

CIVIL AND ENVIRONMENTAL ENGINEERING

OVERVIEW

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

Research includes: groundwater contamination; modeling and remediation including optimal remediation design; environmental restoration and ecological engineering; hydrological processes; air pollution and related health effects; modeling of contaminant fate and transport in the environment; materials; geotechnical and geoenvironmental engineering; dynamic behavior of structures and structural health monitoring; geo-energy; and sustainable transportation systems.

Graduate students of CEE can concurrently pursue certificates of graduate education in sustainable transportation systems, complex systems, and ecological economics.

DEGREES

- Civil and Environmental Engineering AMP
- Civil and Environmental Engineering M.S.
- Civil and Environmental Engineering Ph.D.

FACULTY

Aultman-Hall, Lisa M.; Professor, School of Engineering; PHD, McMaster University

Bombliès, Arne; Assistant Professor, School of Engineering; PHD, Massachusetts Institute of Technology

Dewoolkar, Mandar M.; Associate Professor, School of Engineering; PHD, University of Colorado Boulder

Garcia, Luis; Professor, School of Engineering; PHD, University of Colorado

Ghazanfari, Ehsan; Assistant Professor, School of Engineering; PHD, Lehigh University

Hernandez, Eric M.; Assistant Professor, School of Engineering; PHD, Northeastern University

Hession, William; Adjunct Associate Professor, School of Engineering; PHD, Oklahoma State University

Holmen, Britt A.; Associate Professor, School of Engineering; PHD, Massachusetts Institute of Technology

Pinder, George Francis; Professor, School of Engineering; PHD, University of Illinois Urbana-Champaign

Rizzo, Donna Marie; Professor, School of Engineering; PHD, University of Vermont

Rosowsky, David; Professor, School of Engineering; PHD, Johns Hopkins University

Tan, Ting; Assistant Professor, School of Engineering; PHD, Princeton University

Courses

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. Prerequisites: MATH 271, CS 020; MATH 122 or MATH 124. Cross-listed with: ME 218.

CE 220. Intro to Finite Element Anyl. 3 Credits.

Introduction to finite element analysis: applications in solid mechanics, hydrodynamics, and transport: analysis of model behavior: Fourier analysis. Computer project required. Prerequisites: CS 020; MATH 122 or MATH 124.

CE 226. Civil Engineering Systems Anyl. 3 Credits.

Linear programming, dynamic programming, network analysis, simulation; applications to scheduling, resource allocation, routing, and a variety of civil engineering problems. Prerequisites: Senior/ Graduate standing in Civil & Environmental Engineering. Cross-listed with: CSYS 226.

CE 238. Design/Planning for Bikes/Peds. 3 Credits.

Interdisciplinary introduction to design/planning concepts for bikes/ pedestrians from a systems view. Examines current best practices on how effectively they address social, environmental, economic, and health related transportation issues. Prerequisite: Senior or Graduate standing.

CE 241. Traffic Operations & Design. 3 Credits.

Advanced concepts of traffic engineering and capacity analysis; highway and intersection capacity; traffic analysis and simulation software; design and application of controls. Prerequisite: CE 133.

CE 245. Intelligent Transportation Sys. 3 Credits.

Introduction to Intelligent Transportation Systems (ITS), ITS user services, ITS applications, the National ITS architecture, ITS evaluation, and ITS standards. Pre/co-requisites: CE 133. Cross-listed with: CSYS 245.

CE 248. Hazardous Waste Mgmt Engr. 3 Credits.

Management of hazardous and industrial waste from generation to disposal; emphasis on pollution prevention within industry; waste minimization, recovery, reuse, treatment technologies; environmental regulations, risk assessment, costs and public policy; group projects. Prerequisite: Senior standing in engineering or sciences.

CE 250. Fate/Transport Organic Chem. 3 Credits.

Chemical transfers between environmental media; molecular structure-reactivity models; chemical, photochemical and biochemical transformation rates; emphasis on predicting environmental concentrations and risk. Graduate student independent modeling project. Prerequisites: CHEM 031, CHEM 032, CE 132.

CE 251. Envr Facility Dsgn/Wastewater. 3 Credits.

Design of wastewater conveyance and treatment facilities; sewage treatment plant design; equipment selection. 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. Prerequisites: CE 132, CE 133.

CE 254. Environmental Quantitative 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. 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. 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 259. Msmt of Airborne Contaminants. 3 Credits.

Quantifying airborne contaminants from processes and ambient levels. Laboratories demonstrate calibration and measurement, stack sampling and ambient air monitoring, and specific contaminant generation and measurement. Prerequisite: CE 132.

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 261. Open Channel Flow. 3 Credits.

Application of the laws of fluid mechanics to flow in open channels; design of channels and transition structures; modeling; uniform and gradually-varied flows. Prerequisite: CE 160.

CE 262. Advanced Hydrology. 3 Credits.

Introduces computer modeling of hydrological systems and involves a semester-long design project. 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. 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. Prerequisite: CE 170.

