

CIVIL AND ENVIRONMENTAL ENGINEERING

<http://www.uvm.edu/~cems/soe/>

OVERVIEW

Graduate programs in Civil and Environmental Engineering (CEE) that lead to the master of science and doctor of philosophy degrees are offered. The curricular and research programs emphasize engineering related to environmental and hydrological processes, sustainable transportation systems, materials, and geotechnical, geoenvironmental and structural engineering.

Research in the department addresses critical issues facing the world related to sustainability and energy; infrastructure systems; climate change, hazard mitigation and adaptation; and environmental and public health. A wide range of research methods are employed from state-of-the-art laboratory and field testing to sensing to computational modeling to artificial intelligence. Example projects include groundwater contamination modeling and remediation, environmental restoration and ecological engineering, hydrological processes, air pollution related health effects, sustainable materials, soil and structural dynamics, geo-energy, and sustainable transportation systems.

CEE graduate students can concurrently pursue certificates of graduate study in Complex Systems, Ecological Economics, and Community Resilience & Planning, among others.

DEGREES

- Civil and Environmental Engineering AMP (<http://catalogue.uvm.edu/graduate/civilenvironengineering/civilandenvironmentalengineeringamp/>)
- Civil and Environmental Engineering M.S. (<http://catalogue.uvm.edu/graduate/civilenvironengineering/civilandenvironmentalengineeringms/>)
- Civil and Environmental Engineering Ph.D. (<http://catalogue.uvm.edu/graduate/civilenvironengineering/civilandenvironmentalengineeringphd/>)

FACULTY

Aultman-Hall, Lisa M.; Professor, Department of Civil and Environmental Engineering; PHD, McMaster University
Badireddy, Appala Raju; Assistant Professor, Department of Civil and Environmental Engineering; PHD, University of Houston
Bombliès, Arne; Associate Professor, Department of Civil and Environmental Engineering; PHD, Massachusetts Institute of Technology
Dewoolkar, Mandar M; Professor, Department of Civil and Environmental Engineering; PHD, University of Colorado Boulder
Garcia, Luis; Professor, Department of Civil and Environmental Engineering; PHD, University of Colorado Boulder
Ghazanfari, Ehsan; Associate Professor, Department of Civil and Environmental Engineering; PHD, Lehigh University

Hamshaw, Scott; Research Assistant Professor, Department of Civil and Environmental Engineering; Ph.D, University of Vermont
Hernandez, Eric M.; Associate Professor, Department of Civil and Environmental Engineering; PHD, Northeastern University
Holmén, Britt A.; Professor, Department of Civil and Environmental Engineering; PHD, Massachusetts Institute of Technology

Pinder, George Francis; Professor, Department of Civil and Environmental Engineering; PHD, University of Illinois Urbana-Champaign

Rizzo, Donna Marie; Professor, Department of Civil and Environmental Engineering; PHD, University of Vermont

Rowangould, Dana; Research Assistant Professor, Department of Civil and Environmental Engineering; PHD, University of California, Davis

Scarborough, Matthew; Assistant Professor, Department of Civil and Environmental Engineering; PHD, University of Wisconsin-Madison

Tan, Ting; Associate Professor, Department of Civil and Environmental Engineering; PHD, Princeton University

Underwood, Kristen L.; Research Assistant Professor, Department of Civil and Environmental Engineering; PHD, University of Vermont

Courses

CE 201. Sustainable Eng Materials. 3 Credits.

Introduces the fundamentals of materials with a focus on sustainable engineering, including structure and bond, interatomic potential, metals, fracture, strength testing, cement chemistry, aggregates, composites, reinforced concrete, asphalt, bamboo and wood. Prerequisite: CE 100, ME 014, or Instructor permission.

CE 218. Numerical Methods for Engineer. 3 Credits.

Foundational concepts of numerical integration, numerical differentiation, and numerical approximation and solution of differential and partial differential equations of the type encountered in the analysis of engineering problems and data processing; project-based. Prerequisites: MATH 271, CS 020; MATH 122 or MATH 124. Cross-listed with: ME 218.

CE 241. Traffic Operations & Design. 3 Credits.

Advanced concepts of traffic engineering and safety; human, vehicle and environment factors; simulation and statistical analysis software; transportation design manuals; project-based. Prerequisite: CE 133.

CE 243. Transportation Demand Models. 3 Credits.

Study of specific methods used to analyze travel demand, travel behavior and network flows; process of travel demand modeling; collection, analysis and expansion of survey data and travel data; mathematical methods common to travel modeling. Prerequisite: CE 133.

CE 247. Sustain Resource Recovery Dsgn. 3 Credits.

Environmental engineering strategies to create circular economies emphasizing the role of wastes as resources. Course topics include life cycle assessment, carbon and nutrient management, materials recycling, and waste-to-energy processes. Project-based. Prerequisite: CE 151.

CE 253. Transportation & Air Quality. 3 Credits.

Air pollution sources, measurement methods, legislation, vehicle emissions formation, control and transport processes. Emphasis on emission factor and dispersion multi-scale modeling using latest modeling tools. Project-based. Prerequisites: CE 132, CE 133.

CE 254. Environmental Quantitive Anyl. 0 or 4 Credits.

