equivalent, or permission.</td>
<td>CIE 962</td>
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<tr>
<td>CEE 967</td>
<td>In Situ Geotechnical Testing</td>
<td>3</td>
<td>In situ geotechnical testing methods for site characterization; theory and practice. Geotechnical testing methods include the piezocone, the pressuremeter, the flat plate dilatometer, the field vane, and the standard penetration test. Includes sampling techniques, geophysical exploration, and recent innovations in site and soil characterization. Prereq: CEE 965 or equivalent.</td>
<td>CIE 961</td>
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<td>CEE 968</td>
<td>Soil-Structure-Interaction</td>
<td>3</td>
<td>Introduction to soil-structure-interaction, elastic and plastic analyses, serviceability calculations, relative foundation stiffness, Pile-soil-interaction, flexible retaining walls, tunnel lining, bridge abutments, dynamic soil-structure-interaction, case studies, and modeling techniques. Prereq: CEE 665 and 778; or permission.</td>
<td>CIE 963</td>
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<tr>
<td>CEE 969</td>
<td>Nonlinear Structural Analysis</td>
<td>3</td>
<td>This course deals with the theory, implementation, and application of methods of geometric and material nonlinear analysis. Geometric nonlinear analysis entails solving for equilibrium on the deformed configuration on the structure. Material nonlinear analysis involves inelastic behavior of materials. Practical design implications include problems of structural stability and inelastic static/dynamic analysis. Emphasis is on methods applied to frame structures comprised of line-type elements; however, the basic concepts also apply to general finite element methods. Prereq: CEE 780/CEE 880 or equivalent.</td>
<td>CIE 935</td>
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<tr>
<td>CEE 973</td>
<td>Advanced Structural Steel Design</td>
<td>3</td>
<td>Advanced design of structural steel elements according to the AISC Load and Resistance Factor Method as applied to advanced topics in steel design. Emphasis will be placed on theory involved in the development of the design code requirements. Course design project will expand on these topics and include experimental work as appropriate. Prereq: CEE 793/CEE 893 or permission.</td>
<td>CIE 993</td>
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<tr>
<td>CEE 993</td>
<td>Problems</td>
<td>2-4</td>
<td>The study and investigation of problems selected to meet the needs of the students.</td>
<td>CIE 995</td>
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<td>CEE 995</td>
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CEE 997 - Doctoral Student Seminar
Credits: 1
Topics of interest to graduate students, faculty, and staff; requires two presentations from doctoral students on their research ideas, progress, and results; lectures by outside speakers. Continuing course: instructor may assign IA grade (continuous grading) at the end of one semester. Course held simultaneously with CEE 897.
Equivalent(s): CIE 901

CEE 999 - Doctoral Research
Credits: 0
Cr/F.
Equivalent(s): CIE 999

Faculty

See https://ceps.unh.edu/cee/faculty-staff-directory for faculty.