CE 272. Structural Dynamics. 3 Credits.

Vibrations, matrices, earthquake engineering, stability and wave propagation. Prerequisites: Senior/Graduate 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. Prerequisite: CE 170.

CE 281. Geotechnical Design. 3 Credits.

Subsurface explorations; bearing capacity, lateral earth pressures, slope stability; analysis and design of shallow and deep foundations, retaining structures, and slopes. Prerequisite: CE 180.

CE 283. Designing with Geosynthetics. 3 Credits.

Geotextiles, geogrids, geonets, geomembranes, geocomposites, geopipes. Design for separation, reinforcement, filtration, drainage, erosion, control, liners. Applications in transportation, drainage, solid waste containment. Material testing, behavior. Prerequisite: CE 180.

CE 284. Site Characterization. 3 Credits.

A comprehensive approach to subsurface site characterization for geotechnical and environmental designs and a systems approach for integrating the two. Prerequisites: CE 160, CE 180.

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). 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 287. Design of Earth Structures. 3 Credits.

Soil and rock properties using laboratory, field and in-situ testing; analysis and design of slopes, embankments and retaining structures. 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 295. Special Topics. 1-18 Credits.

Content is dictated by expanding professional interest in newly developing, or recently developed, technical areas in which there is particular need or opportunity. Prerequisite: Senior/Graduate standing.

CE 304. Adv Engineering Analysis I. 3 Credits.

Analytical methods for the solution of partial differential equations in engineering mechanics and physics, including: eigenfunction expansions; Fourier series; Sturm-Liouville theory and special functions. Prerequisites: Graduate standing in engineering, mathematics, or physical sciences. Cross-listed with: ME 304.

CE 305. Adv Engineering Analysis II. 3 Credits.

Advanced analytical techniques for problems in engineering mechanics and physics, including: integral transform methods, Green's functions, perturbation methods, and variational calculus. Prerequisites: ME 304; Graduate standing in engineering, mathematics, or physical science. Cross-listed with: ME 305.

CE 312. Sustainability & Transportatn. 3 Credits.

Introduction to the complex interconnection of engineering, policy, science and social science that characterize transportation systems, mobility problems and solutions. Interdisciplinary teams conduct case studies. Prerequisite: Instructor permission required. Cross-listed with: PA 342, TRC 312.

CE 314. Risk/Behavior in Transportatn. 3 Credits.

In-depth examination of human, environmental and vehicle factors in transportation crashes. Students develop safety research proposals and statistical measurements of risk and rates. Prerequisite: Instructor permission.

CE 321. Engr Computations on Adv Arch. 3 Credits.

Engineering computations using multiprocessing computers, concurrent processing, algorithms for numerical approximation of differential equations, linear systems. Programming projects required. Prerequisites: Graduate standing in engineering, mathematics or physical science.

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 020, STAT 223 or equivalent. Cross-listed with: CSYS 359.

CE 360. Advanced Hydrology. 3 Credits.

Application of statistics to engineering hydrology; concept, use of instantaneous unit hydrograph; study of runoff models; flow through porous media; design techniques for water resources projects. Prerequisites: CE 260, MATH 271. Offered as occasion warrants.

CE 361. Fluvial Forms & Processes. 3 Credits.

Advanced topics in fluvial forms and processes; focus on river and stream restoration and design; includes journal readings, discussion, field trips and group design project. Prerequisite: CE 160.

CE 365. Contaminant Hydrogeol&Remediat. 3 Credits.

Practical, theoretical aspects of contaminant hydrogeology, advances in technologies, mass transport and transformation in saturated and vadose zones; movement, distribution, and remediation of nonaqueous-phase liquids. Prerequisite: CE 265.

CE 366. Numerical Method/Surface Water. 3 Credits.

Development of the governing equations for geophysical hydrodynamics/transport, shallow water equations, analysis and implementation of finite element/finite difference computational algorithms. Prerequisite: CE 218 or CE 220.

CE 367. Phys Flow&Trs thru Porous Mdia. 3 Credits.

The fundamental equations describing fluid flow and mass transport in subsurface systems are developed from first principles. Prerequisite: CE 265.

CE 368. Groundwater Modeling. 3 Credits.

The fundamental theory of groundwater hydrology is combined with concepts in numerical methods to provide the technology needed to study a real-world groundwater problem. Prerequisites: CE 265, and CE 218 or CE 220.

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: CS 020, STAT 223 or equivalent. Cross-listed with: CSYS 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 380. Advanced Soil Mechanics. 3 Credits.

Stress-strain-strength of soils, introduction to constitutive modeling, critical state concepts, applications of limit analysis and limit equilibrium methods in analyzing stability problems in geotechnical engineering, such as foundations, slopes and embankments and retaining structures. Prerequisite: CE 180.

CE 390. Adv Topics in Civil & Envr Eng. 1-6 Credits.

Special topics to intensify the programs of graduate students in civil and environmental engineering. Hours and credits to be arranged.

CE 391. Master Thesis Rsch. 1-12 Credits.**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 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.