Course focuses on chemical, biochemical and physical processes; diffusion, equilibria, reaction kinetics, acids/bases, colloids, air/water exchange; laboratories demonstrate standard environmental engineering techniques; project-based. Prerequisites: CHEM 032, CE 132, STAT 143.

CE 255. Phys/Chem Proc Water/Wstwater. 0 or 3 Credits.

Theory of physical/chemical processes for treating waters and wastewaters; reactor dynamics, mass transfer, adsorption, ion exchange, precipitation; project-based. Prerequisite: CE 151.

CE 256. Biol Proc Water/Wastewater Tr. 0 or 3 Credits.

Theory and application of biological processes for treating industrial and domestic wastewaters and contaminated ground water; microbiological considerations; aerobic and anaerobic processes; reactor design, in-situ bioremediation; bench-scale and pilot-scale experimentation. Prerequisite: CE 151.

CE 260. Hydrology. 3 Credits.

Theory of precipitation, run-off, infiltration, and ground water; precipitation and run-off data; and application of data for use in development of water resources. Pre/Co-requisite: CE 160.

CE 262. Advanced Hydrology. 3 Credits.

Introduces computer modeling of hydrological systems. Project-based. Simple overland flow, flood routing, water quality, and groundwater models are developed using finite difference techniques. Stochastic hydrology and hydrologic time series analysis are also introduced. Prerequisite: CE 260.

CE 265. Ground Water Hydrology. 3 Credits.

Principles of ground water hydraulics, well characteristics, aquifers, and use of numerical methods to solve ground water flow problems. Project-based. Prerequisite: CE 160.

CE 271. Advanced Structural Analysis. 3 Credits.

Virtual work, energy theorems, analysis of structures by the displacement method and the finite element method, non-linear structural analysis. Project-based. Prerequisite: CE 170.

CE 272. Structural Dynamics. 3 Credits.

Vibrations, matrices, earthquake engineering, stability and wave propagation. Project-based. Prerequisites: Senior standing in Engineering or Physical Sciences or Instructor permission. Cross-listed with: ME 270.

CE 273. Structural Design - Wood. 3 Credits.

Analysis and design of solid and glue laminated timber members and structural systems including tension members, beams, columns, beam-columns, diaphragms, shear walls, and connections; LRFD and ASD design methods; application of IBC for timber systems; current developments in wood design/construction; project-based. Prerequisite: CE 170.

CE 285. Geo-energy Systems. 3 Credits.

An introduction to Geoenery technologies for subsurface energy extraction (shallow and deep geothermal systems, enhanced oil recovery, shale gas extraction) and secure storage of byproducts of energy production (carbon dioxide and nuclear wastes); project-based. Prerequisite: CE 180.

CE 286. Foundation Design. 3 Credits.

Subsurface explorations; geotechnical analysis, design, construction, preservation, remediation, and monitoring aspects of shallow and deep foundations. Prerequisite: CE 180.

CE 290. Independent Study. 1-18 Credits.

A course which is tailored to fit the interests of a specific student, which occurs outside the traditional classroom/laboratory setting under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

CE 359. Appld Artificial Neural Ntwrks. 1-3 Credits.

Introduction to artificial neural networks. A broad range of example algorithms are implemented in MATLAB. Research applications to real data are emphasized. Prerequisites: CS 021, STAT 223 or equivalent. Cross-listed with: CSYS 359.

CE 369. Applied Geostatistics. 3 Credits.

Introduction to the theory of regionalized variables, geostatistics (kriging techniques): special topics in multivariate analysis; Applications to real data subject to spatial variation are emphasized. Prerequisites: STAT 223; CS 020 or CS 021; or Instructor permission. Cross-listed with: CSYS 369, STAT 369.

CE 370. Reliability of Eng. Systems. 3 Credits.

Modeling and simulation of functions of random variables and random processes, propagation of uncertainties in engineering systems, analytical and computational methods for reliability analysis of engineering systems and components, Bayesian methods to update reliability estimates based on operational data. Prerequisite: STAT 151 or equivalent.

CE 391. Master's Thesis Research. 1-12 Credits.**CE 392. Master's Project. 1-6 Credits.**

Independent project related to civil and environmental engineering under the supervision of a Civil & Environmental Engineering faculty member, concluding with a written technical report and an oral presentation to a committee of two Civil & Environmental Engineering faculty members. Prerequisite: Permission of Civil & Environmental Engineering Graduate Coordinator or Civil & Environmental Engineering Department Chair.

CE 393. CEE Graduate Seminar. 0 Credits.

Presentation and discussion of advanced problems, research, and current topics in Civil & Environmental Engineering by faculty, graduate students, and outside guest speakers. Prerequisite: Graduate student in Civil & Environmental Engineering.

CE 394. Independent Study. 1-18 Credits.

A course which is tailored to fit the interests of a specific student, which occurs outside the traditional classroom/laboratory setting under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

CE 395. Advanced Special Topics. 1-18 Credits.

Advanced topics in recently developed technical areas. Hours and credits as arranged.

CE 491. Doctoral Dissertation Research. 1-18 Credits.**CE 496. Advanced Special Topics. 1-18 Credits.**

See Schedule of Courses for specific titles.